JANUARY 2008

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A look at features and options

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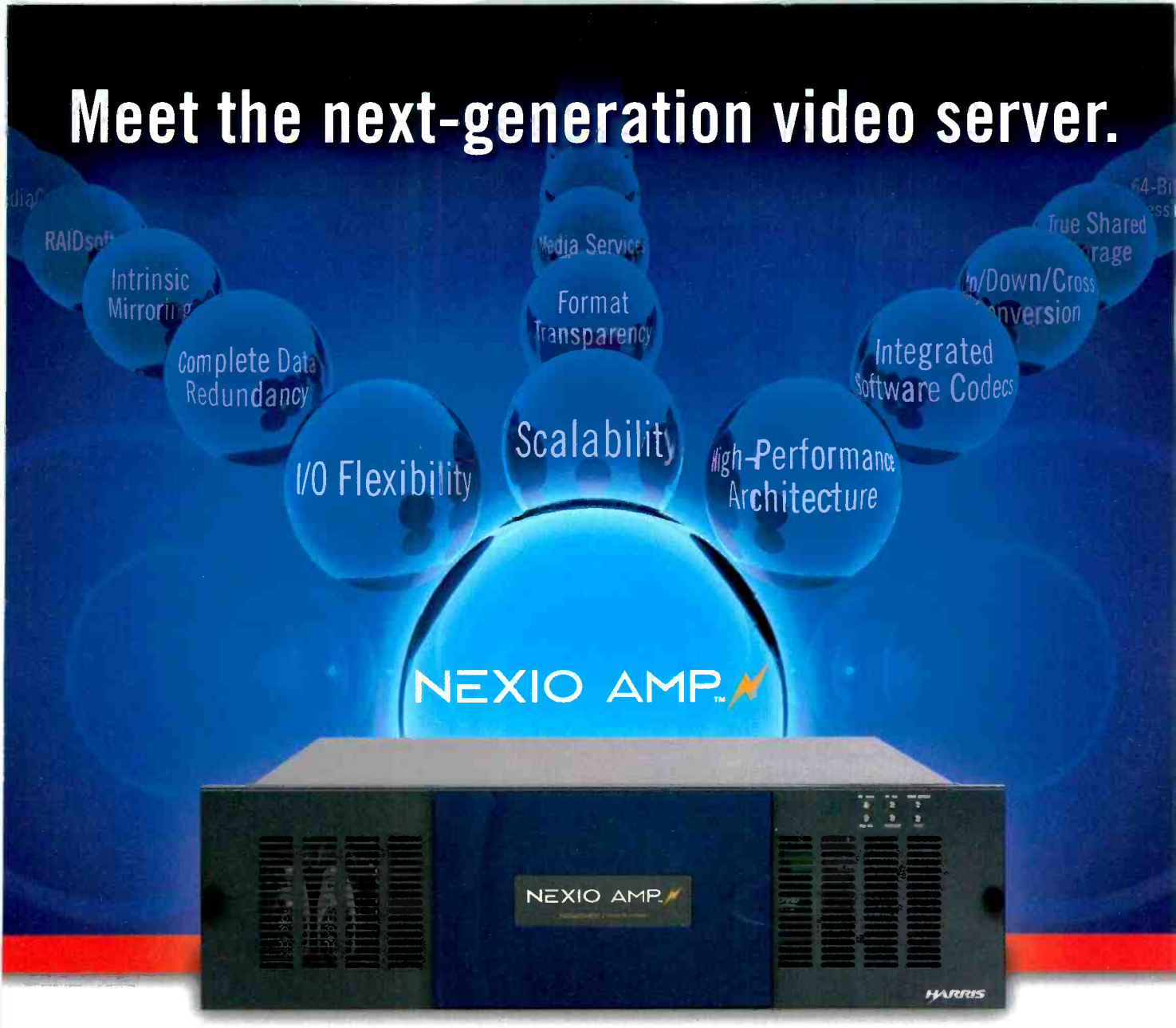

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Broadcast Engineering®

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DOWNLOAD

FCC UPDATE

DIGITAL HANDBOOK

TRANSITION TO DIGITAL

COMPUTERS & NETWORKS

PRODUCTION CLIPS

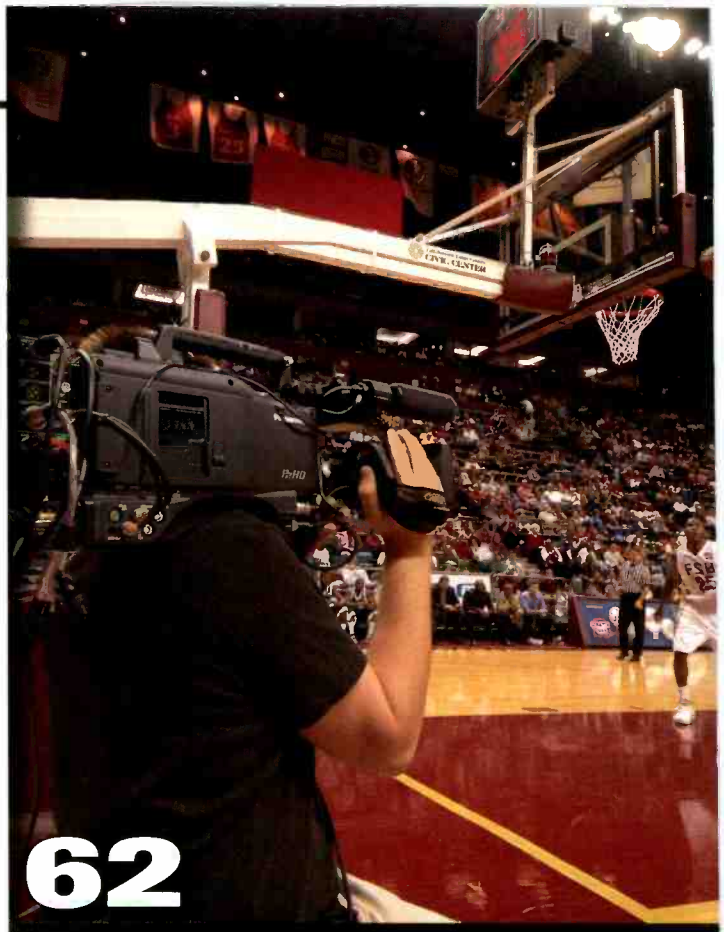
continued on page 8

THIS MONTH'S FREEZEFRAME QUESTION

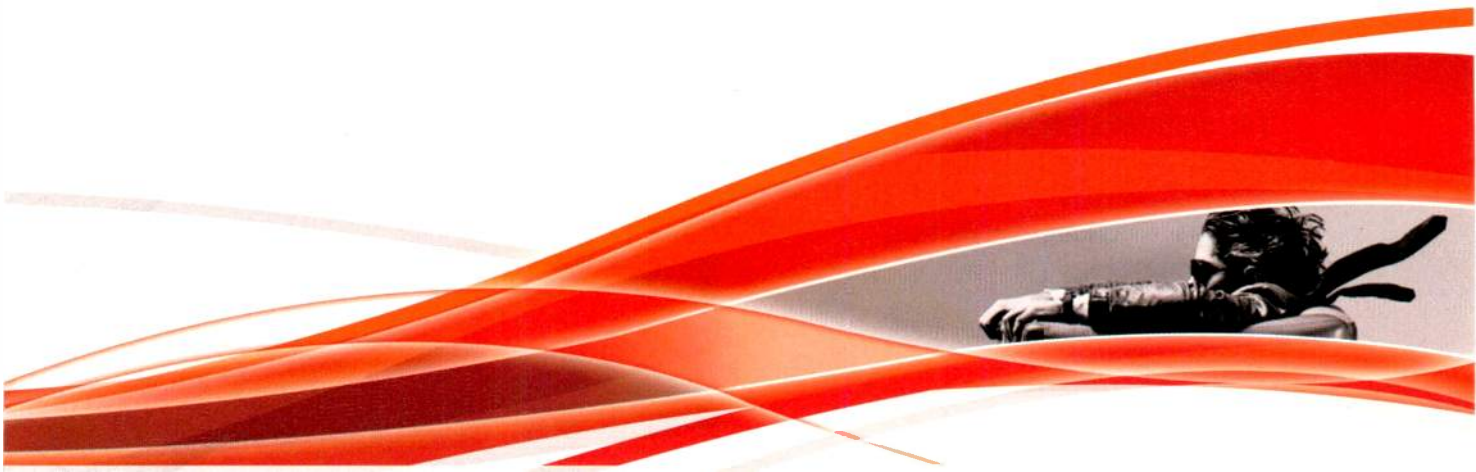
Say what? The FCC's December 2007 Third Periodic Review Report and Order contains more than 100 different acronyms, abbreviations and shorthand notations that only a lawyer could love. See if you can decipher some of the commission's bureaucratic language.

FCC terms: COALS; CDBS; Central location; DTV singletons; FRFA; IRFA; Out-of-core; PCO; PN; PRA; RFA; and SBPRA

The answers are on page 8.



ON THE COVER:
Florida State University's department of communication uses Panasonic AJ-HPX2000 cameras to shoot college basketball footage.



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NEW PRODUCTS & REVIEWS

FIELD REPORT

TECHNOLOGY IN TRANSITION

NEW PRODUCTS

DEPARTMENTS

NOVEMBER'S FREEZEFRAME ANSWER

Readers were asked to submit the following missing words in this sentence (the missing words are highlighted in bold font):

> The subcarrier to horizontal phase (SCH) refers to the **phase** relationship between the **leading** edge of **horizontal** sync at the 50-percent amplitude point and the zero crossings of the color burst. The error is expressed as SCH phase and is expressed in **degrees** of subcarrier phase.

READERS WHO ANSWERED CORRECTLY:
Jim Barnes, Al van Dinteren, Joseph Zeppuhar

FREEZEFRAME ANSWER

FCC terms	Definitions
COALS	Cable Operations and Licensing System
CDBS	Consolidated Database System
Central location	Roof
DTV singletons	Stations without a paired channel
FFFA	Final Regulatory Flexibility Analysis
IRFA	Initial Regulatory Flexibility Analysis
Out-of-core	TV channels 52-69
PCO	Private Cable Operator
PN	Public Notice
PRA	Paperwork Reduction Act
RFA	Regulatory Flexibility Act
SBPRA	Small Business Paperwork Relief Act

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Invention: 60 years later

What electronic device recently celebrated its 60th anniversary? Not sure? Here are some hints.

- It was called the greatest invention of the 20th century.
- Walter Brattain, John Bardeen and William Shockley built the first one.
- Think germanium.

The last hint should have made most of you recognize the answer as the transistor. This single technology revolutionized the electronics world more than any other and made possible many of the exciting innovations we've all come to enjoy.

This image of the first point-contact transistor shows how far the technology has come. Photo courtesy Bell Labs.

For baby boomers, solid-state devices represented the second device technology they needed to understand during their career. The first was tubes. For you younger engineers, tubes were vacuum-enclosed glass devices filled with metal structures called screens, plates and cathodes. Tubes required large high-voltage power supplies, generated lots of heat, and were large and weighty devices. Semiconductors had none of those drawbacks.

Early transistors were small, operated at low voltages and had only three connections: an emitter, a base and a collector. Depending on your age, you may not even know what emitter, base or collector mean. For that matter, could a boomer engineer still identify a transistor's emitter, base and collector with an ohmmeter? Fortunately, that is seldom necessary today.

Early transistors were packaged as single-junction devices. In other words, a typical transistor consisted of a 1/4in-sized package containing only one semiconductor junction. Boomer engineers grew up building amplifiers and radios with individual transistors named CK722 and CK703.

An interesting aside is that the name transistor was only one of six names on a ballot circulated among Bell Labs engineers. Other names on that ballot included: semiconductor triode, surface states triode, crystal triode, solid triode and iotatron. The name transistor resulted from an abbreviated combination of the words transconductance and varistor.

Raytheon released the CK722 in 1953, making it the first low-cost junction transistor available to the general public. It quickly became a hit with DIY electronics buffs as well as broadcasters.

By the mid-'50s, radio manufacturers used the number of transistors in their products as an indication of product superiority. A five-transistor radio was considered better than a four-transistor radio. My aunt had one of the first five-transistor Sony pocket radios. We were amazed at how a radio could be made small enough to fit into a shirt pocket. OK, maybe it took a large pocket, but to us, this was revolutionary.

Consider the differences between the simplicity of that five-transistor AM-only radio and today's desktop PC with a CPU chip that may contain up to 2 billion transistors.

Sometimes it's fun to look back at technology, if nothing else, to remind ourselves of the tremendous advances our industry has made. It's also worth reminding ourselves that others, working in what we'd call primitive conditions, contributed so highly to the technology we enjoy today.

So, the next time you browse the Web, watch HDTV or answer your cell phone, give a nod to Walter Brattain, John Bardeen and William Shockley. Without their vision, we might still be watching fuzzy black-and-white images on round, 21in CRT, tube-based TV sets. BE

Brad Dick
EDITORIAL DIRECTOR
Send comments to: editor@broadcastengineering.com

Rethink

what you can do with two cards

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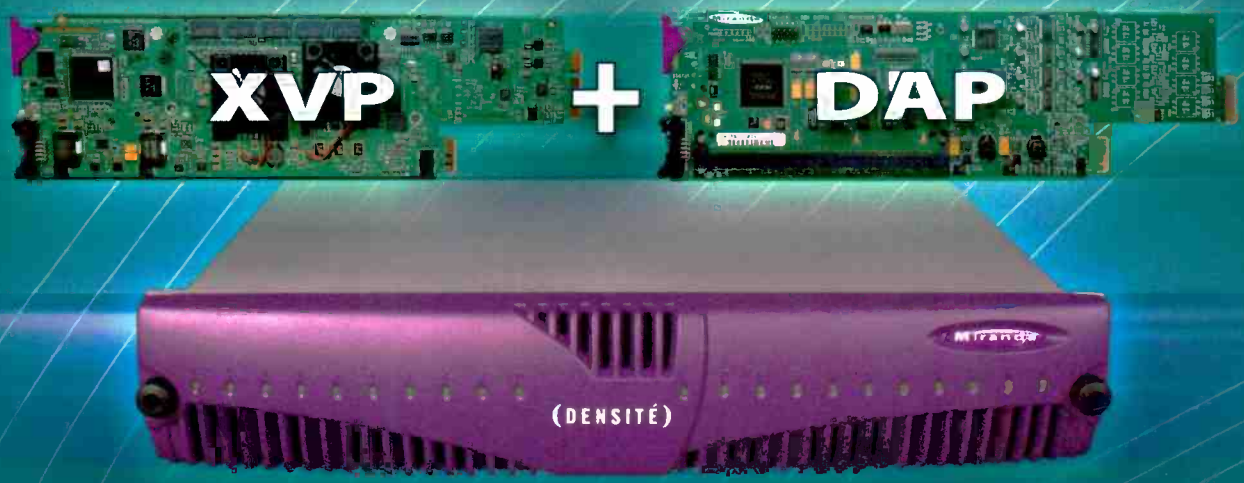

VIDEO: XVP-1801

UP / DOWN / CROSS CONVERSION	[✓]
AFD ASPECT RATIO CONTROL	[✓]
SIDE PANEL BACKGROUND KEYING	[✓]
SIGNAL PROCESSING	[✓]

AUDIO: DAP-1781

UPMIXING WITH UpMAX	[✓]
DOLBY E ENCODING / DECODING	[✓]
DOLBY AC-3 ENCODING / DECODING	[✓]
EMBEDDED & AES PROCESSING	[✓]

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Doing dialnorm correctly

Dear editor:

While I applaud the article "Dialnorm: A good idea gone bad?" from December 2007, you give too much credit to NBCU. So far, only its broadcast channels (KNBC HD in my market) are doing dialnorm "correctly." Its satellite channels (CNBC, MSNBC, etc.) run with an average dialog of -22dBFS with the dialnorms fixed at -31dBFS. That's 9dB too loud.

A better corporate example would be Turner Broadcasting in Atlanta. Mike DeHart's group has achieved dialog normalization across its entire broadcast suite.

Mike Lilly
Time Warner Cable

Problem with product link

Dear editor:

I really enjoy reading about new product announcements in *Broadcast Engineering*. One of my greatest frustrations, however, is when you send me off to a Web site for more information, and it's just not there. For example, you had a write-up about the new Canon BU-40H pan/tilt camera, and at the end of the announcement it says: "For more information, visit *www.usa.canon.com*." But when you go there, there is no information on the product. Worse yet, Canon has no e-mail contacts listed, not to mention a terrible search engine. So, after getting me all interested, I hit a dead end. Do your writers even check the links they recommend? Canon will get a piece of my mind tomorrow by phone. In this day and age, there is no excuse for a poor Web site.

Thanks for letting me vent.

Bob Woodward
Systems Electronic Group

Editor responds:

I agree with your frustration.

In product information stories, we use the links provided in company product press releases — in this case, the exact link provided by Canon.

Yes, we do check every link. However, when the company only gives us a corporate link, that's all we can do.

Who's in charge?

Dear editor:

When working with a systems integrator, who defines the workflow of a project? Is this to be decided by the customer or the consultant?

RV Krishnan
K Konsult

John Luff responds:

Any competent consultant should be able to analyze your operation and recommend an appropriate workflow solution. However, sometimes there are cultural or business reasons why certain options must be considered, of which a consultant might not be aware. It should be a goal of the consultants to conduct interviews with the customer to elicit all relevant factors from the client before making a recommendation. In the end, the client makes the choice of final workflow choices. BE

02.17.09 **Countdown to Digital**

Broadcast Engineering's weekly online poll

Is your station operating at your full DTV-licensed power?

Yes	55%
No	33%
Not sure	11%

Visit *www.broadcastengineering.com* to take part in the weekly online poll.

Test Your Knowledge!

See the Freezeframe question of the month on page 6.

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Change is imminent

As viewing options proliferate, can broadcasters adapt?

BY CRAIG BIRKMAIER

Here we are in another presidential election year, and change is in the wind, not to mention on the tips of the tongues of every candidate.

It should come as no surprise that change is also on the tips of the tongues of television broadcasters. I'm talking about the media conglomerates that own more than 90 percent of the broadcast and cable TV programming we watch, local TV broadcasters and the multichannel TV services. These changes may represent a threat to the broadcast industry — an industry that has been resisting change for decades.

According to the BIA Financial Network (BIAfn), 2007 was another down year for local television broadcasters. The financial and strategic advisory firm serving the media and communications industries reported 2007 television revenues as $22.2 billion, a 2 percent decrease from revenues of $22.7 billion in 2006. (See "Web links" on page 16.)

In the face of the Writers Guild of America (WGA) strike, which has put much of the prime time television season on hold, one might predict that 2008 will be another down year for broadcasters. However, that's not what is going to happen. BIAfn predicts, instead, that local TV station revenues will increase by as much as 11 percent in 2008, a 10-year high.

Broadcasters in Iowa and New Hampshire already know why times are looking up. It's a presidential election year. Add to this the 2008 Olympics, and 2008 is looking very promising indeed.

Local network affiliates wonder what role they will play in the future as the media conglomerates begin to make content available via new outlets.

Local network affiliates wonder what role they will play in the future as the media conglomerates begin to make content available via new outlets. Near the end of 2007, FOX sold eight of its owned and operated stations to Oak Hill Capital partners for $1.1 billion. During 2007, NBC pulled its shows from the Apple iTunes store and then announced NBC Direct, a service that allows many of the network's shows to be downloaded for free.

Could the Internet dribble become a BitTorrent?

For now, the new media that the WGA wants a cut of is still in beta, a term that NBC uses for its NBC Direct download site. Downloading TV shows requires a good broadband Internet connection, something that is available in a little more than half of U.S. homes. Mobile TV is even more of a curiosity as it is still dominated by the wireless telcos who want to sell the services as an add-on package for their cellular phone customers.

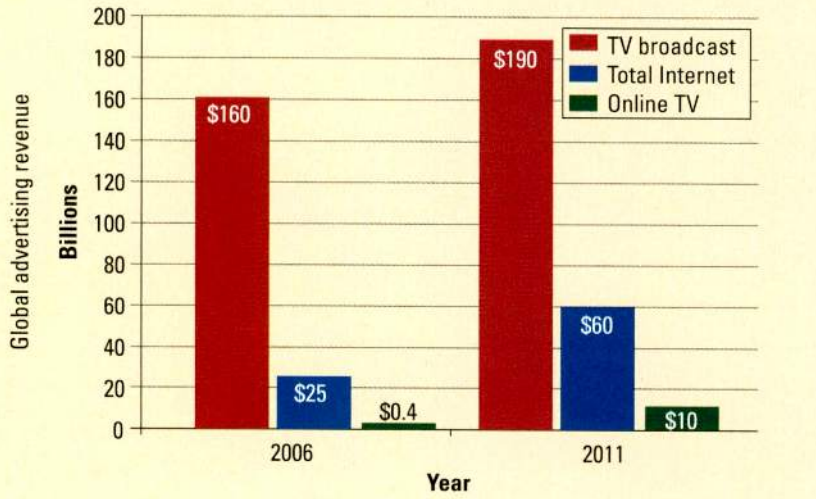
However, Wi-Fi hot spots are popping up everywhere, and new mobile media devices, such as Apple's iPhone and iTouch, can tap into YouTube today, as well as a new FOX News video download service.

