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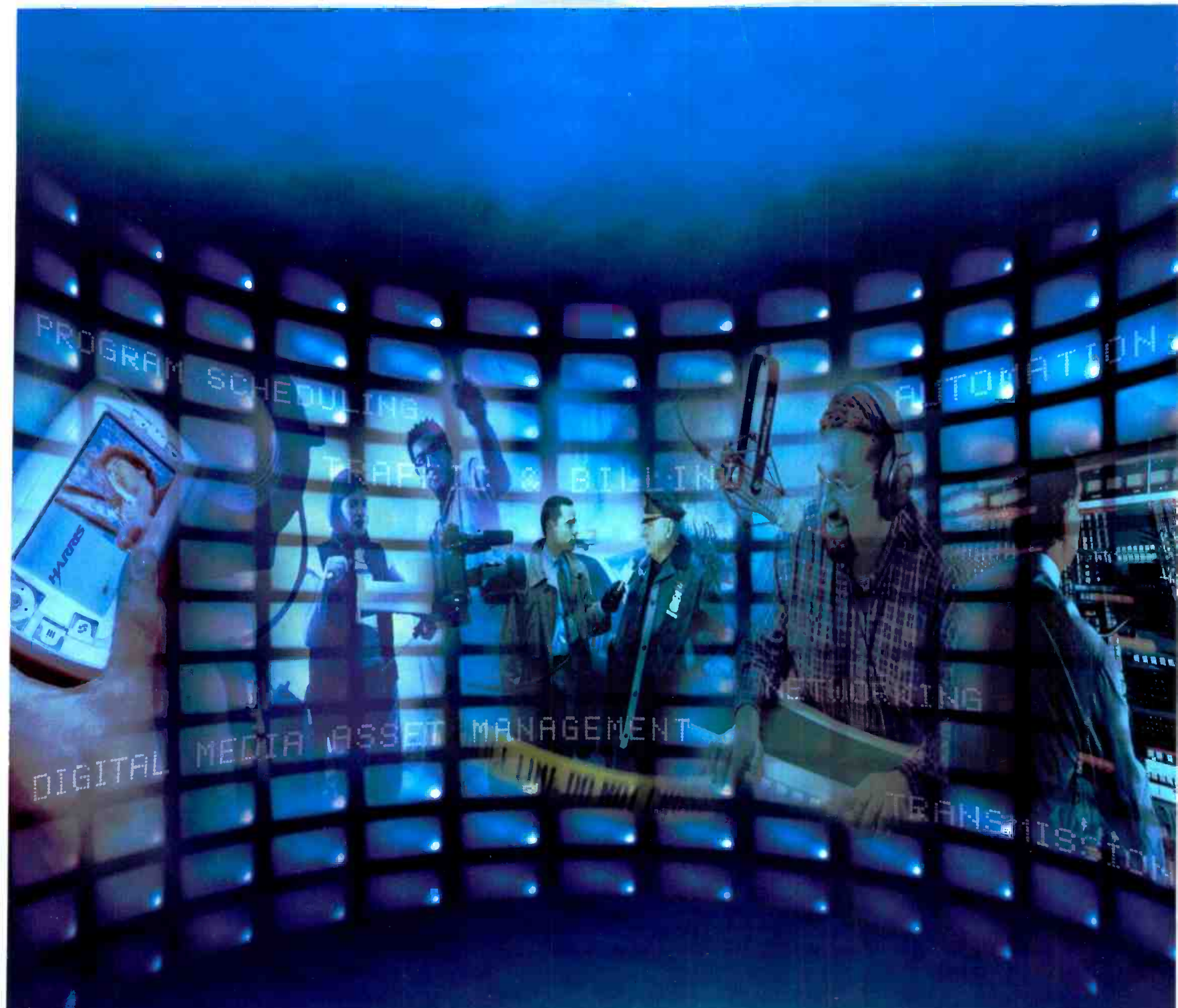
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The Barber Shop Studios control room employs a 72-input Solid Station Logic XL 9000 K Series SuperAnalogue console, custom Griffin loudspeakers and a Pro Tools|HD mix system. Photo courtesy George Roos Photography

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DIGITAL HANDBOOK

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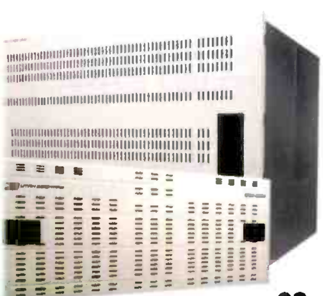
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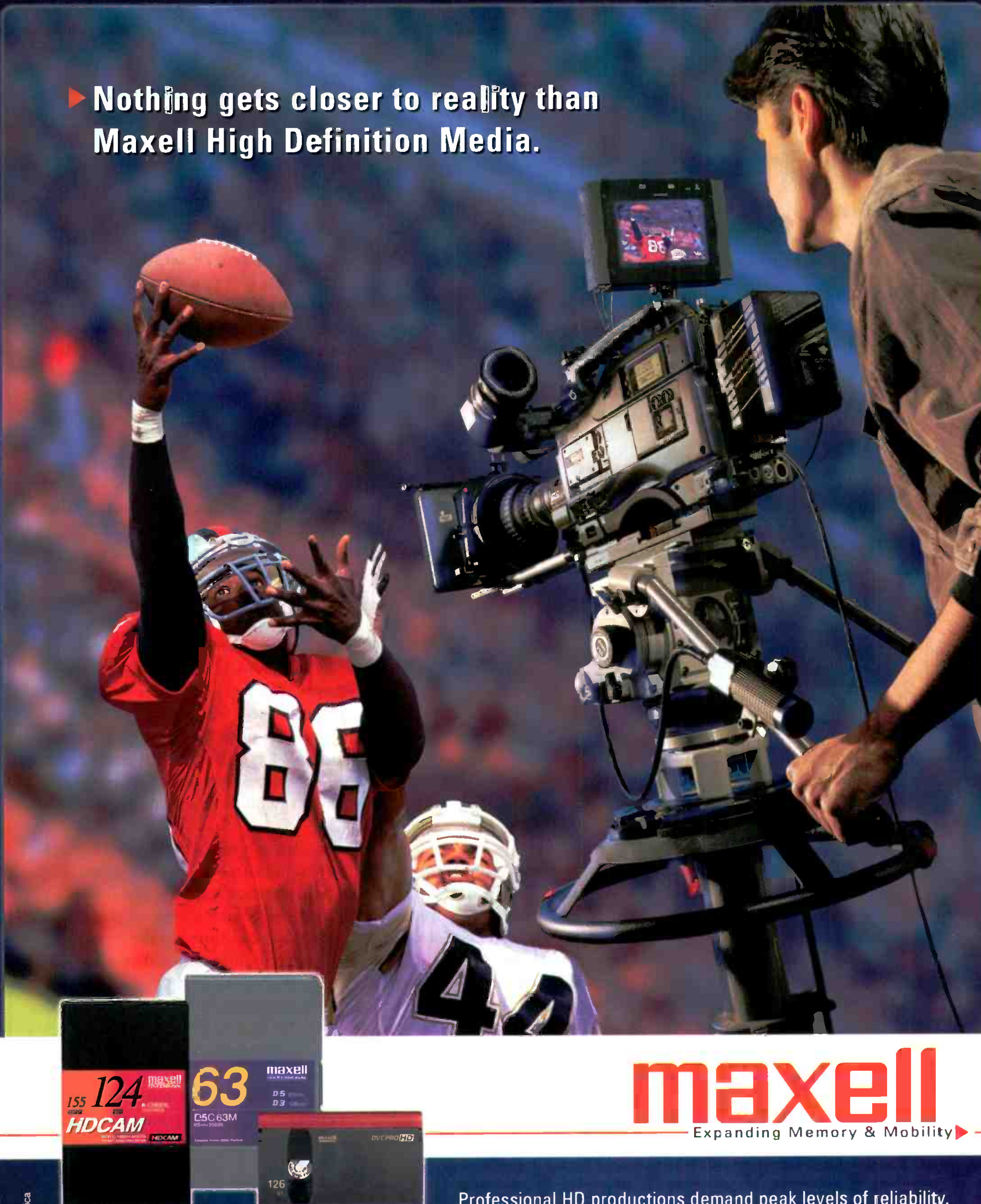
Freezeframe

Can you wire an RJ45 Ethernet cable?