A new study by Horowitz Associates reveals the rapid growth in consumption of broadband video among adult Internet users. (See "Web links.") According to the 2007 report, six out of 10 high-speed Internet users watch

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

Worldwide Internet advertising increasing

By 2011, total Internet TV revenue could reach $10 billion



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For cable and IPTV

- Broadcast media file QC and loudness correction
- Automated VOD file analysis and loudness correction
- Automated digital program insertion (DPI) file analysis and loudness correction

For satellite

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

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or download online video content at least once a week, and 86 percent do so on a monthly basis, compared with 45 percent and 71 percent, respectively, in the 2006 study. News and user-generated, nonprofessional content are the most often viewed genres, followed by movie previews and trailers, music videos, and previews and segments of TV shows. The report also notes that weekly viewing of full episodes of television shows online doubled from last year, with 16 percent of high-speed Internet users now watching TV online on a weekly basis.

On the positive side, the study shows that television is still the preferred platform for traditional TV content. The vast majority (70 percent) of Internet users who watch TV online do so because they missed the episode on TV. About two out of 10 of these respondents say they watch TV shows online to view them a second time (after having watched them on TV), or that they watch TV shows online just when they happen to find them or when someone else tells them about them.

But this is changing too. In its coverage of the recent Consumer Electronics Show in Las Vegas, "The New York Times" reported that "televisions, enormously wide and remarkably thin, were front and center, and overhead." These new televisions represent the hope of the electronics industry — televisions connected to the Internet and ready to display new forms of on-demand entertainment.

The "Times" report also noted that several television makers announced a series of partnerships with media companies that will allow delivery of Internet content, including videos, news feeds, weather and sports directly to the TV, without the need for a PC.

Comcast's CEO Brian Roberts used the CES stage to announce Project Infinity, an effort by the nation's largest cable system operator to compete more effectively with the growing number of HD channels being delivered by competing DBS operators.

The Comcast video-on-demand platform — which currently has more than 1300 movie titles available each month — will be the major focus of the multiple systems operator's content growth. Beginning next year, Comcast will offer more than 6000 movies per month, with more than one-half of them available in HD.

Roberts also officially introduced Fancast, the Internet content portal that Comcast Interactive Media has been developing for more than one year and beta testing since late summer. The ad-supported portal offers content to Comcast subscribers, as well as general Internet users. It will now provide free content from ABC, CBS, FOX, Lifetime Television, NBC, Viacom and other major programmers through a Flash-based video player. It will offer more than 90,000 videos. And Roberts demonstrated a new technology that ties multiple digital cable channels together to download an HD movie in four minutes.

Meanwhile, FCC chairman Kevin Martin, speaking at CES, said that the commission is investigating a complaint filed last November that Comcast has been interfering with peer-to-peer downloads of video using the BitTorrent protocol. Most important to broadcasters was Martin's comment that there is no chance that the nation's shift to digital television will be delayed, regardless of questions and pleas from various industry executives.

The real threat

Broadcasting exists today because it is still an efficient way to deliver advertising messages to large audiences. Just ask any politician running for office.

Unfortunately, these advertising messages typically miss the mark, much like the junk mail that shows up in your physical and electronic mailboxes each day. However, when viewers download a program, they provide useful demographic data, and the potential exists to deliver highly targeted messages for which advertisers will pay a premium.

Television is still the preferred platform for traditional TV content. The vast majority of Internet users who watch TV online do so because they missed the episode on TV.

The real threats from new media lie in two areas:

1. *Channel surfing vs. Web surfing.* The good old days when the family gathered around the electronic hearth to watch "Happy Days" are now distant history. Appointment television is all but dead except for a handful of live TV events. Channel surfing has replaced appointment TV. Now channel surfing is threatened by the new kid on the block, the Internet-connected TV. Why limit your choices to 100 channels when the Internet offers the potential to find exactly what you want to watch, when you want to watch it?
2. *Advertising efficiency.* The second

Web links

- BIAfn television market report *www.bia.com/pressitem1.asp?id=1115*
- Horowitz study of video consumption across multiple platforms *www.horowitzassociates.com/bcspr.html*
- "Fixated on TVs, and What's on Them" *www.nytimes.com/2008/01/10/technology/10electronics.html?_r=1&th&emc=th&oref=slogin*

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

threat comes in the new form of advertising that will support downloadable TV, if the viewer does not pay directly for the content. Content providers are looking for ways to hook up their advertisers with real prospects. Shotgun advertising is expensive and inefficient. Google has grown into an advertising giant by helping viewers find what they want when they search the Internet. They are now directing their considerable resources at the problem by doing the same for radio and TV advertisers.

So what is a broadcaster to do as the world of digital media distribution is transformed? The time for fundamental changes to the business model that broadcasters have relied on for decades is rapidly approaching. It's easy to throw stones; it's much harder to use them to build a solid foundation for the future. Here are two suggestions for that new foundation:

1. *Get connected.* Broadcasters have the ability to proliferate their content via the Internet too. More importantly, this effort will pay dividends as broadcast stations learn how to hook up local viewers with local advertisers.
2. *Go wireless.* Remember, TV broadcasting is a wireless medium with vast potential to reach a new generation of viewers on the move. Relying on competitors to carry your bits (and charging them for the privilege) is just a short-term profit maximization strategy. What happens when people start dropping their extended basic TV packages in favor of a broadband package that can access an entire world of content? BE

It's easy to throw stones; it's much harder to use them to build a solid foundation for the future.

Craig Birkmaier is a technology consultant at Pcube Labs.

? Send questions and comments to: craig.birkmaier@penton.com

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FCC imposes new rules

Stations must file a quarterly form listing various types of programming.

BY HARRY C. MARTIN

The FCC has announced a major overhaul of the quarterly issues and programs list requirement for TV station licensees.

New form requirements

Instead of the quarterly report that stations had to compile and place in their public inspection files for the last couple of decades, the commission now wants stations to complete and submit a quarterly form listing various types of programming. The types of programming include local public affairs, local election coverage, public service announcements and independently produced programming.

The new form also will require "information about efforts that have been made to ascertain the programming needs of various segments of the community," as well as information "regarding closed captioning and video-described content."

Local inspection files

In addition to the new quarterly filing, the FCC is also requiring TV licensees to make their local inspection files (with the exception of their political files) available online if they have Web sites.

Also, TV licensees must notify their audiences about the location of their public files twice daily. These new rules will be effective in the first quarter of 2008.

Implications of the new rules

The new rules are reminiscent of the program-related record-keeping and reporting requirements that existed 25 years ago. One example of this is a formalized "ascertainment" standard under which licensees are expected to confer with representatives of various segments of the community to get their views on local needs and interests.

Commissioner Robert McDowell expressed concern about these retrograde measures in a dissenting statement, saying the FCC is "heading in the wrong direction."

The full text of the commission's decision has not been released, so it is hard to tell how far the rules will take the TV industry back in the direction of content regulation. In separate concurring statements, both Democrat commissioners, Michael Copps and Jonathan Adelstein, said the change is aimed at broadcasters who do not tend to local problems and needs. They suggest that the new reporting requirements may be a step toward more extensive programming review and record-keeping requirements by the agency.

If the commission were going to consider nonrenewal based on programming performance, it would also have to announce reasonably specific quantitative and qualitative standards that would apply in such an analysis. This approach would have serious First Amendment implications.

In the end, it is unlikely the FCC will set standards that would involve the agency in analyses of program content. BE

In separate concurring statements, both Democrat commissioners, Michael Copps and Jonathan Adelstein, said the change is aimed at broadcasters who do not tend to local problems and needs.

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

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

Dateline

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

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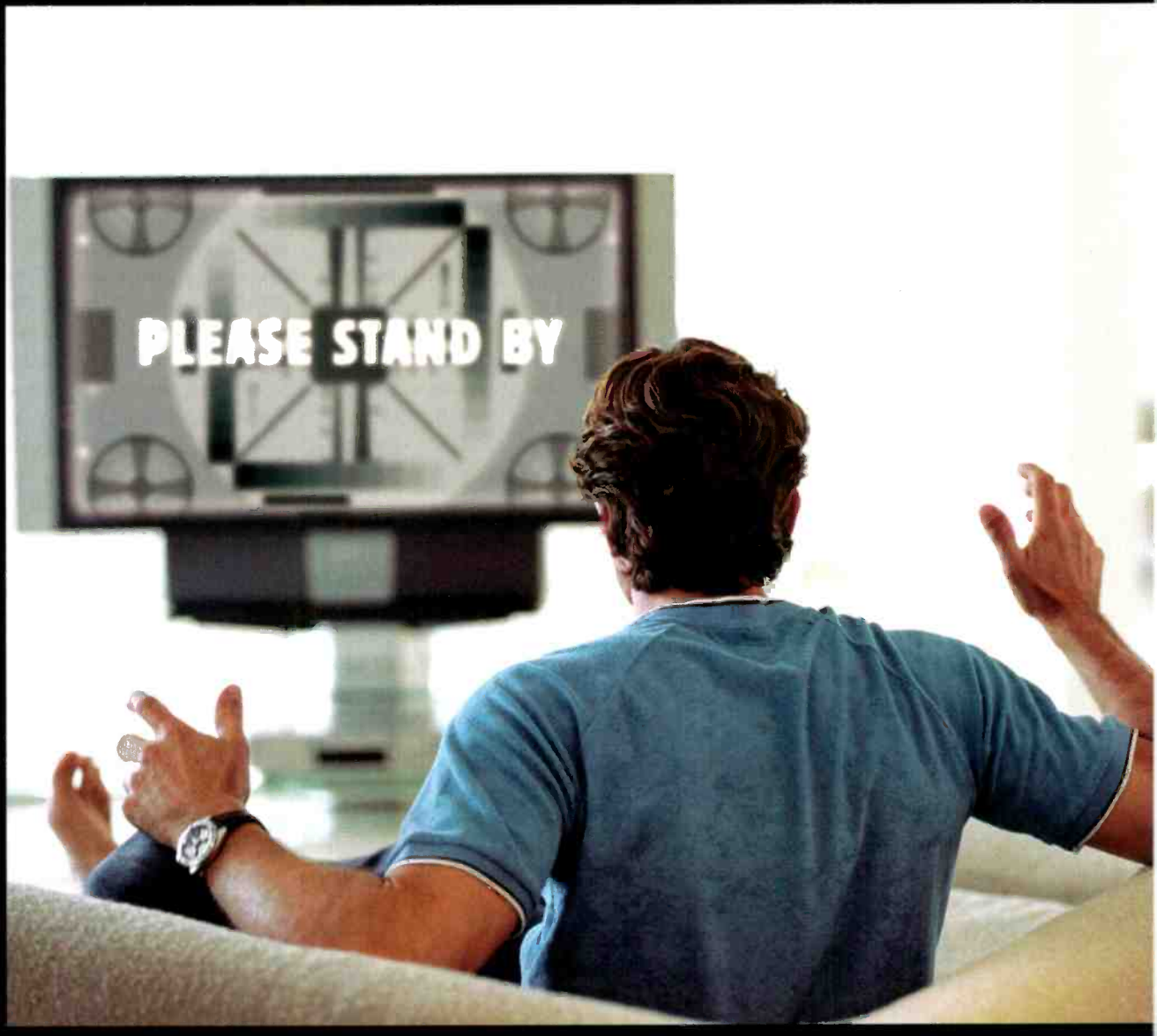

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Broadcast monitors

Measuring up, does your monitor make the grade?

BY ALDO CUGNINI

Broadcast monitors are in the middle of a transition, not unlike the digital transition. CRT monitors, used for decades as the ultimate standard for judging picture quality and manipulating video processing, are on the decline. In Europe, a restriction on the use of certain hazardous substances (RoHS) since 2006 means that new electrical and electronic equipment cannot contain certain materials, including lead, mercury and cadmium. This means that broadcast monitor technology is changing — and much of it is for the better.

At last year's NAB show, several new LCD monitors were introduced, with performance rivaling that of the gold standard CRT. One manufacturer even had the bravado to put its new LCD reference monitor side-by-side with a CRT monitor. With the bezels masked off, the images looked impressively similar, the tip-off to this viewer being the lack of vertical blanking.

The real daring, though, was that the LCD monitor was listed at $25,000 — well above that of its CRT-equipped neighbor. Expect that price difference to eventually vanish.

Specs and features paint a new picture

Digital processing now makes numerous features available in high-performance monitors. In order to present a dependable and repeatable reference, a calibration feature must be available and should offer numerous presets to the user. Various operating modes also ensure that the monitor will always accurately represent the incoming video.

In 2007, the EBU formally defined three grades of broadcast monitors used in a professional TV production environment in EBU Tech 3320. (The different grades are also called "classes" by some.) The most rigorous requirements are for Grade 1 monitors, which are used as reference devices for high-grade technical quality evaluation of picture capturing, post production, transmission and storage. Typical applications of these include camera control, color grading and content evaluation.

Grade 1 monitors are reference devices for high-grade technical quality evaluation of picture capturing, post production, transmission and storage.

In the official document, EBU recommends that in a Grade 1 monitor, the black level should be adjustable to be below 0.1cd/m^2 (nits), the full-screen (sequential) contrast ratio should be above 1000:1, and the simultaneous contrast ratio should be above 200:1. Grade 1 monitors should present pictures at a D65 reference white, and Grade 1 and Grade 2 monitors should have no visible pixel defects. Annoyingly, most nonprofessional monitors — and some professional ones — mislabel the brightness and contrast controls. On these sets, the controls actually set the black level and peak brightness, respectively.

Usually, professional LCD monitors will convert the spatial sampling of the incoming video to appropriately render on the display. However, this may result in new or masked artifacts. To address this, many displays offer a pixel-to-pixel mode, wherein each input sample is mapped to a specific

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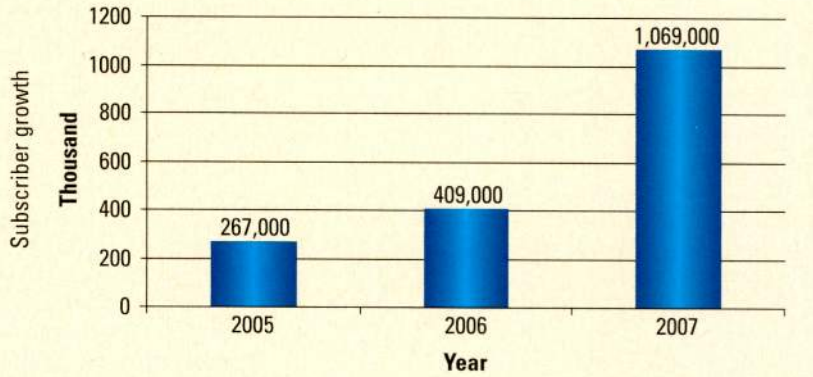

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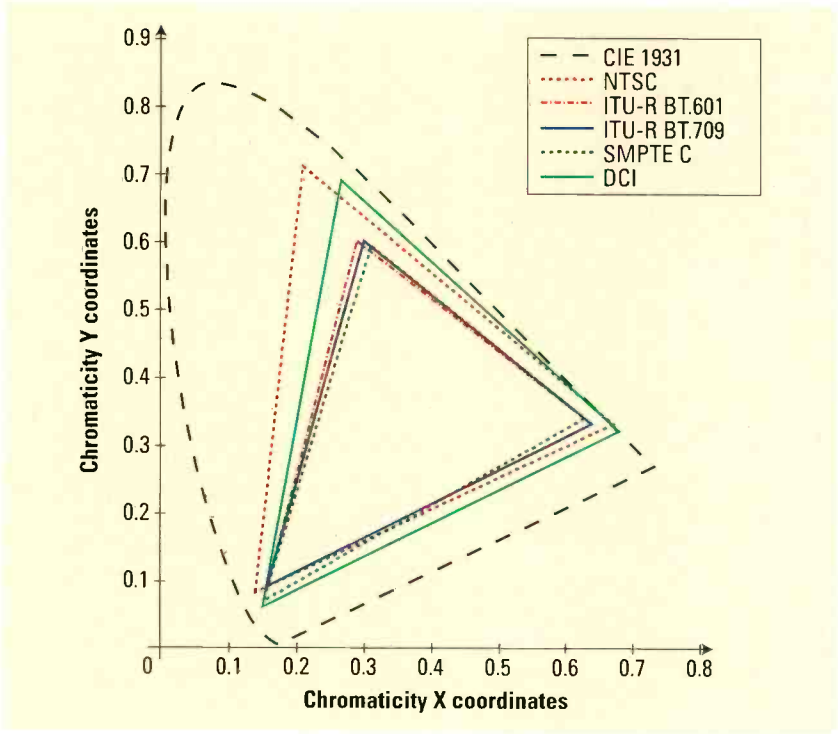

Figure 1. Various color gamuts in use have followed CRT technologies.

pixel. Of course, this will result in cropping, when the input resolution exceeds that of the display, or windowboxing, when the reverse is true. Another available option is a black frame insertion mode that can reduce motion blur by alternating video and black frames at a 120Hz frame rate. Of course, such a mode will decrease the brightness of the image, so it cannot be used at all times. For camera monitors, a focus-in-red function displays object edges in red when sharp focus is achieved.

LCD monitors are always progressive scan devices. Hence, when reproducing an interlaced source, the monitor must provide scan conversion in order to display the video properly. This conversion must be done with a very high quality; otherwise, it will introduce artifacts that were not originally present in the video. Usually, some combination of motion-compensated interpolation, together with variable spatial filtering, will be needed. And often several modes will be offered, depending on the characteristics of the video.

In addition, some monitors now include an interlace simulator, which can produce alternating black lines on the display. By switching the black lines between odd and even fields, a raster is created that can reproduce many of the original line-twitter and spatial-temporal-alias interlace artifacts.

Color gamut

Gamma is the nonlinear input-voltage vs. brightness transfer characteristic of a display. Originally conceived as a display mechanism to compensate for camera nonlinearity, the concept is essentially a holdover from the characteristics of electron-gun image capture. Today, with CCDs in widespread camera use, the gamma correction is used to provide compatibility.

LCD displays, however, have an S-shaped transfer characteristic, so gamma matching is done through digital signal processing. This also means that the monitor must internally use more bits than the video source, so that contouring does not occur when the compensation is large. Most Grade 1 monitors will allow the user to select from different gamma settings.

Color gamut (or chromaticity) is the term used to describe the range of colors that can be reproduced in a color system. Various gamuts have been proposed or used over the years, as seen in Figure 1, together with the original CIE 1931 XYZ gamut describing human color vision. While an

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NTSC gamut was proposed many years ago, it has never actually been used, and has simply become a reference with which to compare other systems. Instead, SMPTE C (SMPTE RP 145) is used to encode analog NTSC video in the United States; ITU-R BT.601 (formerly called CCIR 601 and derived from SMPTE RP 125 and EBU 3246E) is used in Europe; and ITU-R BT.709 is used worldwide for HDTV.

The other gamut shown in Figure 1 is the Digital Cinema Initiatives' Digital Cinema System Specification. Note that this gamut (indicated in green in Figure 1) far exceeds most of the others, especially toward the top of the chart. This means that video shot in this gamut will have to be color-space converted to display properly in the other gamuts. Interestingly, the algorithm for this conversion is not yet specified, owing to disagreement on its subjective effects.

Other functions that should be present in Grade 1 monitors are overscan, H/V delay, mono mode, blue-only mode and image markers. Many of these displays also support bridging inputs and external sync, as well as composite, S-video, RGB, Y-Pb-Pr, SDI and HD-SDI input signals; multiple image formats; tally lights; remote control; and rack mounting.

Grade 2 and 3 specs

Grade 2 monitors have specifications more relaxed than those of Grade 1, and are used for control, switching, editing, camera preview and composition, lighting control, camera viewfinders, editing and graphics generation, and similar applications where critical picture quality manipulation is not generally carried out.

Grade 3 monitors are used for continuity, observation, audio production, signal presence monitoring, video switching and the like. Multiple Grade 3 monitors are often used in large arrays to assist live production. With large-screen displays and specialized signal processors, it is also now possible to replace multiple physical monitors with a single large-screen display. Grade 3 monitors are also used in low-priority situations for confidence checking, and are used as on-camera props.

Grade 2 monitors have specifications more relaxed than those of Grade 1.

Daylight viewing rounds out the possibilities

A new feature that has appeared in recent years is daylight viewability. Although this had existed in the past, it was usually limited to small-form monitors used on handheld camera stabilization platforms. With the high brightness achieved by using a very high beam voltage on a CRT, this led to limited device life. Today, high brightness on an LCD monitor can be achieved by a number of technologies, such as very high output backlights, highly efficient illuminator optics and low-reflection front surfaces.

As with most technologies, we are seeing an evolution of video displays. Amazingly, it has been just over a century since the first CRT devices were invented. Technological progress, however, seems to be accelerating, and we shouldn't be surprised if other developments are just around the corner. BE

Aldo Cugnini is a consultant in the digital television industry.

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Understanding the basics

Read Part I in a two-part tutorial on computer networking.

BY BRAD GILMER

This month's article will explore networking basics from the perspective of someone who is new to the subject. Next month, we will look at networking for professional video applications from the perspective of someone who has general networking experience, but who has not worked on networks in this industry before.

Defining TCP and IP

Transaction Control Protocol (TCP) and Internet Protocol (IP) are two core protocols of the Internet. They almost always work together, but they are actually two separate protocols. TCP/IP indicates that an application is sending network information to the TCP layer and that TCP then sends its packets to the IP layer. From there, the IP layer sends its packets to a physical medium, which is almost always Ethernet.

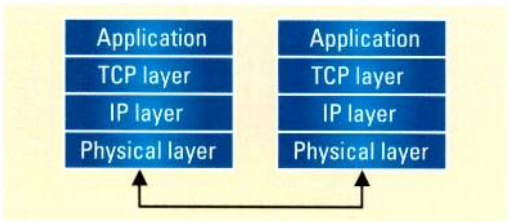

Figure 1. Two applications are connected over a network via TCP/IP and Ethernet. The layering of network protocols is known as a protocol stack.

Network protocols are layered on top of each other. This allows a designer to substitute different networking components with similar functionality at a particular layer without having to rewrite the entire networking application. Layered network protocols are known as a protocol stack. (See Figure 1.)

Almost all business networking uses TCP/IP. Let's begin our discussion of TCP/IP by using an example network comprised of a small office containing five computers that are connected to the Internet using a router.

Assigning IP addresses

TCP/IP networks are built using a numbering system composed of groups of numbers separated by periods (e.g. 10.19.8.215). The group of numbers is known as an IP address. Each device on a network must have a unique IP address. Another group of numbers associated with the IP address is called a subnet mask (e.g. 255.255.255.0). The subnet mask is common to a grouping of computers and networking devices and tells individual workstations the number of possible computers on the local network.

Before building our network, we need to decide what IP addresses to use. The range of acceptable addresses for a local network has been determined by the Internet Corporation for Assigned Names and Numbers (ICANN), the governing body of the Internet. In the early days of the Internet, developers realized that they needed documents to describe how the Internet functioned. These documents, created by the Internet Engineering Task Force (IETF), are known as Request for Comments (RFC). The IETF also generated a handful of standards (STD). IETF STD 07 defines TCP.

RFC 1918, "Address Allocation for Private Internets," defines IP addresses for private networks. (See Table 1.) It sets aside three blocks of IP addresses for private networks. The block of IP addresses we use depends on the number of network devices we plan to install.

Block	IP addresses	Subnet mask	Number of addresses
Class A block	10.0.0.0 – 10.255.255.255	255.0.0.0	16,777,214
Class B block	172.16.0.0 – 172.31.255.255	255.240.0.0	1,048,574
Class C block	192.168.0.0 – 192.168.255.255	255.255.0.0	65,534

Table 1. Private network IP addresses are defined in RFC 1918 by the Internet Engineering Task Force.

For our example, I have selected the address range 10.19.8.1 – 10.19.8.254, with a subnet mask of 255.255.255.0. You could choose any valid group of addresses shown in Table 1. The

IP addresses	Subnet mask	Number of IP addresses
10.19.8.0 – 10.19.8.255	255.255.255.0	254
10.19.8.0 – 10.19.8.127	255.255.255.128	126
10.19.8.0 – 10.19.8.63	255.255.255.192	62
10.19.8.0 – 10.19.8.31	255.255.255.224	30
10.19.8.0 – 10.19.8.15	255.255.255.240	14
10.19.8.0 – 10.19.8.7	255.255.255.248	6
10.19.8.0 – 10.19.8.3	255.255.255.252	2

Table 2. Depending on the number of devices on the network, an IP address block can be further divided.

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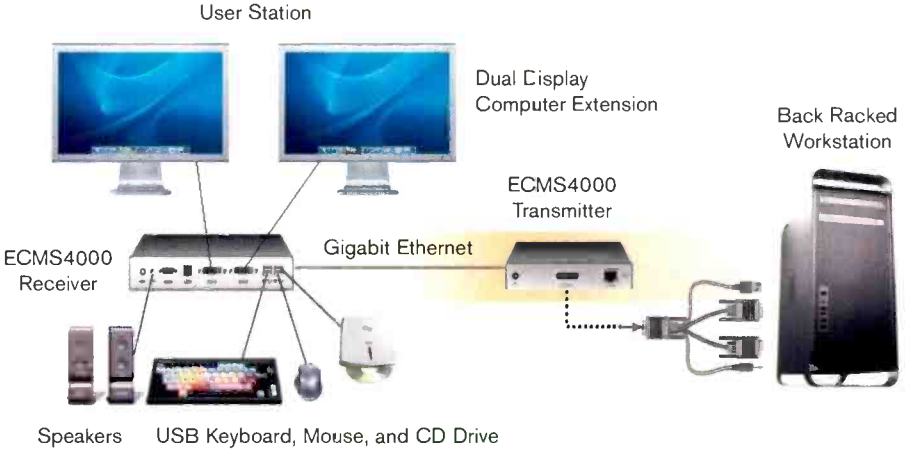

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subnet used for our local network is different from the subnet shown in Table 1. By applying the subnet mask 255.255.255.0, we are using a small number of the total number of Class A IP addresses set aside by RFC 1918. The IP address block can be further divided depending on the number of devices on the network. (See Table 2 on page 30.)

As you can see from the table, the number of addresses in a network can be altered by changing the subnet mask. Any subnet mask from 255.255.255.0 to 255.255.255.248 will work in our sample network.

The subnet mask in a small company network using private addresses is not that important; most use 255.255.255.0. Subnet masks become much more important when configuring routers connected to the Internet and in larger corporate networks.

For our example network, I assigned our first IP address in the block, 10.19.8.1, to the router. (See Figure 2 on page 34.) A router connects two physical networks together. In our case, it will connect our local (private) network to the Internet. The router is nothing more than a computer with two network cards.

The port of the router that is connected to the local network is referred to as the local area network (LAN) port. The side of the router that is connected to the Internet is referred to as the wide area network (WAN) port. The LAN side of the router will use the IP address 10.19.8.1. The IP address for the WAN side is obtained from and assigned by our Internet service provider (ISP). In this example, the ISP assigned our public IP address as 208.148.144.73.

The private IP addresses defined in RFC 1918 are unroutable, which means they cannot be projected onto the Internet. If you want computers on the LAN side of the router to be able to access the Internet, you will need to use a translator, commonly known as Network Address Translation (NAT).

Almost all routers have NAT built into them, and in simple home and office routers, this functionality is configured automatically. The router's WAN address is a public IP address, which means that anyone on the Internet can access the router by typing in the IP address.

The NAT built into the router allows each workstation to access the Internet, but the actual IP address of the individual workstation is never projected onto the Internet. If you were looking from the Internet into our sample network, the activity of the individual workstation would appear as if it were the WAN address of the router (i.e.

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208.148.144.73). I have assigned the computers in our example network the IP addresses shown in Table 3.

Each of our network devices has a gateway address. This address must be present if the users are going to access anything outside of our local network. The gateway address tells a workstation to send all network traffic not bound for our local network to the router.

For example, if you are at a workstation and attempt to go to *www.cisco.com*, the computer first resolves the IP address for *www.cisco.com* to 198.133,.219.25. It sees that this address is not on the local network and forwards it to the gateway address, which is our router. The router looks at the address, sees that it is not on the LAN side of the router and forwards the packet on to its gateway, which is shown in the table as 208.148.114.1. This process continues until the packet reaches 198.133.219.25.

This can be illustrated by going to a computer, opening a system window and typing "tracert *www.cisco.com*" (without the quotes) and pressing "Enter." (See Figure 3.) Each of the 15 hops represents a router, and the subsequent hop represents the gateway address of the previous router. The number of hops will vary depending on the route from your computer to Cisco. BE

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

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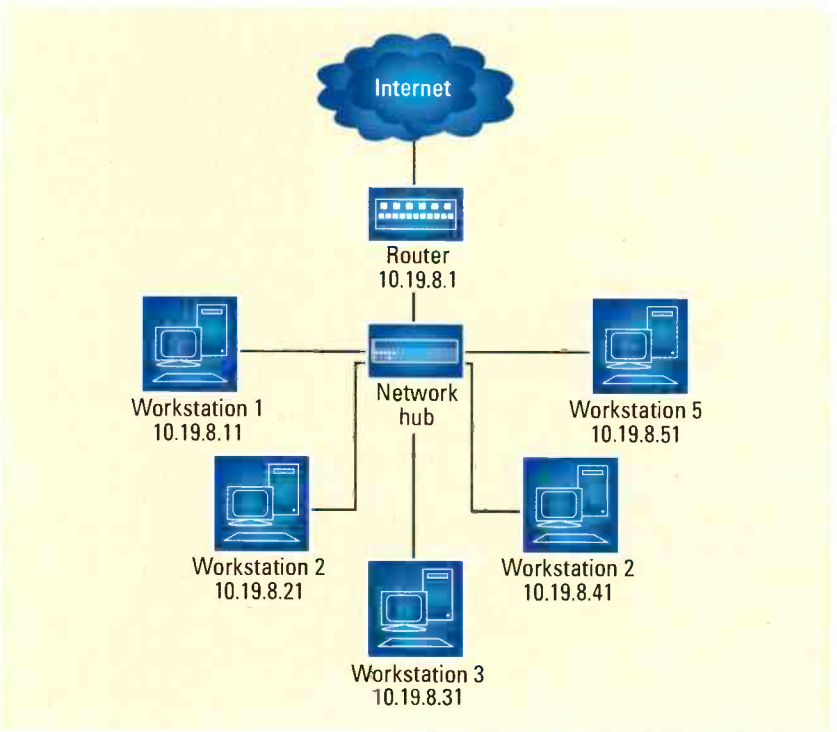


Figure 2. Building a simple network requires selecting appropriate IP addresses on the private side of the network.

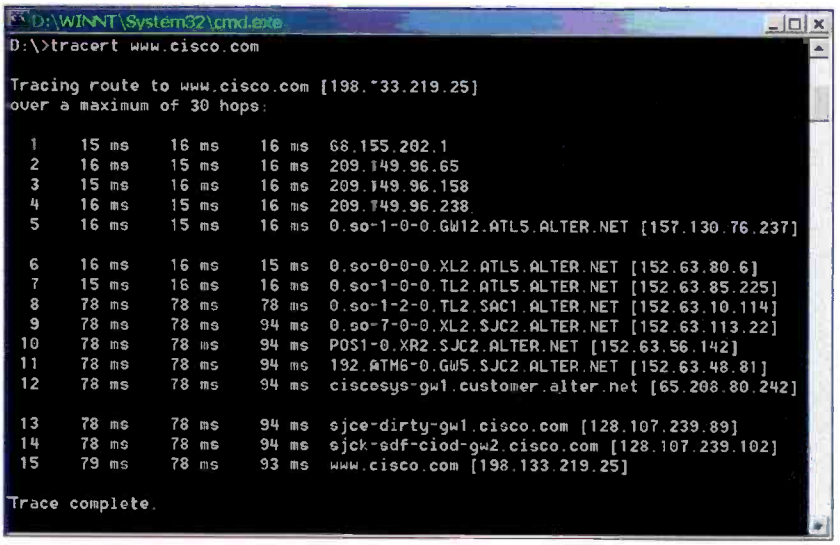
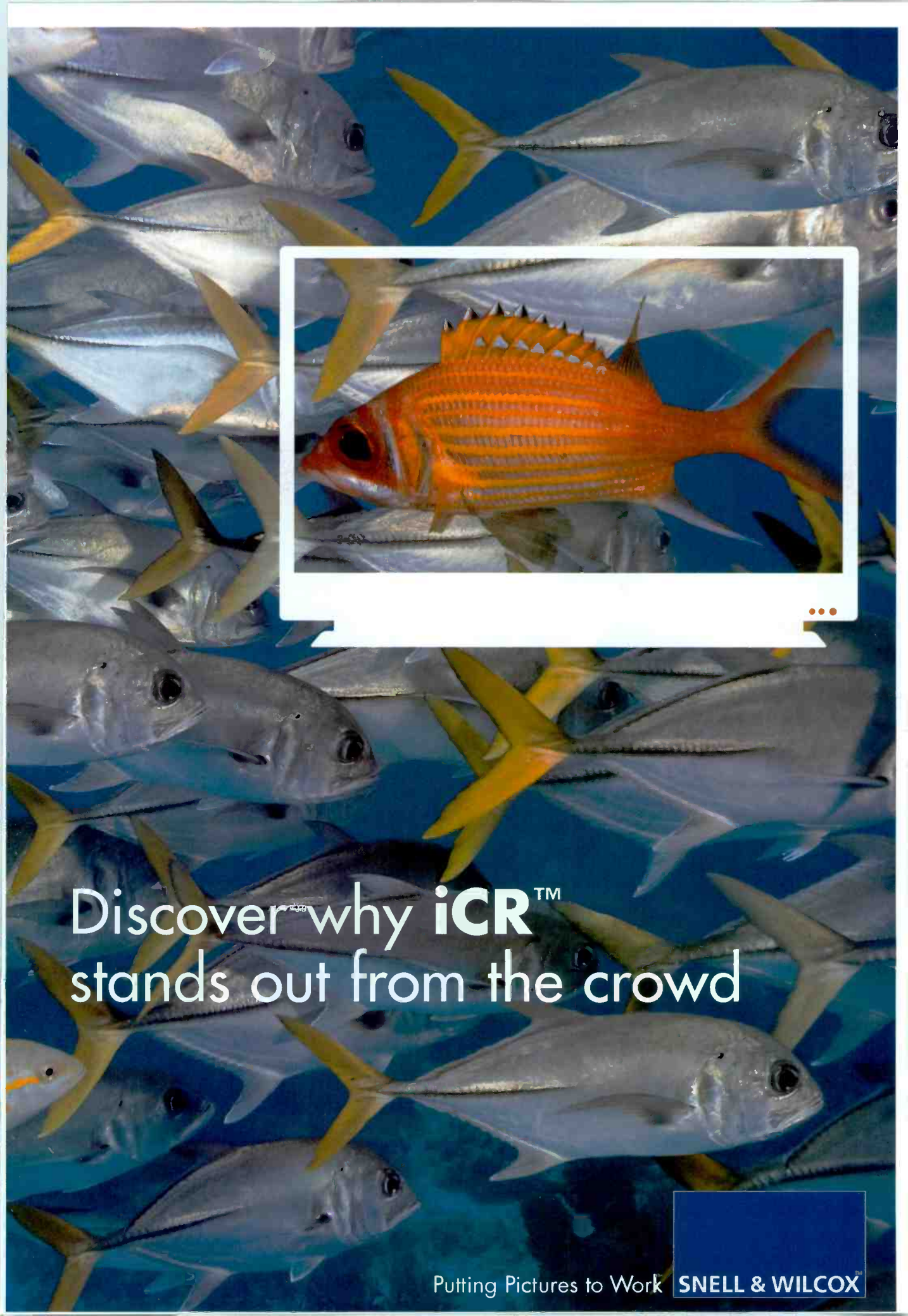


Figure 3. When applying a tracert command to your computer, you should see something similar to what's shown above.

Computer name	IP addresses	Subnet mask	Gateway addresses
Router	LAN – 10.19.8.1 WAN – 208.148.144.73	LAN – 255.255.255.0 WAN – 255.255.255.252	WAN – 208.148.144.1
Workstation 1	10.19.8.11	255.255.255.0	10.19.8.1
Workstation 2	10.19.8.21	255.255.255.0	10.19.8.1
Workstation 3	10.19.8.31	255.255.255.0	10.19.8.1
Workstation 4	10.19.8.41	255.255.255.0	10.19.8.1
Workstation 5	10.19.8.51	255.255.255.0	10.19.8.1

Table 3. The above IP addresses were assigned to our example network.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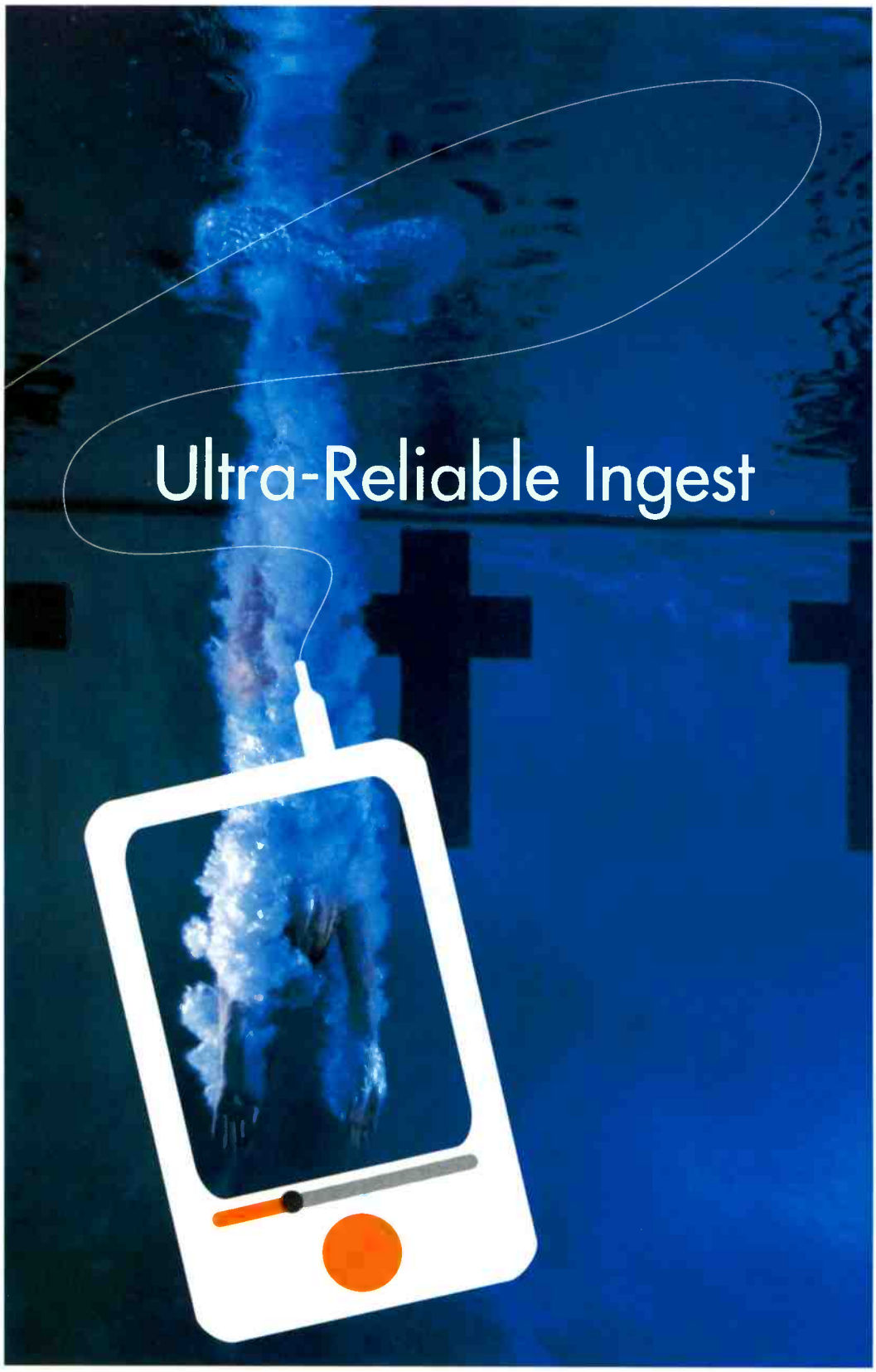