Match the RJ-45 pin numbers to the correct wire color. You must correctly list each pin and matching wire color. Readers submitting winning entries will be entered into a drawing for Broadcast Engineering t-shirts. Enter by email. Title your entry "Freezeframe-September" in the subject field, and send it to: editor@primediabusiness.com. Correct answers received by November 1, 2005, are eligible to win.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The smell of "free" money

Scene opens in a typical American home. Time: early 2009. Husband and wife in living room with old-style TV set.

"Goody, goody, goody! Yahoo! We're getting a new TV set! We're getting a new TV set!" chimes George. He dances around the room with the Sunday newspaper advertisements in his hand as his wife looks on. Seldom has she seen him so excited.

"Come on, honey, let's go pick out our new TV set. We'll start at Best Buy. Then we'll go over to Circuit City and maybe even Fry's," he almost shouts.

"Hold it, George," she says. "What's all this about getting a new TV set? This old one is perfectly fine. With the cost of cable, we really can't afford a new one."

George blurts out, "Haven't you heard?" He waves the newspaper in front of his wife. "Analog TV is being turned off at the end of this year, and everybody has to get a new TV set or set-top box." He almost whispers the latter part.

"Just a minute, buster," his wife replies. "We're not spending any money on a new television, HD or otherwise."

Undaunted, George continues, "We don't have to spend much, dear. Thanks to Congress, everyone will get a $250 credit towards a new TV set (or a free set-top box). Because we have an older set, we're better off using the credit on a new TV set. With the recent price drops, we can get that new 57in HDTV model I've been looking at for less than $1500!"

It's here we leave our mixed-up couple to bring some clarity to this story.

First, Congress has yet to vote on giving anyone a free new set-top box (STB). Second, if you don't take what will be a free STB, there's no guarantee you'll get a cash credit towards a new TV set.

However, you can bet that once the politicians smell the money the spectrum is expected to generate, they'll tack on more self-promotional goodies than you could count in a lifetime.

The dust hasn't settled on this matter, and the Consumer Electronics Association will certainly demand that any legislation include provisions for voters — ahem, I mean viewers — to get a credit or cash towards the purchase of a new digital TV set. After all, these guys sure don't want 17 million old TV sets to have their lives extended by cheap STBs.

Instead, these set makers will argue that using the "free" money from the upcoming spectrum auction to help fund new TV sets will actually speed the digital transition. New televisions will display pristine HD images complete with surround sound; the cheap STBs will not.

Besides, no politician in his right mind will tell grandma that she has to settle for a bare-bones STB when, by adding a little cash, grandma can get a brand-new TV. And, that politician will be sure to remind grandma at election time (via the free airtime he cleverly included in the legislation) that grandma should vote for him. After all, this politician helped her get that new TV set.

Scene ends with garage door closing as our couple drives away. In the background, we hear, "We're getting a new TV set! We're getting a new TV set!"

Video: Fade to black.

Audio of deep male voice, "Remember, any government big enough to give you everything you need is big enough to take away everything you have."

Brad Dick
editorial director

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

REV technology

In response to "Iomega's REV drive: Yet another storage technology" in Broadcast Engineering's *July issue:*

Perhaps I'm missing something, but I cannot understand why anyone needs the Iomega/Grass Valley REV drive. Aside from being *yet another* media format, of which we already have too many, I cannot discern what makes this product advantageous.

It's a hard disk platter in a cartridge, with the head mechanism located inside the host unit. This requires elaborate methods to keep out contamination and increases the fragility of the disk/head interface. The cartridge contains the same kinds of balky parts that routinely cause problems in similar formats. Let's be honest: Nobody misses their Bernoulli drives or Control Data disk packs, do they?

I can buy a tiny Firewire drive right now with several times the storage capacity and four times the data throughput of the REV and without any of the mechanical complexity. For archival storage, I'd rather use data tape (cheaper storage density) or ATA hard drives in robust sealed cases. Why should we return to magnetic cartridge storage when optical and solid state are making huge advances? It strikes me that the REV is an idea whose time has gone.

ERIC WENOCUR
LAB TECH SYSTEMS

Grass Valley responds:

Yes, there are too many proprietary, restrictive and expensive approaches to recording and storage media today. Our industry needs to stop relying on the proprietary recording formats from a couple of manufacturers and embrace and leverage the capabilities and performance available from off-the-shelf IT-based technologies. Rather than manufacturers dictating decisions such as recording and storage formats, it's time to put the power of choice into the hands of users where it belongs.