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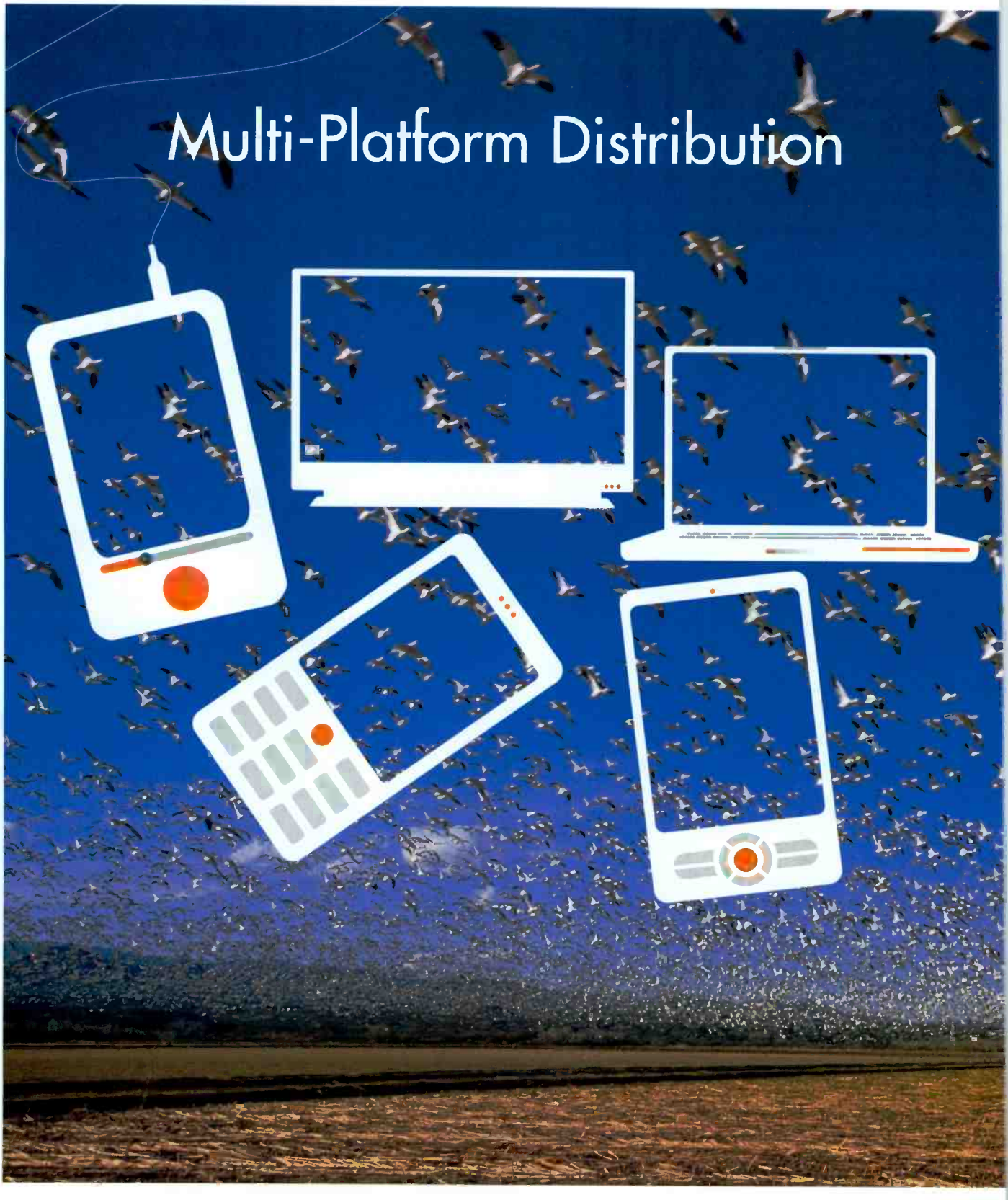

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Next-gen audio coding

Understand the theory behind high-end audio coding.

BY JEFFREY C. RIEDMILLER

Today many broadcasters and cable programmers are under increasing pressure both to prepare and to distribute their content to viewers over more diverse pathways. These next-generation distribution paths often have limited bandwidth. This requires broadcasters, service providers and operators to use audio and video coding systems that allow them to deliver broadcast streams more efficiently while simultaneously maintaining a predictable level of quality. The overall goal of using these new coding systems is to maintain the preestablished benchmark of broadcast quality.

Today, some networks simultaneously prepare and deliver content in the format that their existing and primary viewers require, as well as in the new formats that several of the next-generation service providers (e.g. IPTV operators or download services) require. This simulcast of content is ideal because the next-generation service providers can simply pass through the precompressed low bit-rate content without having to perform any quality altering process (on the way through their systems).

However, there are many cases today in which these next-generation service providers simply take a network's primary signal and transcode it (i.e. converting it in real time from one format to another) into a format that will yield the lower bit rates required for their network. Unfortunately, making this process work typically requires a full decode of both the audio and video before re-encoding into one of the future audio and video formats — a process that often results in a degradation in quality.

This article series will focus on the most important and often overlooked factors when considering a next-generation audio codec in applications where transcoding (from one format to another) cannot be avoided. In particular, it will examine what to expect in terms of quality when two different audio coding systems are used in tandem and include a brief explanation of the standardized methods used to test the quality of audio coding systems. In addition, it will also explore how to interpret test results and most importantly, define broadcast quality.

Human listeners need to be involved to assess an audio coding system. There are two standardized methods for assessing the perceived quality of audio coding systems that involve human test subjects.

Quality measurement

The term quality is a key concept in audio coding, yet it is also quite challenging to describe or measure in objective terms. Using traditional methods, such as signal-to-noise ratio (SNR), to assist in quantifying the perceived audio quality of any audio coding system will often lead to little success because measures like this do not consider psychoacoustic principles.

In the late 1980s, researchers Brandenburg and Johnston from Bell Labs presented an interesting case supporting the need for something other than a simple objective measure. Referred to as the 13dB miracle, the researchers presented two processed audio signals, each having a measured 13dB SNR. In one of the signals, they introduced white noise, while the other was injected with perceptually shaped noise.

Even though the SNR was identical for both signals, the perceived quality was quite different to the listener. The signal with the injected white noise had an annoying background hiss. The signal with the shaped noise was characterized as having good quality because the noise distortion was being partially or completely masked by the signal itself.

Based on the case just described, it is clear that human listeners need to be involved at some level to assess the quality of an audio coding system. Fortunately, there are two standardized methods for determining the perceived quality of audio coding systems that involve human test subjects. They are both standardized by the International Telecommunication Union (ITU) and referred to as:

- ITU-R BS.1116-1 (Methods for the Subjective Assessment of Small Impairments in Audio Systems Including Multichannel Sound Systems); and
- ITU-R BS.1534-1 (Methods for the Subjective Assessment of Intermediate Quality Levels of Coding Systems), also known as MUSHRA, which stands for MUltiple Stimuli with Hidden Reference and Anchor.

Assessing audio codecs

It can safely be stated that the perceived difference between a coded audio signal and the source (that is, the reference) has a direct correlation with quality, and the term impairment (often used in this discipline) can be thought of as the difference

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between the two. Another important term used when assessing audio coding systems is transparency.

Transparency is used to describe coded audio signals where the coding system under consideration is operating at a data rate such that listeners cannot reliably distinguish between the source (the reference) and the coded signal itself (where the source audio is encoded and then decoded). Therefore, the goal of any subjective listening test is to use a variety of test signals and then identify and grade how annoying audio impairments are when the codec is operating within its region of transparency and below its region of transparency.

It is important to note that different test strategies and methods are typically used to assess coding system and data rate combinations that fall within each of these categories. When completed, the results of these tests are intended to assist us in determining whether an audio codec operated over a range of data rates will consistently perform at a known level of quality for a specific application.

ITU-R BS.1116-1

The ITU-R BS.1116-1 method is the more critical subjective listening test methodology of the two listed previously. It is typically used to assess audio coding systems that introduce impairments small enough to be undetectable without strict control of experimental conditions and proper statistical analysis. The grading scale is based on a (continuous) five-grade impairment scale, as shown in Table 1. A grade of 5.0 is considered to be transparent, while a grade of 1.0 is reserved for annoying impairments. The ITU-R BS.1116-1 grading scale also has a relationship to a standardized quality scale, which is defined in ITU-R BS.1284-1 and shown in Table 2.

Impairment	Grade
Imperceptible	5.0
Perceptible, but not annoying	4.0
Slightly annoying	3.0
Annoying	2.0
Very annoying	1.0

Table 1. ITU-R BS.1116-1 grading scale

The BS.1116-1 method itself is a double-blind, triple-stimulus with hidden reference type of test. A subset of a test session is a trial that begins with the presentation of a set of stimuli (the reference and two test items) and finishes with the test subject grading each of the test items.

For each trial, the listener is presented with three signals or stimuli. One signal is the uncompressed reference signal (which is always known to the test subject), and the remaining two are the test signals, one of which is identical to the reference and the other of which is the same signal coded at a particular bit rate of interest.

Listeners are asked to assess and then grade the impairments between each of the test signals compared with the known reference. They can freely switch between any of them. Because one of the test signals is actually the (hidden) reference signal, the listeners should be grading it as a 5.0, and the remaining test signal should receive a grade based on the listener's subjective assessment of the degradation. If listeners are unable to reliably perceive any differences between the test signals, the audio coding system and the tested bit rate are said to be in the particular codec's region of transparency.

Coding margin

It is obvious that tests like this often include signals coded at multiple bit rates in an effort to quantify the coding margin of the coding systems in question. Coding margin is the difference between the quantization noise from the codec/bit rate combination and the masking threshold. Generally speaking, operating a codec at a higher data rate will typically yield an increase in coding margin.

Coding margin can be thought of as the difference between the quantization noise from the codec/bit rate combination and the masking threshold.

What about the criteria for selecting listeners? When assessing small impairments, it's important that the test subjects are expert listeners and have experience detecting small impairments introduced by audio coding systems. This often involves screening test subjects before and

Quality (ITU-R BS.1284-1)		Impairment (ITU-R BS.1116-1)	
5	Excellent	5	Imperceptible
4	Good	4	Perceptible, but not annoying
3	Fair	3	Slightly annoying
2	Poor	2	Annoying
1	Bad	1	Very annoying

Table 2. ITU-R BS.1116-1's grading scale compared with ITU-R BS.1284-1's scale

after to determine their ability to correctly identify the hidden (uncompressed) reference. The size of the final listening panel often consists of 20 to 30 expert listeners.

What about test material? BS.1116-1 requires that only critical material be used to expose differences among all of the audio coding schemes being tested. Critical material stresses the audio coding system in question and must be investigated and sought out for each system that's tested.

There is not a universal set of audio test material that can be used to assess all audio coding systems for all conditions.

It is not uncommon to find several of the same audio test sequences among different subjective evaluation tests. However, there is not a universal set of audio test material that can be used to assess all audio coding systems for all conditions. This key aspect of the testing process is absolutely crucial because failing to find truly critical (stressful) test sequences for each audio coding system will result in inconclusive test results.

More to come

For a detailed explanation of the MUSHRA test method, please see the extended version of this article on the *Broadcast Engineering* Web site, at *http://broadcastengineering.com/issue_20080101*. And in a future Production Clips article, we'll tackle part two of this audio coding series, defining broadcast quality, as well as tandem coding losses and their effect on perceived quality. BE

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

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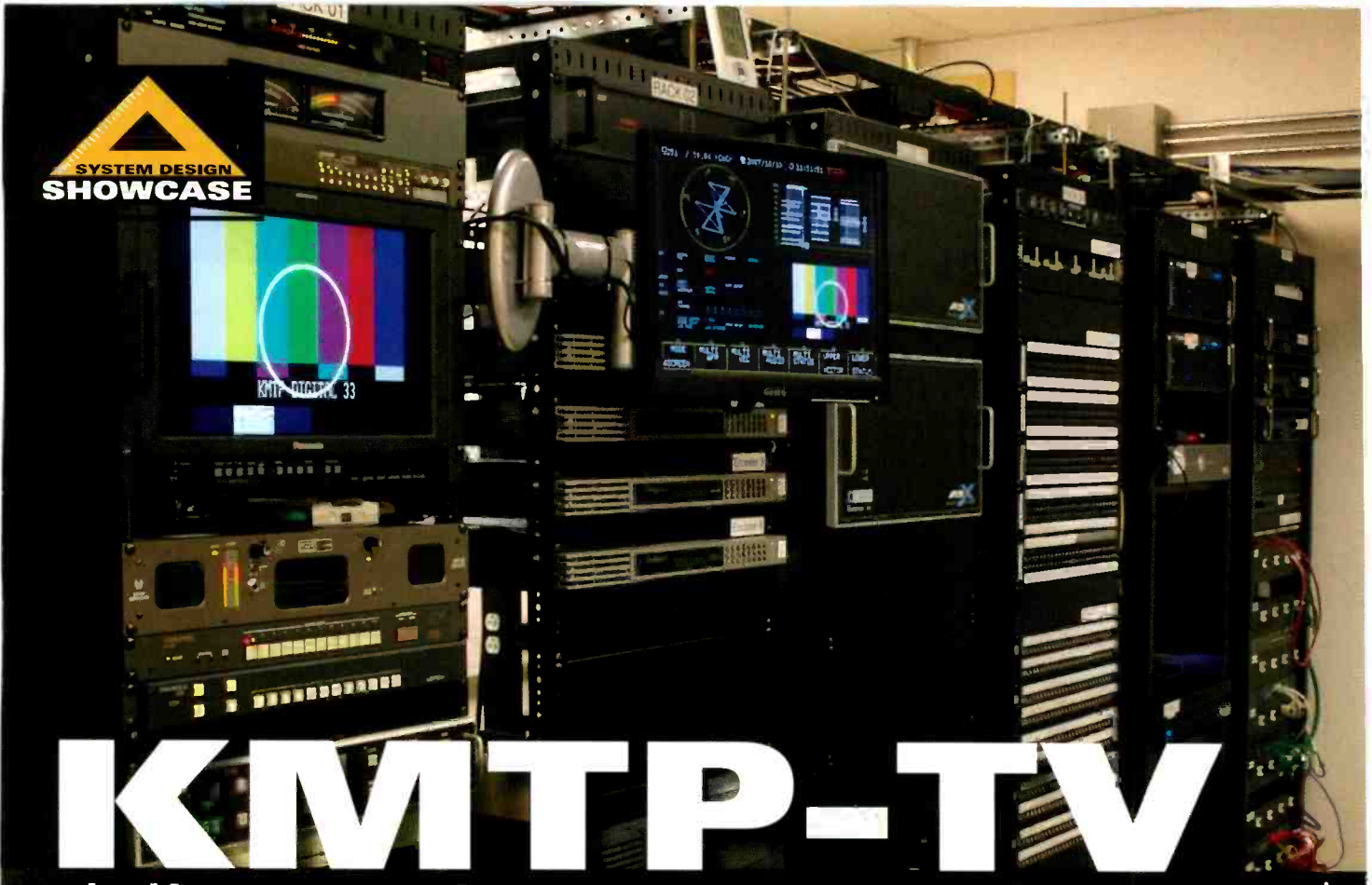

KMTP-TV delivers unique programming from a new digital facility

BY RUSSELL BROWN

KMTP-TV has been a part of San Francisco broadcasting for 16 years, bringing ethnically diverse programming to its viewers as an independent public television station. During this time, the station rented studio and office space and depended on equipment donations from local TV stations.

When the FCC mandated the transition to digital, KMTP was housed in the bottom floor of a one-time brewery, running with hand-me-down equipment and a 40-year-old analog transmitter. The station saw the digital transition as an opportunity to upgrade its entire operation, which included purchasing a new transmitter and a building of its own.

The planning stages

In 2004, KMTP installed new Thomson Grass Valley analog and digital transmitters at Sutro Tower. Fortunately, a community digital antenna system had already been installed in 1999, so this made the

Top: The main technical room features a monitoring rack with a Leader LV7720 rasterizer and Panasonic BTLH picture monitors. The room also includes an encoder, a routing switcher, patch bays, video servers and automation.

Bottom left: The four monitors on the left wall are used for off-air monitoring. The center monitor is switchable. The right one is off-air analog and includes a routing switcher. The computer station on the left is run by Crispin automation. The right workstation handles video server monitoring, file ingest, as well as playlist creation and editing.

Bottom right: The facility houses a Thomson IOX analog transmitter and a Thomson DCX digital transmitter. Both are IOT water-cooled.

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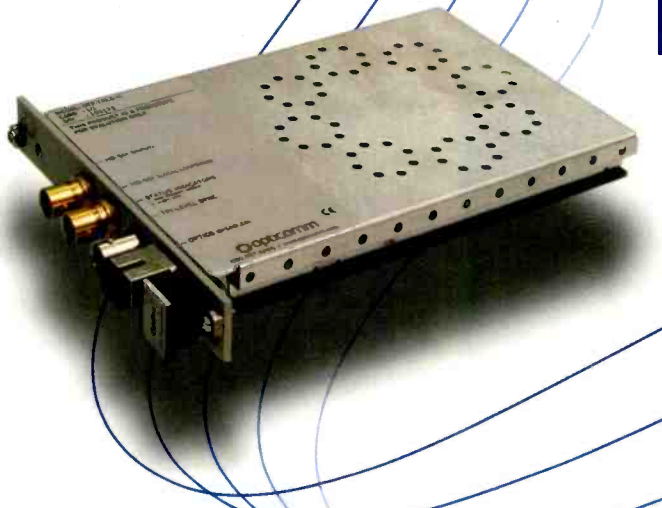

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process a little easier. However, the station still had to fit the new transmitters in the same room as its existing GE UHF transmitter. The engineers cut a hole in the wall to the station next door and brought the cabinets and HVPS through it. They ran the DTV transmission line up to the roof and into the combiner building. Then they connected it to the mask filter, which was also installed in 1999.

The digital transmitter and its exciter are controlled from a digital workstation that has two computers, one for system control and the other for setting up the digital exciter.

KMTP installed a Video Technics Apella video server, which is based on a gigabit network. The server can be expanded in the future as the station grows.

It took time before KMTP could find a suitable and affordable building. Because of the technology downturn several years ago, the station found a building in the heart of Silicon Valley that fit its budget. The new building is located near Stanford University in the city of Palo Alto, about 30 miles south of San Francisco.

Its 21,000sq-ft space is more than enough room for the station's present needs. It even gives KMTP extra space, which allows the station to rent out sections of the facility to on-air clients. An added bonus is that the building includes two classrooms, which the broadcaster plans to use in the near future.

In order to stay within the budget, economy and simplicity were the primary goals of the design for the new facility. The new facility was a fresh start for the station, because most of its existing equipment would not be needed in the new facility.

The station decided that the new facility should be all-digital, using SDI, SMPTE 259M, video and AES/EBU balanced audio throughout, with any analog equipment converted directly to digital. KMTP wanted to start out with four SD digital channels, which required a fully automated, multichannel master control room that could be run by a small staff or left unattended at times. Because of the station's small staff size, it was decided that all tape ingest would be accomplished within the facility's master control, which meant putting all the VTRs within it.

The heart of the station's system includes three main components: the video servers, an automation system and a routing switcher. Each part is crucial to the success of the new multichannel facility.

Video servers

The first step was selecting the video server, which needed to have several output channels and at least two ingest channels. It also needed to be expandable to handle future growth. KMTP would have liked to build in HD capability, but it was outside of the station's budget. Therefore, the station decided to handle HD capability as a completely separate playout system in the future.

The heart of the station's system includes three main components: the video servers, an automation system and a routing switcher. Each part is crucial to the success of the new facility.

KMTP installed a Video Technics Apella video server because it has many of the functions and the expandability the station required. The server is based on a gigabit network. Digitized audio and video travel over the network from ingest to storage or storage to playout.

Storage is handled by a Ciprico DiMeda 1700 NAS server. If more space is needed, NAS can be easily added to the network.

The chassis hold a maximum of four playout/record channels. Each channel can be used for ingest or playback, and the chassis are connected to the network with just one cable. KMTP uses two chassis with a total of six channels.

The video server allows off-the-shelf PCs to run software that

enables the station's staff to view any clip on the server and edit it as well as add voice-overs to any video clip. This feature is important to KMTP because the station produces foreign language news programs. It allows the station to add voice-overs to pre-produced segments without using its limited number of edit bays.

A hot folder on the NAS allows the station's Final Cut Pro editors to drop completed files into it. Then the files are processed and placed on the video server automatically and ready to be played on-air. The same editors can also browse the contents of the NAS and pull files off of it.

Automation

KMTP was determined to find automation that was stable, reliable and backed by excellent customer service.

Four Samsung DTB-H260F set-top boxes are connected to audio and video distribution amplifiers.

The station selected a four-channel Crispin RapidPlayX 2000, which includes free lifetime support. In order to facilitate the marriage of the servers to the automation, Video Technics sent an Apella system to Crispin to ensure that the two systems would communicate to one another when the equipment arrived at the new facility.

Routing switcher

Lastly, KMTP needed a routing switcher to tie the system together. The station couldn't afford a dedicated master control switcher for each channel, so it decided that the routing switcher would act as its master control switcher. This obviously meant the station needed a reliable SD digital routing switcher that fit the budget.

KMTP went with a Sigma Electronics ADX router with 64 inputs and 32 outputs. It can be expanded up to 128 x 128, but even at its present size, the station will not use all of it for some time.

The station also purchased seven Sigma SYX control panels. The AES audio is balanced, and the facility uses

The main transmitter racks include a digital rack on the left, monitoring in the middle and analog on the right. The monitors on the top are digital off-air, analog off-air and cable.

ADC PPA3-14MKII26NS audio patch bays, as well as Belden1800A digital audio cable. The facility is outfitted with Switchcraft VPP26K3HD75T video patch bays and uses Belden 1694 digital video coax for SDI video cabling.

Monitoring

The new facility required all new monitoring equipment because the station switched to digital. Engineers installed four 17in Panasonic BTLH monitors, which handle SDI-HD, SDI-SD as well as analog inputs. The monitors come in a one-piece design, making them easy to mount.

The station's budget only allowed it to purchase one SDI waveform/vector scope rasterizer, so it installed a Leader LV7720. The main unit is mounted in the equipment room and uses a VGA splitter, another feed goes to master control where it is an input on a KVM switch at the dubbing position. The facility also includes a Sigma TSG490Y sync generator with SDI test patterns and AES test tones.

In master control, there are three work positions:

- *automation*, where all four channels are controlled;
- *workstation*, which gives the station access to the video servers and a place to create and edit playlists; and
- *dubbing*, where VTR ingest is accomplished and clips can be transferred into the video servers.

The only equipment KMTP kept from its old facility was its Beta and U-Matic VTRs, which are mounted in the MCR racks for ease of use. The satellite receivers are also mounted in the MCR racks.

Contrary to the rest of the facility, monitoring in master control is mostly analog, which was done for purely budgetary reasons. Off-air monitoring of the station's DTV signal is accomplished through four Samsung DTB-H260F set-top boxes, each tuned to a different channel. The STBs are connected to Thomson Grass Valley 8550 audio DAs and Hedco VDA 100 video DAs, which in turn feed Tatung TLM1503 15in monitors, a Videotek RS12A analog switcher and Harris Leitch Panacea Lite Digital 12 x 1 switcher in master control. One digital router output is converted to analog and fed to the same switcher, which is then connected to a Magni WV560 analog waveform monitor and a Tatung V32GCGI 32in monitor/DTV receiver also in the MCR.

Encoding

The encoding system is comprised of four Harmonic MV45 SD encoders as part of an NMX statistical multiplexer. The system uses a GUI interface to monitor and control the encoding system, from tracing and recording faults such as a bad video input to changing the bandwidth priority of any channel. It is easy to use, and it can automatically switch in a spare encoder if one fails, as well as send an e-mail to let you know.

The output of the stat mux is connected to a Thomson Amber multiplexer, which is where the Program and System Information Protocol (PSIP) data is added to the transport stream. KMTP also uses the company's Pearl PSIP generator to create the PSIP data.

Computer networks

The technical room uses five

Design team

VMI
Ron Wells, main supplier
KTMP-TV
Russell Brown, chief engineer
Doug Benson, Kelly Quan, Bianca Brown, Joy Brown, Phil Hartman, construction assistants

different computer networks, not including the Internet. The station keeps all its IP address ranges separate for security purposes. All the network routers and switches are located in one rack to make it easier to monitor all the systems. This also allows engineers to patch any system to the Internet when remote access is needed.

Studio production equipment

For studio productions, KMTP purchased three Canon XLH1 camcorders, which double as studio and field cameras. They have genlock and SDI outputs so the station can use them in the studio.

The facility's Broadcast Pix 2000 production switcher features both analog and digital inputs and outputs as well as a DVE, built-in video clip playback and Inscriber TitleMotion DV V4.3.1 CG. The system can be controlled from its control panel or via the network browser.

The station's two classrooms will be used for equipment training. In addition, the classrooms may be used to teach classes in video engineering and production. BE

Russell Brown is a chief engineer for KMTP-TV.

Technology at work

ADC PPA3-14MKII26NS audio patch bays
Belden
- 1800A digital audio cable
- 1694 digital video coax

Broadcast Pix 2000 production switcher
Canon XLH1 camcorders
Ciprico DiMeda 1700 NAS storage
Crispin RapidPlayX 2000 automation system
Harmonic
- MV45 SD encoders
- NMX statistical multiplexer

Harris Leitch Panacea Lite Digital 12 x 1 digital switcher
Inscriber TitleMotion DV V4.3.1 CG
Leader LV7720 rasterizer
Magni WV560 analog waveform monitor
Panasonic BTLH monitors
Samsung DTB-H260F set-top boxes
Sigma Electronics
- ADX router
- SYX control panels
- TSG490Y sync generator

Switchcraft VPP series video patch bays
Tatung
- TLM1503 15in monitors
- V32GCGI 32in monitor/CTV reciever

Thomson Grass Valley
- 8550 audio DA
- Amber multiplexer
- CTT-U-50CXIC analog transmitter
- CTT-U-DCX digital transmitter
- Pearl PSIP generator

Video Technics Apella video server
Videotek RS12A analog switcher

DTV transmitters

Stations broadcasting from the Sears Tower designed a way to coexist.

BY DON L. MARKLEY

When the DTV rules were first announced, or even offered for comment, broadcasters started to worry about how a second channel could be accommodated within the framework of their existing facilities. Transmitter space could be handled by, at worst, adding on to buildings, but antennas and lines were often a problem, especially on older towers that were built to different specifications than today's towers. For stations that were tenants on sites where space was a problem, either regarding the building or the towers, the problems quickly became real and difficult.

On the Sears Tower, three multiplexers were squeezed into what was previously a restroom off of what had been an old observation deck.

The layout of the Sears Tower

In Chicago, D.L. Markley and Associates was hired to work with the Sears Tower and broadcasters to determine what their needs would be and find a way to accommodate new hardware. The building operations manager determined the transmitter space needs and came up with a plan that gave each station the amount of space it needed — which wasn't necessarily what each station wanted, but it worked.

It was quickly determined that while the transmitters would fit, there simply wasn't enough vertical real estate to get everyone on the air while all the analog antennas were still in place.

I'm sure that everyone has seen the antenna installation on the Sears Tower. Just watch an NFL game from the aesthetically challenged Soldier Field Stadium. Shots often include the Sears Tower, clearly displaying the antenna layout.

The original structure consists of two towers, totally enclosed in radomes, mounted on top of two huge steel cylinders. The walls of the cylinders have not been penetrated by anything other than small openings for cables to maintain structural integrity.

The towers are in three levels, with each level being smaller than the one below it. Each level does not have more than one full-size UHF antenna, with some VHF activity on the lower level. The west cylinder has a couple of VHF antennas mounted on its face under a large fiberglass bubble. Those two antennas, now used as auxiliary, were once used for some of the early

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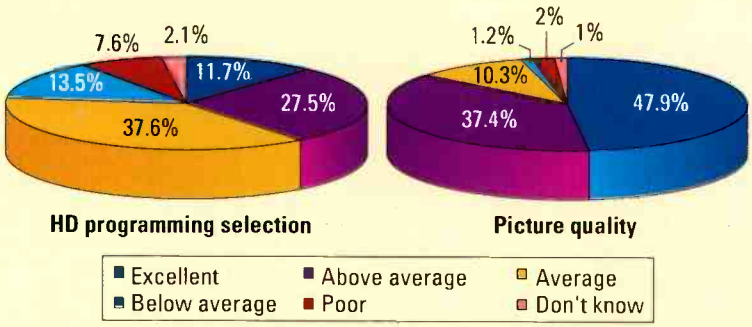

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measurements and data gathering concerning circular polarization for VHF TV.

Other than the second space down from the top of the east tower, there wasn't room for anything new. Changes would either have to be made by cooperation between the existing tenants or something new would have to be added to the installation. In the final analysis, both paths were taken.

Resolving an issue of space

With little significant objection, the tenants worked out their problems. This involved using some new space, to be discussed in a bit, and reconfiguring an existing antenna.

The antenna at the top of the west tower was a big unit designed for 5MW ERP. Through a series of maneuvers, both after and prior to the DTV problem, that antenna was reconfigured. It was removed and replaced by three DTV antennas, lovingly referred to as the triple-stack.

The new technology and much lower power requirements for DTV enabled three channels on the antenna space. The antennas were directional, which is the norm for the UHF stations on the building. To the northeast lies Lake Michigan. The stations run out of steam in that direction before hitting the other side, so the use of the directional antenna is obvious.

The building was originally designed to accommodate broadcasters with a tower/cylinder combination. Like most designs, that worked for a long time — until DTV came along. In trying to work out a solution to the real estate problem, the structural engineer on the project mentioned that there were four load platforms on the roof, located between the cylinders and the building corners. The structures could hold a fairly good load for future uses, whatever those might be.

With little significant objection, the tenants worked out their problems.

At first, not much thought was given to those platforms as they weren't thought to have the necessary mechanical loading abilities to hold a self-supporting structure. Anything mounted on those pads on the east side would have to at least get the top antenna near or above the cylinders for good service. The same applied in part to anything on the northwest pad due to shadowing from the west cylinder.

Eventually we decided to install monopoles on the pads, which could be anchored by a couple of braces to the cylinders. That greatly reduced the horizontal loading problem for the rooftop pads. The vertical loads were acceptable. Due to the shadowing that would occur over parts of the market area, we used the two east monopoles for auxiliary service only with multiplex panel antennas.

Next came the juggling act. We contacted the manufacturers of these antennas to determine the specifications of their units that could handle the projected power and pattern. That data then went to the structural engineer for analysis and approval from a loading point of view, which then was used as a filter for the proposed antennas. Finally, one was selected and was used on both the northeast and southeast monopoles.

In a similar fashion, a high-power panel antenna with the same pattern was installed in the last available space on the east tower. That antenna could accommodate two stations at 5MW each or several lower power antennas. It was installed easily as it was not set in place in one unit but was actually constructed on the existing tower. After that, the only problem was getting all those signals to their respective antennas. The numbers included three signals into the new main, five into one auxiliary and seven into the other.

Manifold technology

Handling all those signals wasn't easy. High-power multiplexers are traditionally large structures. However, the space for those units was not big. Therefore, we needed multiplexers that did not take up much space. The search quickly settled on manifold technology. UHF use at high power is normally done by using a waveguide base with waveguide filters on directional couplers installed into that base.

All the stations were accommodated, and there is some growth potential. Although, to do so the new multiplexers may have to be broken up into two pieces, with the new sections being connected to the old by cables.

Conclusion

So far, we have discussed this antenna project as though no problems were encountered. That wasn't the case. There were enough problems — some terribly significant — to fill another article. Look for the next article in this series in the March issue of *Broadcast Engineering* magazine. BE

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

? Send questions and comments to: don.markley@penton.com

Building HD news sets

Consider these factors when preparing for an HD launch.

BY MICHAEL P. HILL

With more stations making the leap to HD newscasts, important lessons are emerging about preparing the front-of-the-camera visual elements to look their best in HD and 16:9.

WFTV-TV debuted its first HD newscasts in July 2006 with a new set from FX Group.

Planning

The first, and most important, consideration in preparing for an HD launch is to allow adequate time to integrate all departments. This factor holds true to everything from installing equipment, designing graphics and building a set.

WFTV-TV in Orlando, FL, launched its HD newscast in June 2006. Coordinating each department's expertise in technology, workflow and day-to-day operations filled gaps in knowledge and pooled information to create better solutions faster for staffers having similar problems.

It took the station 10 months to transition to HD, a time frame that worked well for news operation manager Dave Sirak and his colleagues. However, Sirak says that having a clear plan is key to any changeover.

At KCRA-TV in Sacramento, CA, director of marketing Jessica Rappaport headed up the station's HD conversion with the station's assistant news director and director of engineering. Planning began more than a year in advance, and she says, "the three of us were practically joined at the hip for that entire time."

A hybrid world

With a realistic, collaborative plan in place, the next challenge stations making the transition to HD face is the fact that today's studio sets and graphics are hybrids. They need to work in the 16:9 aspect ratio as well as the still-dominant 4:3 screen size.

Russ Nelligan, creative services director at Hearst-Argyle's WCVB-TV in Boston, says his crews pay close attention to what viewers in both formats see. During a recent team coverage newscast, the station contemplated using the array of LCD monitors in the station's tech standup center to display multiple live shots for anchors to toss to — something it wasn't designed to do. But during experimentation, getting the shot framed wide enough to allow for the more rectangular 16:9 screen size caused the images on the monitors to be too small for viewers to discern.

Not all shots that work well in one aspect ratio work well in the other, says Glenn Anderson, senior designer at FX Group in Orlando, the company that designed sets for WCVB, KCRA and WFTV. He says it's important to remember that shots for 16:9, which keep active elements within the 4:3 center zone, require wider framing. Once everyone is viewing in 16:9, this will no longer be an issue.

To ensure everything looks its best, WCVB staffers have access to both 4:3 and 16:9 monitors throughout the station and are constantly reviewing how newscasts look in both aspect ratios.

Designing graphics

WCVB's biggest challenge has been designing on-screen graphics that are effective in both 16:9 and 4:3 while keeping in mind that essential information can't spill into the left or right side of the 16:9 screen. The station learned that creating a bottom-of-the-screen graphics ticker that communicates as effectively in 4:3 as 16:9 requires a little give and take.

Nelligan and his team also had to carefully consider where the station's familiar "5" bug would be placed on-screen. They didn't like how the bug floated in the middle of the screen for 16:9 viewers. In the end, WCVB's master control was configured to output two versions of its bug, one for each aspect ratio.

WFTV's bug placement wasn't an issue because the station's graphics package was developed to closely integrate the logo when lower thirds are displayed. Its designers did, however, have to ensure the graphics worked

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with both the WFTV "9" and its sister station, WRDQ-TV's "27," because the two share newscast facilities and production.

Getting ready

One way to familiarize production crews with hybrid formats is to do a phased introduction of the new technology. Sirak and his team used this strategy at WFTV. The station was using its HD studio cameras in the weeks leading up to the launch, giving camera operators the chance to practice framing for both aspect ratios. Then, as the launch date grew closer, newscasts were produced from the new HD control room, although the signal leaving the building was still analog.

WCVB took a similar approach by producing its nightly newsmagazine "Chronicle" in HD prior to taking its newscasts HD earlier this year.

Nelligan says that another way to gradually transition to HD news is to do so during the midday newscast. Most midday broadcasts run only 30 to 60 minutes, so it's a good practice run to give crews several hours to work out any issues before the nonstop slew of early evening newscasts.

Shot-by-shot planning

Hybrid sets require careful planning of every shot used in a newscast before construction begins. Beginning with one-shots and working out to wider shots such as four-shots and tosses is the best way to approach this, Anderson says. FX stresses the importance of using 3-D computer renderings for accurate shot previews.

Not only is it crucial to avoid anchors encroaching on each other's shots, but attention must be paid to what's behind the anchors. When WCVB uses its rear-projection screen for nonweather stories, crews are cautious to avoid having weather-themed graphics from the adjoining weather center appear in the wider 16:9 shot.

Something that looks good in one shot won't always look good in another shot, Rappaport says. Her team recognized the detail that goes into shot planning. They spent hours adjusting which graphic and video feeds would be displayed in the dual monitor walls behind the anchors.

In the end, the most important role a set and its shots play is to help newscasters tell stories. Decide how you want to do news, and then design the set around that, Rappaport says. She urges stations to consider what shots they like in addition to what shots they'd like to see on the new set, including those for special coverage and franchise reporting.

Refreshing a set?

When gearing up for HD, many stations consider refreshing their news set instead of replacing it. However, replacing an old set with a new design is usually more cost-effective in the long run — and gets better results.

KCRA-TV unveiled its HD newscasts on Feb. 12, 2007, with a new set. The station found it was more cost-effective to replace its old set with a new design.

A refresh can often cost almost as much as a new set, and most older sets don't hold up under the crisper HD resolution, Anderson says.

KCRA originally considered renovating its then six-year-old set but realized it needed to start from scratch. You go into the studio and realize that HD is a completely different ballgame, Rappaport says. Her team found the old set's layout and surfaces wouldn't work in HD.

Depth vs. clarity

Along with HD's more vivid pictures comes a note of caution when considering set backgrounds. The contrast between light and dark in background materials and graphics doesn't need to be as high in HD, says Mack McLaughlin, CEO at FX Group. HD cameras tend to make things look more like humans see them, he says.

WCVB learned the contrast lesson the hard way. The station's creative team developed a unique cityscape background for its main anchor area that featured stylistically blurred outer edges. Within days of debut, the station received hundreds of complaints. Many viewers found the blur distracting, while others found it disappointing after spending thousands on an HDTV. Nelligan says viewers wanted clarity, and they felt they weren't getting it. WCVB tackled the issue head-on by contacting every viewer who registered a complaint. The station sent them samples of the proposed replacements and then picked the best one based on viewer feedback.

Material quality also plays a big role in how a set will look on-air, McLaughlin says. It's important to ensure that HD-ready sets are built by experienced turnkey fabricators who don't skimp by using subgrade materials. Cameras can no longer make low-quality laminates look like expensive, fine-furniture woodwork.

HD sets must be carefully maintained. KCRA, WCVB and WFTV rely on a custom-selected assortment of cleaning supplies provided by their set design firm to keep things looking well-cared for.

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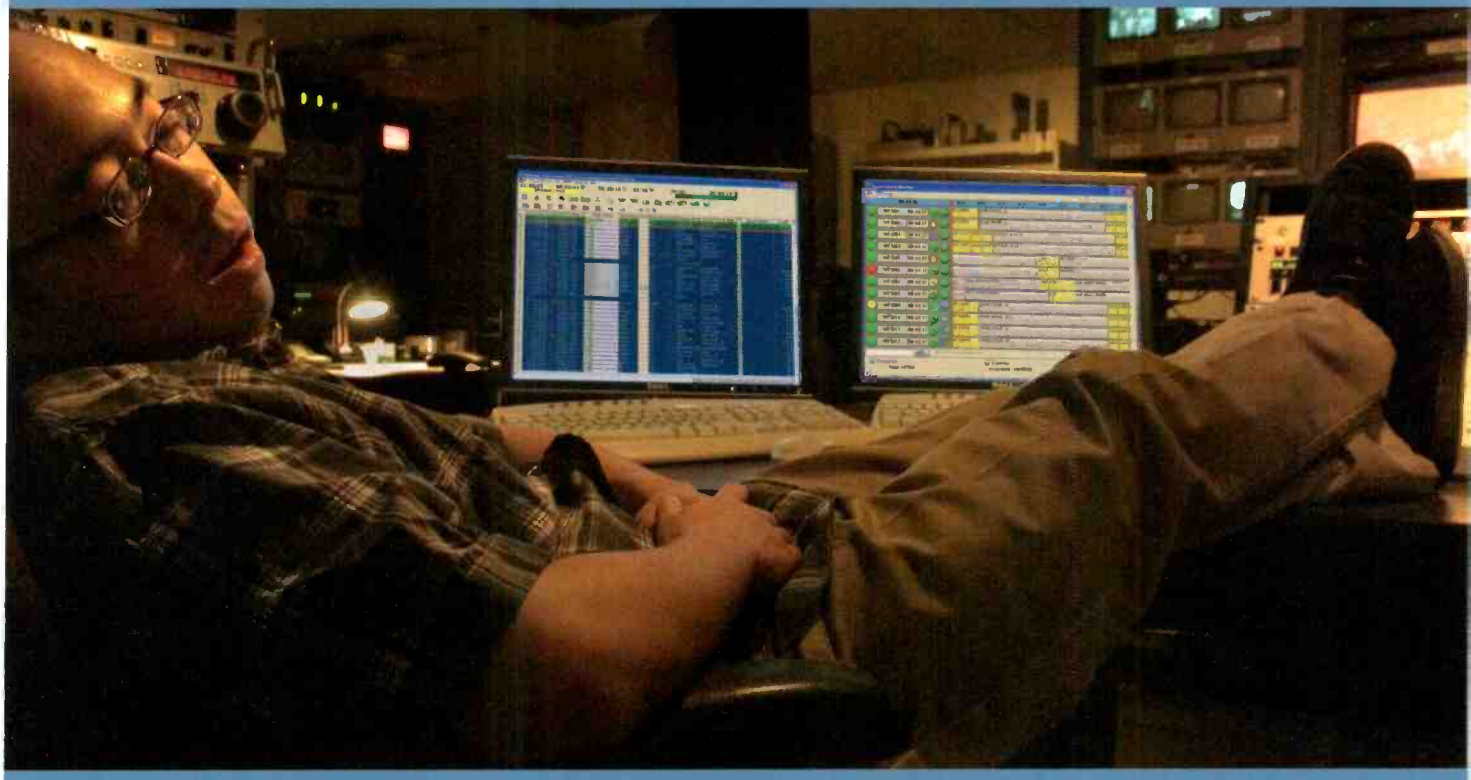

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Lighting and makeup

The challenges of HD don't end with the set and graphics. Lighting and makeup both play a key role in how the talent and the set look. Combining stellar makeup with professional lighting is key for making HD look 3-D, McLaughlin says.