The Iomega REV technology offers real alternatives, such as removability, durability and the convenience of tape, combined with the true nonlinear performance of a hard disk drive, at an affordable price.

The technology is highly adaptable into a number of applications across the production workflow, including recording, editing, playout and archival. Recorded content can be edited directly from the REV disk, so there is no need to transfer content onto a separate hard drive before editing.

REV removable rigid disk technology is based on standard laptop hard drive components — engineered for much greater durability by placing only the magnetic media and motor within the removable cartridge. All the sensitive drive heads and electronics remain in the drive itself. This not only benefits durability, but it also helps to keep the media costs down.

There is nothing fragile about the Iomega REV disk. The REV drive and removable media are robust and durable. The disk is capable of surviving repeated 48in drops, and its long-term archival capability is more than 30 years. Solid-state media is also rugged, but REV's removable disks are less expensive per gigabyte.

To a degree, there should be flexibility in choice of recording media. It's a great idea to allow camcorders and VTR-like devices to record to external media such as Firewire drives and USB Flash sticks. It'll be interesting to see how other manufacturers enable this type of capability.

Grass Valley believes in the performance and durability of the REV technology so much that it's integrating it into the company's new Infinity series of acquisition, recording and storage devices designed for a networked world and efficient production workflows. **BE**

April Freezeframe:

Q. Complete the following sentence: The ____ ____ is the portion of the video signal that lies between the trailing edge of the horizontal sync pulse and the start of active picture time.

A. Back porch

Winners:

Firdaus Sikumbang, Marty Yoskowitz, Larry Stratton, Guerin C. Goldsmith, Gil Martinez, Charles Laflamme, Bui Khai Hoang, Vitaliy Oiynyk, Pham Van Tam, An Chinh Truong Vu, Paul Kucharski, Dwight Moots, Robert Hoffman, John L. Harris, Zoran Ruzic, Miguel Tierhs, Michael French, J.P. Nathani, Alan Schoenberg, Jerry Foreman, Rich Brockman, Guy Lewis, Neil O'Brien, David Lawry, Bob Peticolas, Marty Kirkland, James Allen, Tim Costley, John Klambauer, Don Norwood, Xen Scott, Gregory Chambers, Joanne Bandlow, Tom Morford, Al Van Dinteren, Dave McGillen, Roger Wilcox, Rich Lohmueller, Tony Michalski, Mark Everett, Dick Dewese, Chuck Condie

Test Your Knowledge!

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

Send answers to bdick@primediabusiness.com

The outer limits of fair use

BY CRAIG BIRKMAIER

*There is nothing wrong with your television set.
Do not attempt to adjust the picture.
We are controlling transmission.
For the next hour, sit quietly, and we will control all that you see and hear.*

The '60s. What a time to be growing up in America! It was the golden age of TV, when families gathered around the electronic hearth and a new medium took control of our lives. They controlled the horizontal and the vertical. They could change the focus to a soft blur or sharpen it to crystal clarity. They decided what we could see in the not-so-vast wasteland of a three-commercial-network universe.

We listened to music on AM radio and scratchy vinyl discs. We watched movies in theaters. There was no need to manage how we consumed entertainment media. There were no VCRs, CDs, DVDs, video games, car theater systems, PCs, Tivos or iPods.

Rights? You don't need no stinkin' rights. They are in control.

It's like dejá vu

Four decades later, the issue of control has come back to haunt us. During those decades, we have seen our entertainment choices proliferate. Families rarely gather around the TV set in the living room anymore. The TVs have multiplied in our homes like rabbits, as have the devices and services that can be used to feed them. The TV audience has fragmented like an imploding CRT.

Along the way we acquired something called fair use rights, granting us the rights to control when we want to watch a TV program by recording it for time-shifted viewing, to make copies of entertainment media for our personal use, and to move this content from one device to another so that it can be enjoyed anywhere, anytime.

We have seen the entertainment industry expand and then consolidate, creating conglomerates with awesome power to influence the flow of entertainment and information. We have seen the influence on our culture and our political institutions. We have watched as politicians have used the media to consolidate their power.

Now we, their customers and constituents, have become a threat — a rowdy band of pirates — using emerging technologies to control the ways in which we choose to be entertained and informed.