Professional lighting design should be installed by a trained expert and maintained on a regular basis. WFTV gets periodic visits to fix lamps that have slipped or burned out.

Regarding how a talent's makeup should look for HD, the general rule is less is more. Try to achieve a natural look for the anchors and reporters. Makeup should be clean, lightweight and color-correct. Finer molecule HD makeup offers better coverage and, when applied with an airbrush, looks more natural. Heavier SD makeup absorbs more light, looking blotchy.

WCVB-TV viewers found the stylistic blur behind the anchors distracting.

Let cameras do the lifting

Another way to help on-air talent look their best is to use the advanced features found in most HD cameras. WFTV uses the skin detailing feature on its Sony HD 1500 studio cameras, using the camera control units to analyze and automatically enhance talent images over a wide range of skin tone, imperfections and hair color.

Sirak appreciates how this technology softens skins tones but still allows viewers to see extreme detail in an anchor's tie, jewelry or hair, for example.

WCVB contacted each person who complained about the stylistic blur (shown in photo on page 60) and showed them samples of proposed background replacements. Ultimately, they selected a more traditional cityscape (shown above).

Even non-HD viewers notice clearer and sharper images of the set and talent. The station's clearer picture has attracted some viewers from the other, non-HD stations in the market.

The real challenge for HD will come when field cameras move to HD and talent in the field lose the selective flesh tone soften feature installed on the studio cameras, Sirak says. His crews shoot in 16:9 SD when covering stories in the field.

Lessons learned

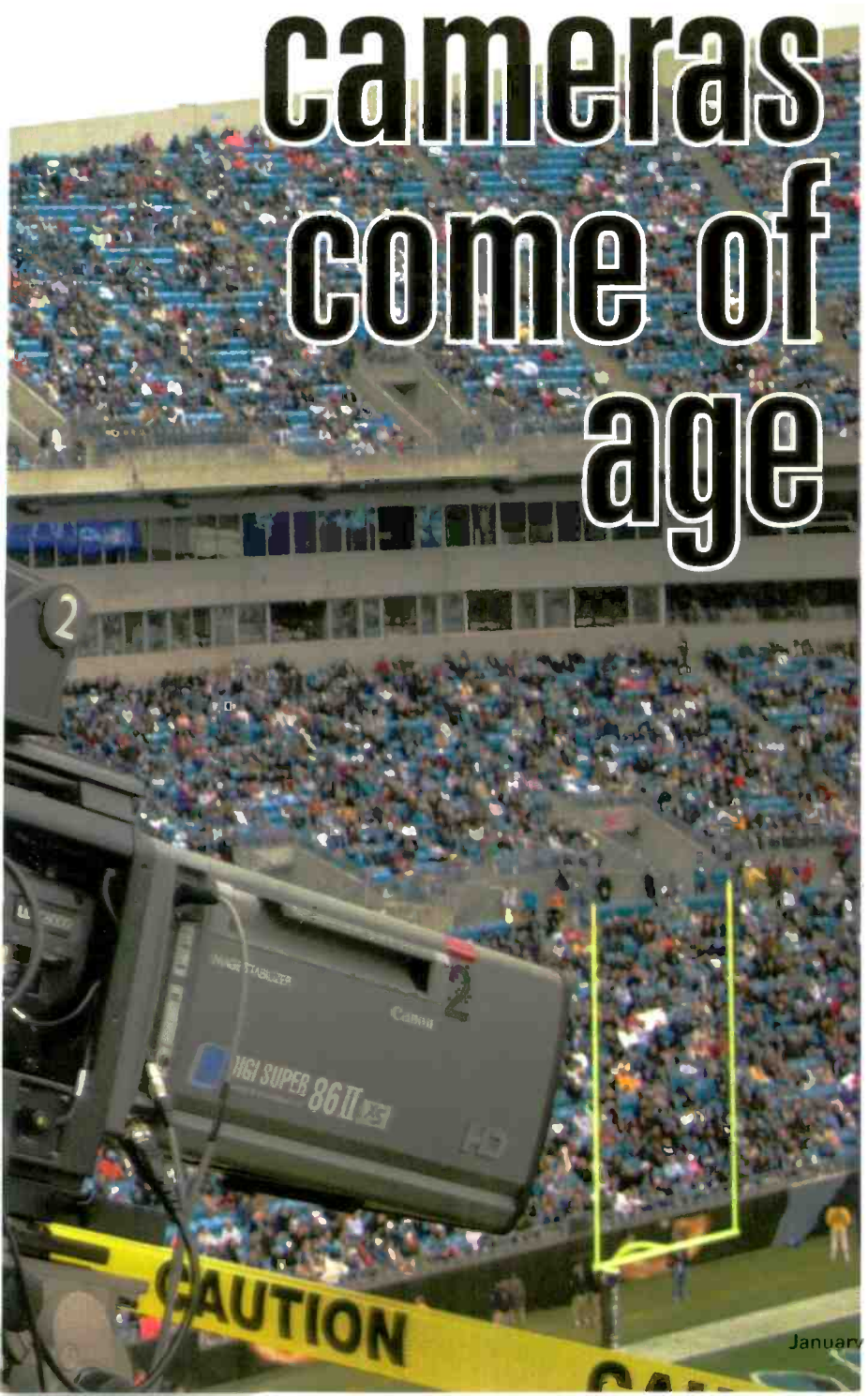
In the end, KCRA, WCVB, and WFTV all learned valuable lessons during the HD conversion process. Being part of a station group allowed them to share the wealth of information. Rappaport and her team were closely involved with sister station WESH's HD conversion, which launched Nov. 1, 2007. She says she wishes her team had been more knowledeable about the HD process before they started and that they learned something every day.

Still, that shouldn't be a discouragement, McLaughlin says. He points out that everyone is learning new things all the time about HD. It's a rapidly changing area that makes this an exciting time to be in the TV industry. BE

Michael P. Hill is founder of SetStudio, a television news set design Web site.

For the San Francisco vs. Carolina NFL game at the Carolina Stadium, the production crew relied on this Thomson Grass Valley LDK 8000 camera to help capture the Panther's only home game win of the season.

High-def video cameras come of age



BY DAVID BIRDY

From live sporting events to news and entertainment, high-definition cameras are the wave of the future. And they have become a fixture on many movie sets and TV compounds.

Low-cost HDTV sets, new camera technology, fiber optics, MPEG-4 and faster CPU processors are making HD affordable and dependable for both consumer and professional applications.

As consumers grow to expect higher quality images, broadcasters and content producers will increasingly move to HD production. All roads lead to heavy demand for native HD programming.

To better understand the players in this space, let's take a closer look at some of the HD camera options available. While not every type and model of HD camera will be discussed, these units are representative of what's being used today to create HD programming. These thoughts are based on my 20 years of experience as a broadcast engineer.

What is available?

Ikegami, Sony and Thomson Grass Valley all make triax- and fiber-based HD cameras that are used for live sports and entertainment productions. Panasonic and Sony are key makers in the standalone, onboard recorder camera market. A new player, RED Digital Cinema, just delivered its first round of RED ONE HD cameras in September 2007. Marketed as an HD digital cinema camera, the unit provides a 12 megapixel CMOS imaging system. The camera has generated a lot of interest. We'll have to see if it can deliver on the claims. Now, let's look at some of the cameras available.

Thomson Grass Valley LDK 6000 mk II

Three 9.2 million HD-DPM (Dynamic Pixel Management) and CCDs (9.2 megapixels) coupled with 12-bit A/D conversion and native format switching from 720p to 1080i are all standard features for the Thomson Grass Valley LDK 6000 mk II camera.

It was the first widely used HD camera to incorporate triax-based operation. Triax connectivity is an attractive option to facility providers and broadcasters because it makes camera setup quicker, and the cabling is less expensive to install and maintain for venues.

When triax lengths exceed 3000ft, a triax repeater is available, doubling the triax reach to 6000ft. By replacing the triax base station and camera adaptor with a SMPTE fiber base station and camera adaptor, it's possible to achieve more than 13,000ft of distance by adding a 110V power source to the camera. There are several third-party solutions that provide two single-mode fibers in a cable along with breakout boxes at both ends.

The Thomson Grass Valley LDK 6000 mk II offers the option of 720p or 1080i output without crossconverting.

In addition to the advantage of incorporating triax, the LDK 6000 mk II also offers the option of 720p or 1080i output without crossconverting, which is an attractive option for both broadcasters and truck owners.

Sony HDC-1550

One of the newest additions to Sony's live broadcast cameras is the HDC-1550. The 1550 is a speedy work horse, configurable as a handheld or as a studio camera. The cameras use three newly designed 2/3in 2.2 megapixel progressive-scan Hyper Hole Accumulation Diode (HAD) CCDs. The new imaging system boasts a sensitivity rating of F10 at 2000lux. The camera provides 14-bit A/D conversion and the ability to output all HD formats and frame rates, including 1080p 60f.

The company's engineering team decided to keep a SMPTE system on the base station side and camera side, and then convert the SMPTE fiber to triax as needed. By adding the HDTX-100 and HDFX-100, these cameras can operate on triax up to 4500ft using a 110V power source located at the base station. The camera end uses triax into the HDFX-100 and a SMPTE four-pin hermaphrodite cable from the HDFX-100 to the camera.

Ikegami HDK-79EC

Ikegami recently integrated CMOS imaging technology into the HDK-79EC. The CMOS system is cost-effective to manufacture and requires 20 percent less power than a comparable CCD imaging device. This camera features three 2/3in 2.2 megapixel CMOS images sensors. The AltaSens ProCamHD 3T sensors offer an imaging system-on-chip (SoC) solution. The company's Tapered-Rest technology reduces fixed pattern noise.

Ikegami's HDK-79EC uses three 2/3in 2.2 megapixel CMOS imaging sensors.

The standalone handheld camera fits into the SE-79D system expander kit. This includes a 9in low-lag color LCD viewfinder for use in a studio configuration. Two camera adaptors convert the SMPTE four-pin hermaphroditic cable to triax. The TFC-790 CCU-side unit of the converter system is placed on the base station side, and the TFH-790 unit is on the camera side to achieve operation over 4500ft of triax cable.

In perspective

The above three HD broadcast cameras work on both SMPTE fiber and triax. By adding the appropriate third-party adapters, these cameras can also operate on single-mode fiber.

Each camera chain has a specific power-up sequence. Sometimes, multiple power-up sequences may be needed to get both ends of the camera chain working together properly.

Now let's look at some standalone HD camcorders.

Panasonic AJ-HDC27H VariCam

Panasonic's AJ-HDC27H VariCam uses three 1.1 megapixel CCDs with a sensitivity rating of F12 at 2000lux to achieve a dynamic range of nine f-stops. The onboard recorder uses the DVCPRO HD tape format at multiple data rates up to 100Mb/s. Panasonic developed CineGamma to help the video look more like film by increasing the dynamic range through gamma setups.

This camera has a loyal following. The ability to shoot video at 24p — or any variable frame rate from 4p to 60p — generated interest, especially within the film industry. Each time a variable frame rate is selected, the camera re-records frames. Shooting at 30p (29.98) frames and recording at 60p (59.94) frames, the image will be recorded twice. For acquisition at a frame rate of 24p (23.97), the math is more complex and uses a mixture of fields combined into frames, commonly referred to as a 3:2 pull down. The DVCPRO HD recorder is always recording at a rate of 59.94. For selectable frame rates, the recorder uses pull-down technology, recording more frames as needed.

The Panasonic AJ-HDC27H VariCam can shoot at variable frame rates from 4p to 60p.

The 24p camera does not record in

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the same fashion as a film camera, but the end result is similar. The camera yields a 24p look by showing half of the progressive frames that were shot at 59.94. The onboard DVCPRO recorder allows a camera assistant to reload tapes and keep track of time code and frame rates in a similar fashion as with film reels. This was one of the first HD cameras offered at an affordable price and has garnered wide appeal.

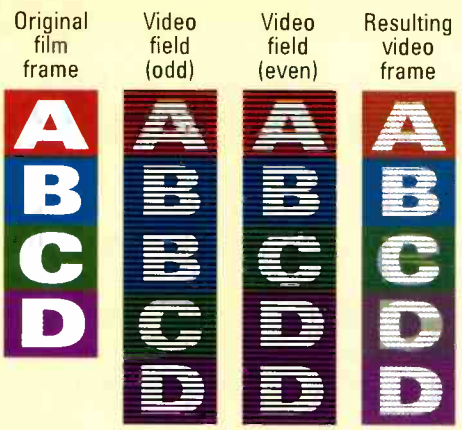
Frames and fields

The confusion is endless when we mix film and video terminology and then use naming conventions derived from each medium to explain frame rates and how they are converted. Variable frame rate broadcast cameras use old theories derived from telecine machines to accomplish variable frame rates. Here's a quick look at the basics of fields and frames and why we convert them.

Films broadcast on television are converted with a film-to-tape transfer machine called a telecine. The first telecine was a camera shooting a projected film recorded on tape then played back at 59.94 for use on broadcast television. Why 59.94? The electric system in the United States is 60Hz; picture flicker is avoided by maintaining video playback and acquisition at 59.94Hz to match the 60Hz power cycle.

To comply with broadcast standards, film is shot at 23.97fps. That is half of the NTSC rate of 59.94 fields, making up 30 frames. To even the math, the telecine machine scans in one progressive frame of film and then breaks that frame into two fields — field one with odd lines and field two with even lines. The film frames are split into two fields by odd and even lines, yielding eight frames. The two new frames are added by combining four fields into two frames derived from the original frames for a total of 10 frames.

The original film frames are split into odd and even fields and now yield A1 A2 B1 B2 C1 C2 D1 D2. Two frames are then added by combining fields to create new frames made up of A1 and B2 and B1 and C2. These are two separate fields derived from different frames that are combined to form a new frame of video. These new frames are referred to as the dirty frames, as they are a mixture of two different frames now in field form combined to make one new frame of video.



The result is now [A1 A2] [A1 B2] [B1 C2] [C1 C2] [D1 D2]. This is where cadence comes into play. The combined dirty frames always need to be in sequence and should never be an edit point. Some NLE software assumes a 3:2 pulldown and will not edit on a dirty frame. Early nonlinear editors would need to carefully calculate an edit point based on finding the lead frame and counting odd or even frames to avoid mixed frame edits.

Many multiple camera shoots have had long, agonizing edit sessions to match frames and audio. Preplanning frame rates for each shot and keeping an accurate log is the best approach to multiple camera, multiple frame rate projects.

Sony HDW-F900

The HDW-F900 HD HAD imaging system is equipped with three 2/3in CCDs ASA rated at 320 with a dynamic range of nine f-stops. The system is made up of three 2.2 million pixel CCDs, resulting in 1920 x 1080p resolution.

Imaging control features help to soften the crisp edges, making the picture appear more film-like. This system can record segmented frames (PsF) for a 24p look. Segmented frames are recorded in progressive frames, and then divided into two fields: one with odd line information and one with even line information. The user can select 23.97PsF, 25PsF or 30PsF, or interlace versions at the same frame rates.

Sony's HDW-F900 camera can record progressively segmented frames.

Camera setup values and gamma curves can be plotted on a computer and then transferred to each individual camera using a memory stick. The F900, with an onboard HDCAM record deck, has gained wide acceptance from many DPs and HD producers.

RED Digital Cinema RED ONE

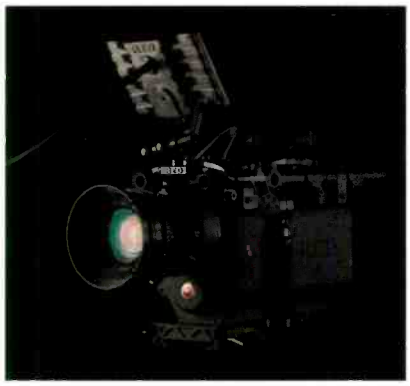
The RED ONE from RED Digital Cinema has finally hit the streets. This camera is often touted as a revolutionary device providing impressive stats at a reasonable price. It is being marketed specifically to digital cinema artists and independent filmmakers.

The camera's ability to add hardware to the main body allows this unit to be rigged on a variety of mounts. At the center of this system is the Mysterium sensor, a 12.2 megapixel Super 35mm CMOS imaging block capable of delivering 4520 x 2540 at 30fps and 4:4:4 sampling rates.

The data management system offers multiple format outputs and multiple frame options ranging from 1fps to 30fps at 4K and 1fps to 100fps in 2K. The sensor captures the image using the REDCODE RAW codec. This is a wavelet-based compression scheme that records the image RAW without color bias. While recording RAW can create some image monitoring issues, all of the image's data has been recorded without color modification.

Once recorded, the media is opened with a desktop application. The files are then colorized and converted to whatever file formats are desired. This might be uncompressed RGB or compressed 4:2:2 video formats, including ProRes, DNxHD, DV100 or M-JPEG QuickTime movies at 720p or 1080p.

The media is copied from the CompactFlash storage card to the computer's hard drive, or it can be mounted directly as a drive when the RED digital media drive is used. The spinning disk storage drives are two 180GB drives configured as RAID 0, which provides wide bandwidth and transfer rates, but not data redundancy.



RED Digital Cinema's RED ONE features the REDCODE RAW codec, which records images without color bias.

HD capture

Manufacturers continue to push the envelope in finding innovative ways to capture and broadcast events in HD. One high-definition camera even made a trip to the moon onboard the Japanese explorer Kaguya in October of 2007. It sent back spectacular footage, including a scene of the earth setting behind the moon.

The next frontier for HD is 3-D imaging, and a few pioneers have already started down the trail. The movie "Speed Racer" is now in production, and a 3-D Hannah Montana concert will be shown as an encore companion to her sold-out live concerts. BE

David Birdy is the director of engineering with Digital DNA productions.

Building better EPGs

PMCP and BXF communicate key metadata related to PSIP for on-screen guides.

BY JOHN WILLKIE

The ATSC implementation of MPEG-2 technology provides broadcasters with tremendous potential and ample bandwidth to deploy traditional and innovative broadcasting services. To make the most of the potential, traffic, automation, ingest, content management and transmission subsystems must interoperate harmoniously in real time.

Previously, many broadcast systems vendors propounded proprietary data interfaces and all-encompassing solutions. The first decade of digital broadcasting was limited by the cost and difficulty of implementing and testing proprietary interfaces for each device needed to seamlessly transmit video, audio and data services. By one count, more than 200 interfaces needed to be supported.

As an example, a traffic system could be expected to communicate with a PSIP generator using one interface and protocol, exchange schedules and as-aired log information using one or more other interfaces, and communicate with automation or content management systems via yet another interface. When new systems were adopted in the facility, each of the existing devices would need to be reconfigured, updated or replaced to support each new device. Expecting devices from a variety of vendors to work faultlessly in real time with such arrangements is unrealistic and expensive for both stations and vendors.

Compatibility and interoperability are key

Fortunately, the visionary ideas of two engineers — and the ATSC and SMPTE subcommittees that developed their ideas into complete specifications — has enabled broadcasters a clear path to dynamic digital services. This means making sure that all future broadcast systems support either the Programming Metadata Communications Protocol (PMCP) or the Broadcast Exchange Format (BXF), or both.

These two compatible and interoperable protocols have widespread

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support among broadcast vendors. The adoption of nonproprietary interfaces for these mission-critical systems foretells a future where vendors concentrate on features and particular advantages instead of developing and debugging interfaces that they defend unto death. For broadcasters, the protocols mean that decisions on future system purchases will be based more on price, value and features instead of which system supports the interfaces of existing systems.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample PMCP document showing various caption services-->
<PmcpMessage xmlns="http://www.atsc.org/pmcp/2004/2.0" id="4947205" origin="Traffic" originType="Traffic"
dateTime="2003-12-18T09:32:47Z">
  <PsipEvent duration="PT30M" action="add">
    <EventId channelNumber="57-3">
      <InitialSchedule startTime="2003-12-18T09:40:00Z"/>
    </EventId>
    <ShowData>
      <Name lang="eng">Caillou</Name>
      <Description lang="eng">Big Brother Caillou</Description>
      <ParentalRating region="1">
        <Rating dimension="Children" value="TV-Y"/>
      </ParentalRating>
      <Audios>
        <Ac3Audio audioId="1" lang="eng"/>
      </Audios>
      <Captions>
        <Caption608/>
        <Caption708 service="1" lang="eng"/>
        <Caption708 service="9" lang="spa"/>
        <Caption708 service="10" lang="fre"/>
        <Caption708 service="59" lang="ger"/>
        <Caption708 service="60" lang="ita"/>
        <Caption708 service="63" lang="por"/>
      </Captions>
    </ShowData>
  </PsipEvent>
</PmcpMessage>
```

Figure 1. A PMCP message can set the start time and other information for a particular EPG event. Figure courtesy of the ATSC.

The story behind PMCP

PMCP, specified in ATSC A/76, established an eXtensible Markup Language (XML) schema for exchanging data elements used by Program and System Information Protocol (PSIP) generators to describe virtual channels and the programming events on each virtual channel. (For more information about PMCP, see "Web links" on page 72.)

Fred Grenier of Thomson Grass Valley helped develop the Pearl PSIP generator, which could be integrated with the company's Amber multiplexer. With multiplexers and encoders available from many vendors, this tie-in minimized the potential of Pearl. Grenier devised an XML data interface that extended the utility of the PSIP generator. All that was required was for the other systems that communicate with PSIP generators to support the interface.

As a practical matter, the interface had to be developed and adopted by a standards development organization, enabling interested vendors and users to ensure the protocol answered their needs and desires. XML interfaces were new to the broadcasting systems field, so finding the right group to develop the specification involved convincing others of the value of nonproprietary interfaces.

In due course, the ATSC board of directors decided that the work should be the basis of an ATSC voluntary specification for the transmission of metadata within a broadcast facility. The ATSC S1 specialist group was chartered with the task of fashioning the specification, under the direction of the NAB's Graham Jones, S1 chair at the time. The ATSC published the first version of the PMCP specification in late 2004.

How PMCP works

PMCP exchanges data used to create

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PSIP in the form of XML text messages. A message can be sent as a file download or transmitted to other devices using Transmission Control Protocol (TCP) and Internetworking Protocol (IP) or User Datagram Protocol (UDP) and Internetworking Protocol (IP) communications protocols. Even when using the connectionless UDP/IP, message delivery can be assured. Periodic "heartbeat" messages signal a device is truly alive. (See Figure 1 on page 70.)

Within the XML message wrapper, a PMCP message can add, update, read or delete one or more items of data stored in a PMCP-compliant device. Top-level elements describe the analog and digital signals of a station; each of the virtual channels; and "Events" (what viewers would call programs), V-chip ratings and time parameters. An abstract element labeled "Show" permits defining a TV program regardless of when it is scheduled to air.

Upon receiving a PMCP message, a device validates the message against the schema. If all the elements are well formed and comply with the schema, the message is processed into the data forms needed by that device. While PMCP messages might be in textual form, the data is dense and verbose. XML data is about as easy for humans to use as is the HTML source code of a Web page.

Although adoption by some vendors lagged for a while, now all vendors of dynamic PSIP generators in North America support PMCP as a standard or optional feature. Program listings from TitanTV.com are available in PMCP form, but currently, Tribune Media Services hasn't announced support for the protocol. Many automation and traffic systems vendors support PMCP, as do program management vendors.

The Internet Assigned Numbers Authority (IANA) assigned port 3821 for PMCP communications, so aside from security concerns, a PSIP generator doesn't need to be in the same area code as the device that controls it.