The insecurity complex

This revolution has many fronts, many incestuous relationships. The symbiotic relationship between the media and consumer electronics conglomerates erupts into open warfare each time a new technology threatens to give consumers more control over the way they consume entertainment and information.

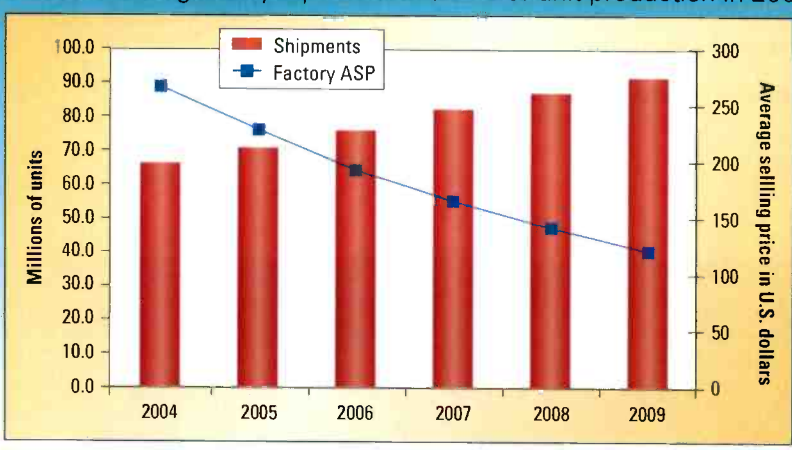
Both view the computer industry as a threat, as PCs and laptops are transformed into media centers and portable media players. And cross ownership between industries makes it nearly impossible to determine what the real agendas are.

Rights management is now a major concern for every company and product that touches any form of digital media content. The rapidly growing world of rights management extends well beyond the world of entertainment. Determining who can access any digital file on any network is a

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

Digital set-top box market continues to grow

Forecasted to grow by 7 percent in terms of unit production in 2004



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rights management issue that touches everyone. Recent revelations of computer system breaches, compromising the financial records of millions of consumers, underscore the importance of rights management.

The asset management systems used at every level of the entertainment industry must deal with rights management at multiple levels. Within organizations, the issue of who can view media files and who can modify them is a rights management issue. For a major cable or TV network, even a local TV station, the need to track the rights to broadcast a program is critical.

In the narrow context of this column, however, the focus is on the consumer and what must be done to prevent the abuse of whatever fair use rights a content owner may choose to allow. In July, I used this column to examine an aspect for this subject: the broadcast flag, which is intended to prevent the copying and redistribution of DTV broadcasts. The FCC issued an order for all downstream devices to honor the flag; however, a federal appeals court ruled that the FCC had overstepped its authority, having no jurisdiction over downstream devices.

Congress could pass legislation authorizing the FCC to regulate these downstream devices. At this time, there is no draft legislation to authorize the flag. However, at least one attempt to attach the rule to a budget bill has been derailed. It now appears likely that, perhaps before the end of the year, Congress will pass a bill setting a date certain for the end of the DTV transition on Jan. 1, 2009. The major issue yet to be resolved involves the possibility of government subsidies for set-top boxes. (For more information, see "The broadcast protection racket" in "Web links.")

It is not likely that Hollywood will give up in its campaign to limit consumer fair use rights for their best content — especially anything at HDTV resolution. The industry is trying to make certain that the new HD DVD formats are well-protected. HD DVDs will be protected by a renewable security system called the advanced access content system (AACS). AACS employs encryption keys in both the player and on replicated discs. If a key is compromised, access can be revoked. (For more information, see "Web links.")

Hollywood would like for all new players to have some form of back channel connections that would allow them to revoke keys after they have been compromised. This raises the real possibility that a legally purchased disc could stop working if it was compromised or that a hacker could compromise the security system and shut down large numbers of players in a manner similar to the way that viruses now take out PCs.