```
<?xml version="1.0" encoding="UTF-8"?>
<BxfMessage id="urn:uuid:ABCCDDDD-2222-22E3-9AFF-0038338391E1" messageType="Information"
dateTime="2006-08-16T20:44:43.16" origin="Traffic System" originType="Traffic" destination="Automation"
userName="Traffic System User"xmlns="http://smpte-ra.org/schemas/2021/2007/BXF" xmlns:xsi="http://
www.w3.org/2001/XMLSchema-instance"xsi:schemaLocation="http://smpte-ra.org/schemas/2021/2007/BXF
BxfSchema.xsd">
  <BxfData action="add">
    <ContentTransfer transferId="urn:uuid:ABCCDDDD-1111-22E3-9AFF-0038338391E1" transferType="Purge"
priority="Normal">
      <Content user="Traffic User">
        <ProgramContent>
          <ContentMetaData>
            <ContentId>
              <HouseNumber>311</HouseNumber>
            </ContentId>
            <Name>A2: SIGN ON</Name>
          </ContentMetaData>
        </ProgramContent>
      </Content>
    </ContentTransfer>
  </BxfData>
</BxfMessage>
```

Figure 2. Shown here is a BXF message that purges media by adding a new purge order for Media #311. Figure courtesy of SMPTE.

Web links

- SMPTE 2021 BXF standard; *www.smpte.org*
- ATSC A/76 defining PMCP; *www.atsc.org/standards/a76.html*
- XML Spy; *www.altova.com*
- XML Writer; *www.xmlwriter.com*

The birth of BXF

In 2006, under then-S1 chairman Art Allison (of the NAB), the PMCP specification was extended to include all metadata elements needed to announce Advanced Common Application Platform (ACAP) data broadcasting services (specified in ATSC A/101), and to make minor editorial corrections in the schema.

One of the founding members of the ATSC group for PSIP Metadata Communication during the development of PMCP was Chris Lennon of Encoda Systems (now a part of Harris Broadcast). For years, Encoda had been trying to leverage its pro-

prietary traffic system interfaces into a strong position in automation and similar systems.

Lennon had a different idea. He wanted to create an XML schema that would overcome the forest of proprietary traffic system interfaces among traffic, automation, playout, switching and program management systems. He had wanted the ATSC to form a group to develop his idea into a published specification, but before work on PMCP started, he was told to take his idea to SMPTE.

By the time of publication of the PMCP standard, SMPTE formed an ad hoc group chaired by Lennon to develop his idea into a full specification. Eventually, that group became a full SMPTE working group called S22-WG10 on Data Exchange in the Technology Committee on Television Systems Technology. The resulting standard, SMPTE 2021, or BXF, should become a final SMPTE specification this year. Some system vendors have already installed BXF-based systems. (For more information about BXF, see "Web links.")

Comparing BXF with PMCP

For a specification like PMCP or BXF to benefit users and vendors, it must address a variety of needs and be adopted by a wide spectrum of vendors. Even before publication, it is safe to say that will be the case with BXF. Virtually all traffic, automation, ingest, and content and program management system vendors are members of S22-WG10 and have fully participated in the development of SMPTE 2021.

The remit of PMCP is much simpler than that of BXF. For example, a PMCP message might tell a PSIP generator to change the title and description of the TV program that begins on channel 51 at 9:30 p.m. tomorrow. A PSIP generator, once given the information and instruction, can transmit the appropriate bits at the correct time without any further interaction.

By comparison, the BXF protocol has to enable synchronizing and coordinating transitions and switches between programs and commercials, along with graphics overlays, effects and voice-overs to transmit seamless multimedia presentations. BXF uses a message structure similar to that used with PMCP. The two protocols are complementary and interoperable, with no overlap in functionality.

There are four types of BXF messages: request, information, heartbeat and message status request. Where PMCP supports timing accurate to the second (with optional frame-accurate timing), BXF timing is specified to the millisecond. (See Figure 2.)

Both PMCP and BXF provide for the exchange of private data elements, permitting implementers and users to extend data exchanges without breaking either protocol. Using XML tools such as XML Spy or XML Writer, even humans can create valid PMCP or BXF messages, albeit slowly. (See "Web links" for more information about XML Spy and XML Writer.)

Conclusion

Judging by the number of broadcast-oriented XML schemas that are currently in development or use, this IT-centric system of handling data between disparate devices has clearly reached the tipping point. You don't need to think back very far to remember a time when most digital broadcasting systems employed proprietary interfaces.

So, the next time you see Fred Grenier or Chris Lennon, thank them for making true digital broadcasting not only simple, but, in truth, possible. BE

John Willkie is the founder of EtherGuide Systems and is a member of the ATSC S1 and SMPTE S22-WG10 subcommittees.

When conditions don't make it possible to send a live video feed, broadcasters rely on telephone hybrids to get the news back from the field.

Telephone HYBRIDS

BY BENNETT LILES

For decades now, a central component of many live television broadcasts has been an interface with telephone lines. Frequently used to send mix-minus signals on a one-way trip back to the originating point for participants in remote locations, the hybrid only uses its send capacity to take an aux out from the control room audio production console. (See Figure 1.) The more demanding application is when two-way conversations are needed for live call-in programs or live inserts from reporters who cannot, at that place and time, set up a video feed. (See Figure 2.) The old QKTs and push-to-talk phone couplers could handle the one-way reports reasonably well, but the telephone hybrid was developed to allow the most natural sounding two-way conversation possible in an interface

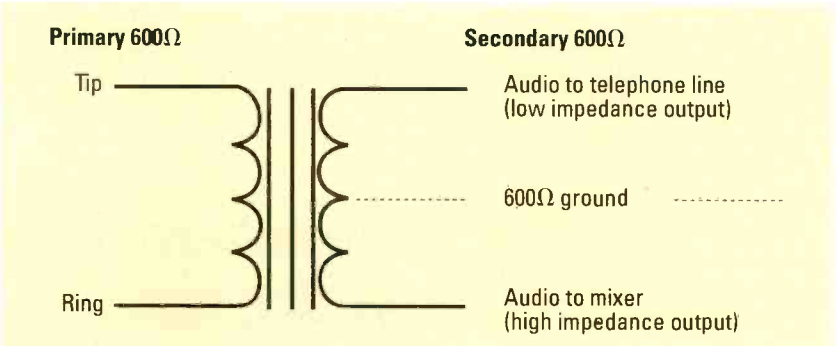

Figure 1. A simple hybrid circuit

between broadcast audio gear and the wildly varying conditions on the plain old telephone service (POTS) line.

Managing sound leakage

Even with the advances made in design, the analog hybrids still require a little interaction and gain riding by the audio operator for the cleanest result. An experienced TV sound operator can anticipate the flow of a conversation and slightly duck the studio talent's mic while the caller is talking, and duck the caller when the show host or a guest speaks up.

While it helps to avoid a hollow acoustic echo, especially when studio guests are monitoring the caller through a speaker, this technique is also necessary to combat the traditional bane of the telephone hybrid: trans-hybrid leakage.

Trans-hybrid leakage has been a source of some confusion. The leakage is the distorted, phase-shifted, tinny-sounding talent speech cross talking into the caller signal. This happens because the telephone circuit is a two-wire conduit carrying both receive and send on the same copper pair while the broadcast equipment operates separately in the send and receive roles.

The amount of trans-hybrid loss in the hybrid determines, in large part, the amount of trans-hybrid leakage.

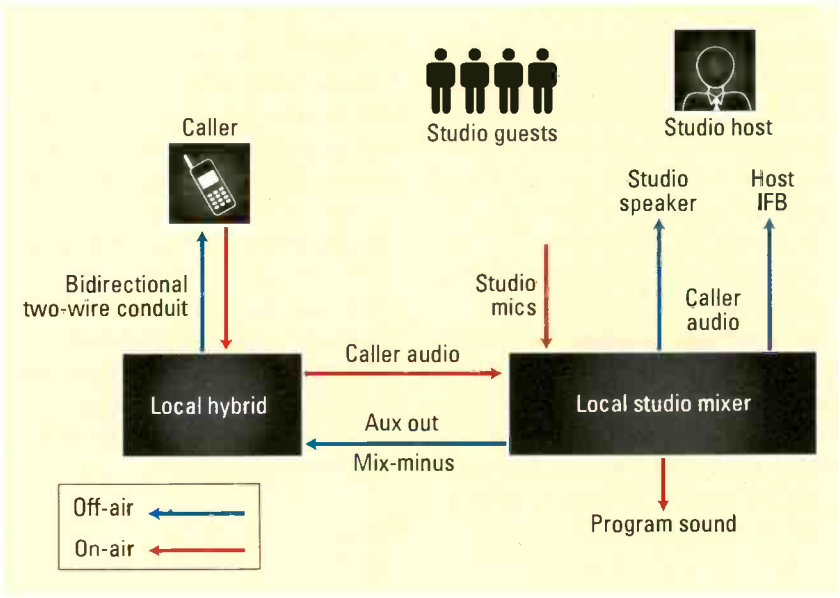

Figure 2. An example of a live call-in using a hybrid system

Impedance matching

Impedance matching is key in telephone hybrids. Loading coils, transformers, repeaters and a host of other components cause the impedance characteristics on circuit-switched lines to vary considerably. Through the push of the button selecting the next caller or reporter, the line conditions can change dramatically. Enter the digital signal processing (DSP) hybrid.

DSP has become the primary enabling technology to allow telephone hybrids to take their next big leap in technology. Once the A/D conversion has been made to the incoming signal, mathematical computations can manipulate it on a level impossible with all analog hardware.

The software performing the interface employs a complex technique called convolutional least mean square

adaptive filtering. This compares the send and receive signals and produces a leakage profile in the form of an error rate. The error signal drives the impedance matching network components to constantly adapt and fine tune the nulling function on the hybrid to suit the line conditions. On a reasonably good phone line, a digital hybrid with its adaptive DSP function can produce a trans-hybrid loss about twice that of an analog device.

Establishing tone

Another key in the adaptation process is that the reference used to measure momentary trans-hybrid loss in dB must be a broadband signal rather than a tone or series of tones. When a call is established on the digital hybrid, it sends out a burst of noise, which only the caller hears. The initial settings take hold in less than a second, and as the call continues, the voices are used to adjust the balance on the internal impedance matching network, including automatic gain control. Of course, SNR is a critical factor determined by the basic design and quality of the components used in the DSP functions. The bit count in the audio path and the distortion level in amplification also figure prominently in performance and have a profound effect on automatic gain control (AGC), ducking functions and noise gating, which in turn spell out the overall performance of the hybrid.

Freeze gating is essential in the attempt to automate the most natural characteristic possible in the hybrid. In this, the automatic gain will not rise and bring up noise during pauses in the caller's speech. The effect avoided here is known as pumping or breathing and is quite obnoxious when there is a constant background noise level such as a large crowd. When the caller speaks again, there is no initial blast of clipped sound before the compression again takes hold.

The AGC works in concert with the ducking function. This essentially performs the same task that the sound operator used to do in the old analog days of riding gain on the hybrid output and the studio microphones to maximize performance above that provided by the trans-hybrid loss figure alone.

Many DSP hybrids have a manual setting on the ducking function. At the extreme, it can be set to cut off the caller audio completely while the studio sound is active. However, this produces a sound that resembles the echo cancellation typical of many video conferencing systems. The difference is profound.

Take for instance, the smoothly conversational effect between host and remote guests on a program such as the PBS "NewsHour" and the choppy interchange with echo cancellation on a conference room video call. The former uses one-way satellite feeds with hybrids carrying only mix-minus into the guests' IFB earpieces (for perfect acoustic isolation), while the other handles everything on open speakers with no human hands riding gain or anticipating the flow of conversation. (See Figure 3.)

Systems at work

In the real world of live production, there now exists a variety of systems on the market that not only work behind the scenes to balance the necessary impedances, gains and equalization necessary to minimize trans-hybrid leakage, but also offer some intuitive tools to enable easy manipulation of caller and send audio with push-button ease. At the same time, devices today can provide sophisticated features in hardware that can be carried and set up on remote.

Studio devices such as the AVT MAGIC ISDN system interface with computer control to provide visual displays showing the various audio channels in use, dual-tone multi-frequency (DTMF) dialing from the computer screen, call queuing, four-wire ISDN interfaces and all-digital AES/EBU inputs. Each caller can be assigned a priority and receive an instant, fully automated mix-minus

audio signal. Call screeners can operate multiple systems remotely, and all the callers can be conferenced. The displays include hold, pre-talk, call drop, forwarding functions and indicators, along with ladder-style audio metering. Priorities such as VIP can be assigned for callers, or the caller with the longest hold time may be automatically switched on-air whenever the call change is activated. Single lines can be locked, and all lines can be dropped at once with a single button push. On some systems, even the callers can exercise a degree of control in situations such as game show formats by using DTMF analysis. The system can read DTMF tones and activate functions either internally or perform tasks completely outside of the telephone system such as activating scoreboard displays.

New hybrid technology has also revolutionized things at the other end of the line. When reporters are out in the field, they can perform many of the audio routing tasks that formerly had to be centrally controlled at the station. Devices like the JK Audio RemoteMix 4 have incorporated a telephone hybrid and keypad into a field mixer along with a private branch exchange (PBX) handset interface and a cell phone interface. Any of the telephone feeds can be sent down an audio line as mix-minus sources, and the unit can connect via Bluetooth to any cell phone or laptop computer. The device even has separate battery compartments for hot-swapping batteries and staying up and running the whole time.

The latest phase of telephone hybrid technology has seen these units migrate from control room rack spaces of their own to light, versatile and portable field units, incorporating all the essential remote audio functions and capability into one physical instrument. At the same time, the studio gear has morphed with computers for unlimited command and control. And to think, it all started with a few little passive black matchboxes stuck on the side of a telephone. BE

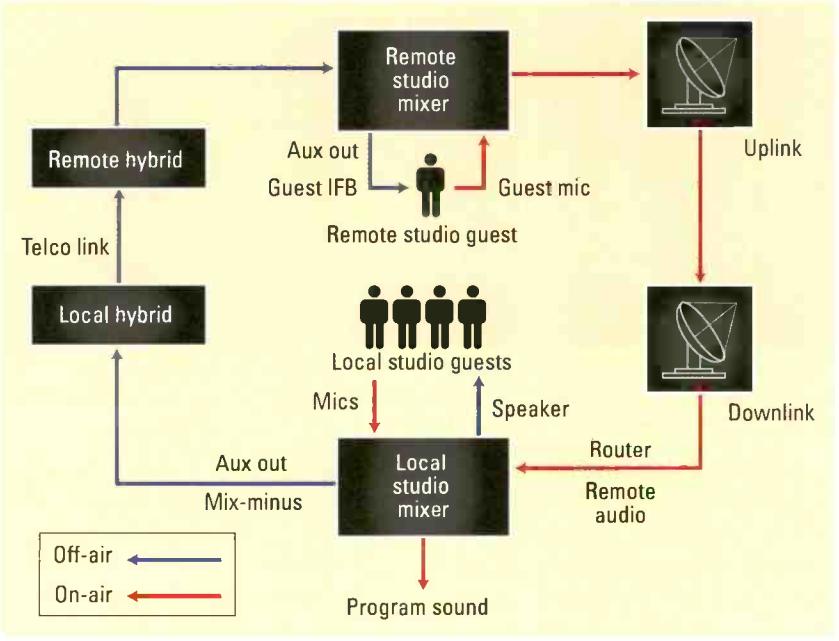

Figure 3. An example of a remote communication loop using hybrid systems

Bennett Liles is a writer and TV production engineer in the Atlanta area.

Lawo's mc²90 at Turner

The production console helps the studio meet the growing demands of a live audio control room.

BY ERINN THORP AND RICK PERRY

While the transition to HD programming has created new opportunities for creativity in the studio, it also places far greater demands on the equipment needed to produce such content. The broadcast production division of Turner provides turnkey services for film, video and audio production for all of the company's entertainment networks. The sheer number of audio channels and the need for better control over numerous multichannel sources placed increasingly insurmountable demands on the previous mixing system in our largest live audio control room. After evaluating numerous products, we purchased and installed a Lawo mc²90 production console for our Audio Control Room 22 (ACR22) in August 2007.

The Lawo mc²90 production console allows Turner Studio's Audio Control Room 22 to effectively handle the 200 channels-to-mix for "Major League Baseball on TBS" and other live shows.

DSP capacity

The key consideration was channel count/DSP horsepower. The new console is built around the Lawo Nova73 HD core. Our system includes seven 48-channel DSP cards — with six in use and one for failover.

We took advantage of the flexibility of Lawo's MADI-based DALLIS I/O system so that there was essentially no rewiring of the existing infrastructure required. Other than adding fiber for interfacing MADI with the new I/O frames, there were very few changes made, as this was primarily an issue of expanding DSP capacity.

Other than adding fiber for interfacing MADI with the new I/O frames, there were very few changes made, as this was primarily an issue of expanding DSP capacity.

The production control surface is configured as 48 channel faders with four free controls each, plus 16 center-section faders in a 12ft frame. The system's I/O structure encompasses 256 AES, 96 mic/line, 48 line, plus 112 MADI inputs for 512 total inputs, along with 256 AES, 64 line, and 112 MADI outputs totaling 432 outputs.

Using the system in a 5.1 studio

The changeover took three weeks: one for the physical installation, another for commissioning of the console and a third for staff training. The system was first used Sept. 2, 2007, for an Atlanta Braves baseball game on TBS.

ACR22 handles live studio shows for "Major League Baseball on TBS" and "Inside the NBA on TNT," both in 5.1, as well as TBS franchise shows, including "Movie and a Makeover."

A 5.1 studio show typically requires more than 200 channels-to-mix. Many elements arrive as pre-mixed 5.1 sources, including content from remote venues, 5.1 music beds, and four upmixing engines for making 5.1 from any stereo source. Because most sources are already surround, joystick surround panners typically are not used in this application.

With our previous console, a control group with six mono channels was employed for each 5.1 source. However, with no metering available on that group, it was impossible to

visually monitor activity.

For this application, a 5.1 channel entity that controls those six channels as a single unit is essential, and the VCA metering feature of the production console handles this very well. Most of the time, the 5.1 sources are managed as if they were a single channel. Nevertheless, there are times when it is desirable to reveal the six individual channels and, perhaps, tweak one or more of them independently. This crucial function is also included in console.

Multiple operator control

Another important feature for our large 5.1 shows is multiple operator control made possible by the IsoBay feature that essentially makes each section of eight faders into its own autonomous center section. This enables additional operators to work independently with full control over banks, layers and parameters without affecting the primary mixer's control at the console's main center section.

Color coding

The console's visual color coding capabilities are also a big improvement over our previous system. Each type of element — such as VCAs, auxes, groups, sums and input, EQ or dynamics parameters — has its own color identification. This type of visual feedback is important, as speed and ease of use are critical considerations with our live-to-air or live-to-tape productions.

Visual feedback is important, as speed and ease of use are critical with our live-to-air or live-to-tape productions.

Redundancy

A large number of sections in this console have redundancy that simply was not available with other production consoles we evaluated. We have redundant DSP and core router cards, along with redundant MADI ports to all of the I/O frames (mic preamps, line returns and control room monitor I/O). The reliability of the system is improved substantially such that just about anything — a kinked fiber line, a bad card or a failed power supply — has a backup, and that's a big plus for our operation. BE

Erinn Thorp is senior production engineer for Turner Studios Engineering, and Rick Perry is studio audio manager for Turner Studios.

MPEG splicing

Adjusting the bit rate can resolve splicing issues.

BY JOHN LUFF

Often, articles like this start by heralding new eras of technology in which paradigms shift and deliver a sea of change destined to alter the workflow and deliver — well, you get the point. There are products that change the game and deliver functionality that was at one time unforeseen.

Video compression was first touted in technical literature as bit rate reduction and was often discussed in terms of lossless and lossy algorithms. Those early discussions, as long ago as the 1970s, were way in advance of the practical introduction of compression in the early 1990s. As often happens, the new technology was based on a desire to reduce transmission bandwidth, which equates to an economic benefit. It also comes with limitations that, once conquered, permanently change how we approach our craft.

Splicing streams, at a cost

MPEG changes deterministic pictures with fixed pixel locations and a fixed number of pixels per second (or frame) into a statistical representation of the picture with sufficient quality to fool the viewer. It reconstructs the image into believing the original picture has been faithfully transmitted.

Of course, nothing could be further from the truth. In the ATSC standard, barely more than 1.5 percent of the original bit rate is used in the bit stream that represents 1080i30 content. MPEG frames are always variable in length. Although with constant bit rate, content null packets are inserted when the encoder calculates no meaningful picture data to transmit, stuffing the bit rate up to a fixed value.

This statistical nature of the bit stream means that deterministic switching of streams on frame boundaries is not possible in the same way that baseband signals allow.

This is for two main reasons. First, it is not possible to know precisely when the next frame will begin unless a sequence is inserted, giving a warning when the switch might happen. Second, the use of B-, I- and P-frames and the rules for their construction mean that a switch on an arbitrarily selected frame boundary to a similar arbitrarily selected incoming frame could mean that a B-frame might be followed by a P-frame from a different bit stream. (See Figure 1.) This makes decoding impossible because of the forward and backward reference each contain.

MPEG changes deterministic pictures with fixed pixel locations and a fixed number of pixels per second into a statistical representation of the picture with sufficient quality to fool the viewer.

The workaround, developed by SMPTE and others several years ago, is a sequence that is inserted into the transport stream, giving a warning when the switch can happen. This is an inelegant solution, but one that works so well that it was adopted by SCTE for the standard that facilitates the insertion of commercials in almost all content on cable systems today (SCTE 35). Multiple splice points can be announced, and SCTE 35 allows messages to be sent in the stream, notifying the splicer when to cut.

However, this allows streams to be spliced without regard to other parameters. For example, it is entirely possible, though perhaps not useful, to splice a piece of 720p content into a 1080i stream. The resulting stream would be legal, but unlikely to be decoded without errors in display.

A more likely issue is splicing streams of two different bit rates together. This can easily be handled by adjusting the bit rate on the new content to match the old content more closely. For example, if a bit stream is running at 14Mb and a commercial is spliced in running at only 4Mb, a decoder would be quite happy. If, on the other hand, the master stream was 4Mb and the commercial was 12Mb, it is quite possible the buffer in the decoder could overflow before the spot is over. It is also likely that the allowed bandwidth in the transmission channel could be exceeded, resulting in a truncated stream or worse.

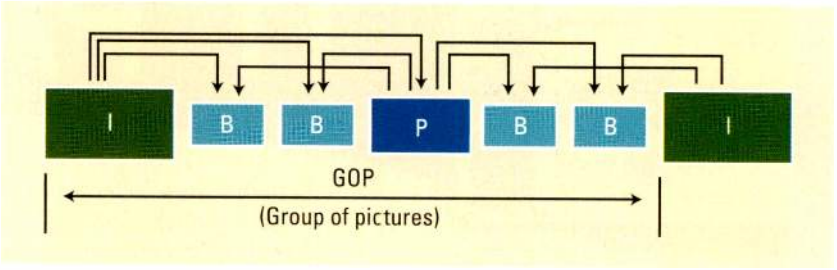

Figure 1. An example of a GOP structure

The solution is transrating

This is easily fixed today. The solution is transrating, or adjusting the bit rate on the fly to a value that fits in the channel and does not exceed the capacity of the channel. (See Figure 2.) In the simplest terms, the quantization tables are changed to make the compression more aggressive, thus lowering the bit rate.

In Figure 2, several feeds are sent to a mux, exceeding the capacity of the channel. After transrating, however, the aggregate bandwidth fits in the available channel. Not all of the feeds would necessarily be scaled, and perhaps one of the feeds contains considerable null packets that can simply be dropped to reduce the capacity needed.

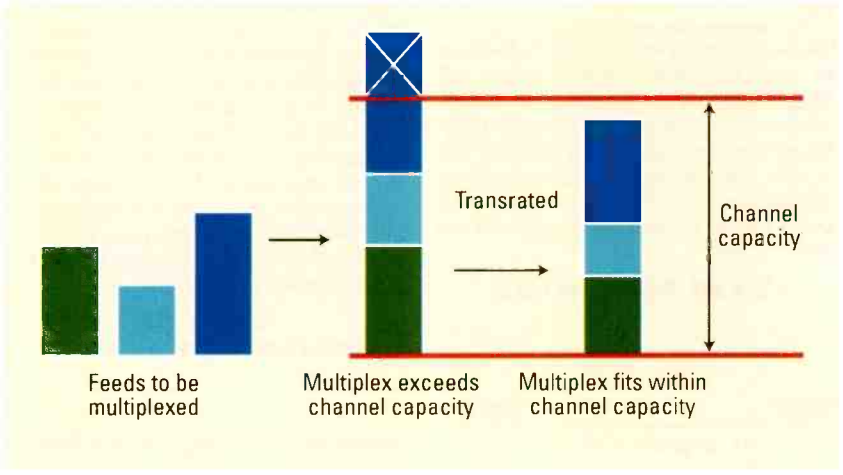

Figure 2. Transrating content can help it to fit a transmission channel.

Reducing the bandwidth in this way affects quality. Some consumer delivery services heavily modify incoming streams to minimize bandwidth and maximize channel count. This technique facilitates consumer demand, though at the expense of preserving maximum quality. For clarity, you could reverse the process, increasing the bit rate, but because the original content has already been lost, it would only produce null packets and wouldn't improve the pictures. Also, you can create a stat mux from a group of unrelated feeds by calculating the bandwidth required at all times and adjusting the individual feeds to minimize the impact on the quality level of the final multiplexed stream.

Conclusion

At one time it was assumed that MPEG streams couldn't be edited. However, various techniques have been developed that make what was intended as a consumer distribution chain technology work in many applications, including editing. Today, complete workflow solutions can be created in the compressed domain. The slow march of technology will certainly make many new techniques possible in the future.

I once told a futurist in our industry he was nuts when he said you could put MPEG encoders in cameras and make transmission over long distances cheaper. Although not practical today, I would no longer question the sanity of such an approach. BE

John Luff is a broadcast technology consultant.

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

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623-328-5800; www.eyeheight.com

Imagestore 750 — Miranda

Processor operates on a Vertigo XG graphics processor and Xpanel playlist-based soft control panel; offers HD/SD master control switching, multilevel channel branding graphics using four independent keying layers and easy selection between SD/HD at 1080i/720p at 50Hz/59.94Hz; supports EAS crawls, audio mix-ins and in-vision digital/analog clock insertion; enables 16-channel digital audio mixing using embedded audio and eight AES pairs.

973-683-0800; www.miranda.com

XT2 — EVS

Production and playout server is built on an open architecture model; offers full integration into any existing broadcast infrastructure for live, near live and studio production application either in SD or HD; features include continuous recording, up to six HD channels per XT2 server and up to eight audio channels per video source.

+32 4 361 70 00; www.evs.tv

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Native HD projector combines DLP image quality with full 1080p resolution; presents HD images with 4100 ANSI lumens brightness and a 1000-75000:1 contrast ratio; features 10-bit image processing, BrilliantColor processing and a range of six high-performance motorized lenses with vertical and horizontal lens shift; configured with a standard RGBCYM color wheel and powered by a dual-lamp, long-life sealed light engine.

714-236-8610
www.christiedigital.com

AG-HMC71 — Panasonic

Shoulder-mount AVCHD camcorder records 1080i images onto SD/SDHC memory cards; features three native 16:9 progressive 1/4in CCDs to record or provide a live feed of widescreen 1440 x 1080 HD images; equipped with a 12X 38.5mm-462mm Leica wide-angle zoom lens, one-push auto focus, integrated optical image stabilization, 3in 16:9 LCD monitor, two XLR mic/line switchable inputs with attenuation, +48V phantom power, and both auto and manual level with record-level dials.

201-348-7000; www.panasonic.com

LV58SER03 — Leader

Composite video interface for the LV5800 modular multistandard waveform monitor; has two 75Ω BNC inputs plus a loop- through BNC output displaying the selected channel; can be used to display waveform, vector, picture and relative phase, and can isolate and display luminance using a low-pass filter; measures amplitude and time parameters using adjustable cursors; is NTSC- and PAL-compatible.

+714-527-9300
www.leaderusa.com

mPlex — TANDBERG Television

Media processing platform enables ultra-low bandwidth video broadcasting to mobile devices such as cell phones, media players, in-car systems and laptops; supports the required encoding and content scrambling for broadcast DVB-H, 3G MBMS and unicast 3G streaming; sits at the core of an end-to-end system for mobile TV that offers picture quality at bandwidths of 200kb/s to 300kb/s, with up to eight channels per rack unit.

678-812-630
www.tandbergtelevision.com

Multibridge Pro — Blackmagic Design

Advanced editing system connects to SDI, HDMI, component analog, NTSC/PAL and S-video for capture and playback, with instant switching among SD, HD and 2K; features eight channels of XLR AES/EBU audio in/out and two channels of XLR analog audio in/out; uses 3Gb/s SDI for twice the SDI data rate than normal HD-SDI; supports real-time effects in Apple Final Cut Pro and Adobe Premiere Pro; includes Blackmagic Deck Control.

408-954-0500
www.blackmagic-design.com

ViBE EM — Thomson Grass Valley

Range of HD/SD MPEG-4 AVC encoders takes advantage of MPEG-4 toolkit and features professional-grade compression engines; EM3000 delivers HD in bit rates as low as 4Mb/s and features a Dolby encoder/transcoder that supports Dolby Digital and Dolby Digital Plus; EM2000 provides MPEG-4 AVC encoding of SD signals and supports MPEG-4 compression tools; EM1000 multichannel SD encoder is designed specifically for IPTV applications.

818-260-3721
www.thomsongrassvalley.com

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COMING IN FEBRUARY

Automation for engineers: Part I: Types and applications

Presented by Sid Guel

February 19, 2008 – 2:00 pm EST

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

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COMING IN MARCH

IPTV design considerations

Presented by Augusto Villaseñor

March 11, 2008 – 2:00 pm EST

While IPTV may be the new kid on the block, much of it still focuses on a video-centric control or media room. This webcast will look at control and media-room considerations for IPTV media centers and broadcast control rooms. Monitor walls, automated monitoring and testing, storage and signal format and encoding will be examined. Whether you are a TV station or new to the IPTV experience, this is a must attend event.

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NEW PRODUCTS & REVIEWS

StreamStacker-HD e² Phase Two — Linear Acoustic

Next phase of multichannel audio system passes Dolby-compatible metadata; can generate and regenerate metadata in both encoders and decoders; enhances the performance of the DTS Coherent Acoustics encoder; offers improved jitter performance and increased error resilience; activates a GPI-controlled soft bypass mode to allow the system to be installed in series with other coding systems to support legacy content; available in a software development kit configuration.

888-292-3117; www.linearacoustic.com

NAVIGATOR DVB v2.1.0 — Audemat-Aztec

New mobile measurement and analysis software enables users to see simultaneously in real time the measurements and video from each channel monitored from the front panel; adds up to two flags during the campaign at selected points and records these events in the campaign file itself, instead of on paper.

305-249-3110; www.audemat.com

Dual-polarimetric radar — Baron Services

Radars transmit in horizontal and vertical orientations simultaneously enabling meteorologists to see twice as much data; offer increased weather detail, higher resolution imaging and enhanced accuracy; provides hydrometeor classification to identify the location and type of precipitation that is falling, providing more accurate information about the size, shape, orientation and state of hydrological data.

256-881-8811; www.baronservices.com

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COMMUNICATIONS ENGINEERING, INC.

Communications Engineering, Inc. (CEI), a leading, award-winning broadcast and multi-media systems integrator located in Newington, VA, is currently seeking qualified candidates for the following career opportunities, which include competitive compensation and benefits:

Senior Systems Design Engineer and Systems Design Engineer

These require a background in the analysis, design and management of broadcast and multi-media systems as well as knowledge of equipment, current trends and technical developments in the industry.

Broadcast Field Service Engineer

This position requires the ability to provide technical repair and maintenance services to broadcasters, post-production facilities and other A/V clients. Applicants must have extensive experience in the trouble-shooting, repair and routine maintenance of broadcast systems, cameras, video tape recorders, Avid systems, servers, production switchers, routers and other production equipment.

Installation Manager

This person will be working in a multi-project, multi-team environment and will be responsible for labor and installation material budgets, time line development and project installation management.

Senior Systems Installation Technicians, Installation Supervisors and Installation Technicians

Duties include pre-wiring and preparing racked systems and furniture consoles for broadcast technical facilities. Must have experience in cable fabrication and termination, mechanical assembly, and rack & cabinet wiring and harnessing.

For more information, see our Web site, **www.commeng.com**. Please email resumes to **humanresources@commeng.com** or fax 703-550-5180.

CHIEF ENGINEER

Truman State University seeks applications for the position of Chief Engineer. The position includes full-time engineering responsibilities for two digital IBOC transmitters, television production/control/master control facility, video and radio remote functions, production and studio equipment, and a satellite receive/cable distribution center. Qualifications include a bachelor's degree or equivalent combination of education and experience and 3 years of experience in broadcast engineering. For a complete job description, including application instructions, visit **http://hr.truman.edu/jobs**. Phone: 660-785-4031 Fax: 660-785-7520 AA/EEO/ADA

BROADCAST ENGINEER

ROSCOR Corporation, a leading Chicago area based video systems integration company, has openings for experienced, highly motivated, and goal-oriented communications systems engineers. The position includes system design, checkout and commissioning of media based integrated solutions, including broadcast and corporate communication customers. Solid background in television systems, transmissions systems and satellite communications system design. Excellent compensation and benefits package. Apply immediately for this challenging and exciting career opportunity within a growing company.

Send resume to:
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MAINTENANCE ENGINEER

KSBI-TV, OKC, is seeking a Maintenance Engineer. Responsibilities include maintaining A/V broadcasting, computer, EAS receive and transmit equipment. Experience in installation of analog/digital television master control, production facilities, and newsroom computer systems; live broadcast productions required. Familiarity with computer and networking technologies, UHF transmitter experience is preferred. Ability to work under deadlines & complete projects without supervision in a multi-tasking environment are a must. Successful candidate will have electronics and IT education or equivalent broadcasting experience. SBE certification a plus. Send resumes to KSBI-TV to info@ksbitv.com or fax: 405 631-7367

CHIEF ENGINEER

Hearst-Argyle Television, licensee of Station WLKY-TV, Louisville, KY, has an opening for a Chief Engineer. This person is directly responsible for the supervision of the daily operation of all broadcast studio and field equipment and the supervision and motivation of the technical staff. Position requires working with the news department on logistics, scheduling and planning of special events coverage. Must possess a formal engineering degree, five years or more of demonstrated experience in studio, SNG and ENG broadcast operations, FCC General Class License and experience with represented employees. Candidate should also demonstrate success in budgeting, capital planning, and personnel management. Located in the heart of thoroughbred racing and college basketball, WLKY is a market news leader, consistently ranking #1 in the late news. Send resume to General Manager, WLKY-TV, 1918 Mellwood Avenue, Louisville, KY 40206. EOE

Help Wanted

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PRODUCTION ENGINEER

Turner Studios seeks a talented, service-oriented individual to join our Engineering team, supporting high-end CGI, Design, Composite and on-air Graphics systems. Multi-OS, IT and related application experience highly desired. View the complete job description and apply online at **www.turnerjobs.com**, Requisition # 78382BR. For more information, please contact Brad Ramer at **brad.ramer@turner.com**. Turner Broadcasting is an Equal Opportunity Employer.

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Advantageous resources

These tools can help you stay abreast of technological change.

BY ANTHONY R. GARGANO

World technical and scientific knowledge doubles every 14 months to every five years. The broadcast industry is a highly technologically driven profession, which, owing to the rapid application of digital technology over the past decade, finds itself at the shorter end of that change cycle.

Since receiving that technical school diploma hanging on the wall, how many of these doubling cycles have you been through? Keeping up with the rapid changes in digital technology can be a full-time job in itself. Given the ever-changing technology landscape, staying at the top of your game requires dedicated effort. Equipment manufacturers often provide valuable resources to aid broadcasters in their pursuit to maintain technical proficiency.

Equipment manufacturers often provide valuable resources to aid broadcasters in their pursuit to maintain technical proficiency.

Self-serving materials vs. educational ones

Virtually all manufacturers offer some type of formal or informal training materials that are specific to their own products. While there can be some educational value in these materials, let's face it: The underlying message is understandably self-serving and promotional. However, some manufacturers provide excellent reference texts and tutorials. These materials are made easily available as downloads from company Web sites or can be obtained in physical form upon request. These materials enable users to read or study at their own convenience, which is a major benefit.

DTV guide for engineers

Rohde & Schwarz offers a 400-page textbook called "Digital Television: A Practical Guide for Engineers," written by Walter Fischer. The book is extremely well written and quite comprehensive, as it covers everything from the basics of MPEG to ATSC, DVB-T and ISDB-T.

The chapter on OFDM is perhaps one of the clearest, easiest to understand explanations of that technology that I have ever read. You can request a copy of this book by calling a company sales representative.

HD basics and beyond

There are downloadable references available that you can easily organize into a technical reference folder on your PC. Harris, through its Videotek subsidiary, offers "HD Basics and Beyond: A Primer for Video Professionals." The 52-page PDF file is basically what its title says — an HD primer.

In addition, the company offers numerous white paper downloadable PDF files and PowerPoint documents that cover a diverse range of DTV topics. To find these resources, do a search for "white papers" on the Harris Broadcast Web site.

A glossary worth bookmarking

A veritable trove of technical information is available from the Snell & Wilcox Web site. Under the "Community" section of the site, go to the "Knowledge Center," and browse through the white papers and presentations. There, you'll find numerous technical references well worth downloading.

Another useful resource can be found in the "Engineering Guides" section of the Knowledge Center. "An Engineer's Guide to Compression" by John Watkinson, for example, is a 93-page PDF that represents an excellent treatment of its subject matter.

Before you leave the site, check out the glossary section. It's incredibly comprehensive and well done. I recommend bookmarking this page.

Digital factbook

Quantel's Web site includes the "Digital Factbook," a 154-page reference work edited by Bob Pank. It uses a glossary format but goes into much lengthier detail than typical glossary definitions. To find the "Digital Factbook," go to the "Library" section of the Web site.

Conclusion

Whether printed text or in the form of downloadable files, there are free, high-quality tutorial and reference materials available. Putting together your own study and reference library is just a few phone calls and mouse clicks away. BE

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

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

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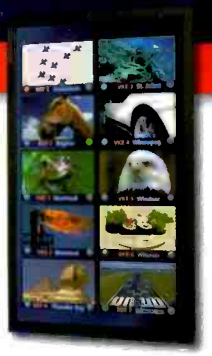

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