Given the potential for yet another consumer format war, and the industry's desire to limit the fair use rights for this content, it is relatively easy to predict consumer response to HD DVDs. When the media conglomerates push the outer limits to control consumer behavior, consumers can just say no! **BE**

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

Web Links

"The broadcast protection racket" by Craig Birkmaier; *http://broadcastengineering.com/mag/broadcasting_broadcast_protection_racket*

Advanced access content system; *www.aacsla.com*

AACS White Paper; *www.aacsla.com/media/aacs_technical_overview_040721.pdf*

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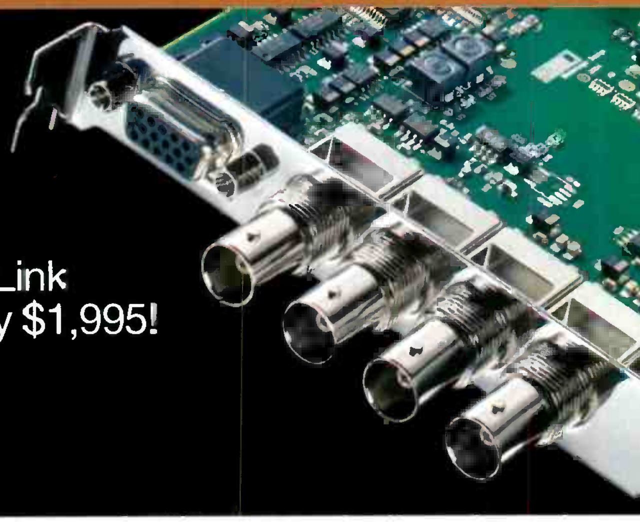

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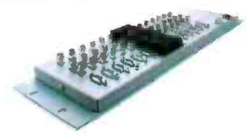

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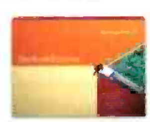

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New captioning requirements

BY HARRY MARTIN

The FCC has adopted a notice of proposed rule making looking to toughen the closed-captioning rules as statutory requirements for more universal closed captioning loom.

Nearly 10 years ago, Congress amended the Communications Act to require that all video programming be closed captioned. Closed captioning had up to then been undertaken on a voluntary basis, without the need for prodding by the legislature. However, Congress was concerned that the explosion of new channels of video programming might result in new programming sources, which might not feel that voluntary spirit. Congress believed it important to require that new programming sources be accessible to persons with hearing disabilities.

One of the last benchmarks is January 1, 2006, the deadline by which all new English-language programming must be captioned. In light of this impending deadline, and in response to a petition for rule making filed by several public interest organizations that focus on accessibility issues, the commission released the notice in late July that includes several new proposals.

Quality standards

The commission is seeking comment on whether it should adopt technical and non-technical quality standards. Specifically, it questions whether complaints by parties relating to such issues as accuracy of transcriptions, typos and other errors associated with closed captioning justify the establishment of minimum standards in those areas.

In addition, while broadcasters and cable systems are already required to pass through closed captioning already embedded in the programs they transmit, the FCC is asking whether it should adopt any supplemental rules to ensure that viewers who rely on closed-captioning services do not suffer from technical glitches and other service disruptions. One partial remedy suggested is to require TV stations and cable systems to actively monitor and maintain the closed-captioning service.

Complaint procedures

The FCC is considering shortening the time provided for television stations and cable systems to respond to complaints regarding non-emergency closed captioning. While the commission itself directly responds to complaints relating to problems associated with the closed captioning of emergency programming, it requires complaints regarding non-emergency broadcasts to be directed in the first instance to the television station or cable system. And, under the current rules, the station/system has more than 45 days in which to contact the program supplier and formulate a response. According to the commission, because all new English-language programming will have to be captioned as of January 1, 2006, it might no longer be necessary or appropriate to permit such a lengthy response time.

The commission also is considering adoption of a standardized form for closed-captioning complaints as well as specific forfeiture penalties for violations of the captioning rules.

Compliance reports

A proposal likely to attract opposition is a planned rule that would impose a certification requirement on broadcasters concerning the amount of closed-captioned programming each television station is providing. This raises the problem of coming up with a method that could be used to verify that such certifications are accurate. Another issue is whether a station would be permitted to rely on the certifications of the companies that provide their programming.

Electronic newsroom techniques

Under the current rules, stations located in the top 25 markets cannot count towards the closed-captioning requirements. The rules require, instead, live closed captioning of news and other live programming. The commission is seeking comment as to whether this standard should be extended to include all television markets so that live programming on all television stations would have to be closed captioned on a real-time basis. BE

Dateline

October 3 is the deadline for TV, TV translator, LPTV and Class A TV stations in Iowa and Missouri to file 2005 renewal applications, biennial ownership reports and EEO program reports.

October 1 is the date that TV stations (but not translators, LPTV or Class A TV stations) in Colorado, Minnesota, Montana, North Dakota and South Dakota must begin renewal pre-filing announcements in anticipation of filing renewals on December 1.

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

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

Audio compression and noise

BY MICHAEL ROBIN

In a previous article, we discussed analog audio SNR concepts. As mentioned, the dynamic range is restricted at the top by clipping (THD ≤1 percent) and at the bottom by the thermal noise combined with the ambient acoustical noise picked up by the microphone. This article will discuss some aspects of digital audio noise and digital audio compression-related noise.

Digital audio noise concepts

Digital audio noise is the result of the A/D limitations resulting in quantizing errors. Essentially, the analog-to-digital conversion quality is limited on the one hand by the sampling frequency (F_s) and the maximum audio frequency (F_{max}), and on the other hand by the number of bits per sample (n). The digital audio SNR is given by:

$$SNR(dB) = 6.02n + 1.76 + 10\log_{10}(F_s/2F_{max})$$

where
n = Number of bits per sample
F_s = Sampling frequency
F_{max} = Maximum audio frequency

Assuming that n=20, F_s=48kHz and F_{max}=20kHz, the resulting SNR=122.95dB. Quite impressive!

The perception of quantizing error is signal-dependent. At high audio signal levels, approaching 0dBFS, the Human Auditory System (HAS) perceives the quantizing errors as random noise. At lower audio signal levels, the HAS perceives the quantizing errors as harmonic and intermodulation distortions.

Consider a digital audio data stream with an 18-bit resolution and a sampling frequency of 48kHz. The essential bit rate is equal to:

18 bits per sample x 48kHz = 864kb/s

Six 5.1 audio channels and 18 bits per sample, as in ATSC, would result in a bit rate of 5.184Mb/s. It is obvious that compression is necessary for transmission purposes.

Audio compression methods

The audio compression methods rely on the human psychoacoustic characteristics and their limitations to remove redundant digital audio data. The audio coding is thus best described as a perceptual coder as opposed to a waveform coder. In a perceptual compression process, the codec (coder/decoder pair) does not attempt to recreate the input signal waveform. Its goal is to ensure that the recreated signal sounds natural to a human listener. The HAS has certain characteristics that are exploited by audio compression systems:

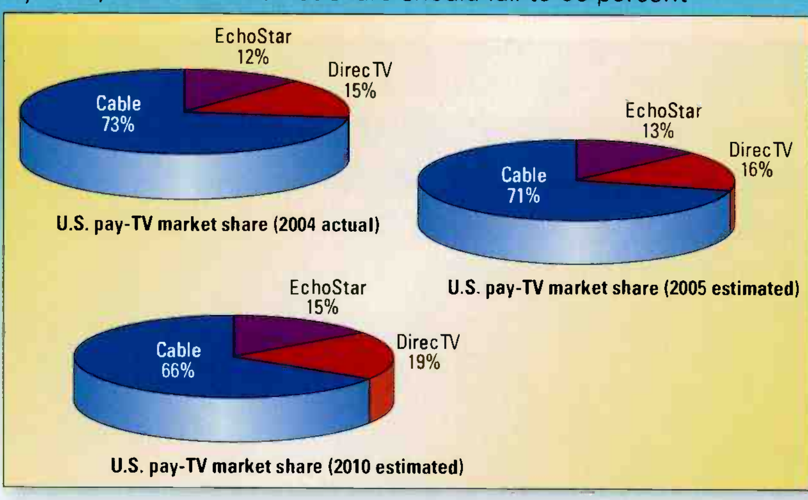
- *The spectral response*: The HAS behaves like a spectrum analyzer. It separates the audible sound spectrum into 25 frequency bands called critical bands. The bandwidth of the critical bands is proportional to the center frequency and varies from 100Hz, below 500Hz, to 3500Hz at 13,500Hz.
- *The frequency response*: The sensitivity of the ear decreases at low and high frequencies and is dependent on the sound pressure level (SPL) being relatively flat (±10 dB) at 120dB SPL.
- *The masking effects:* The HAS suppresses some sounds in the presence

FRAME GRAB

A look at tomorrow's technology

Cable TV is on the decline

By 2010, cable TV's market share should fall to 66 percent



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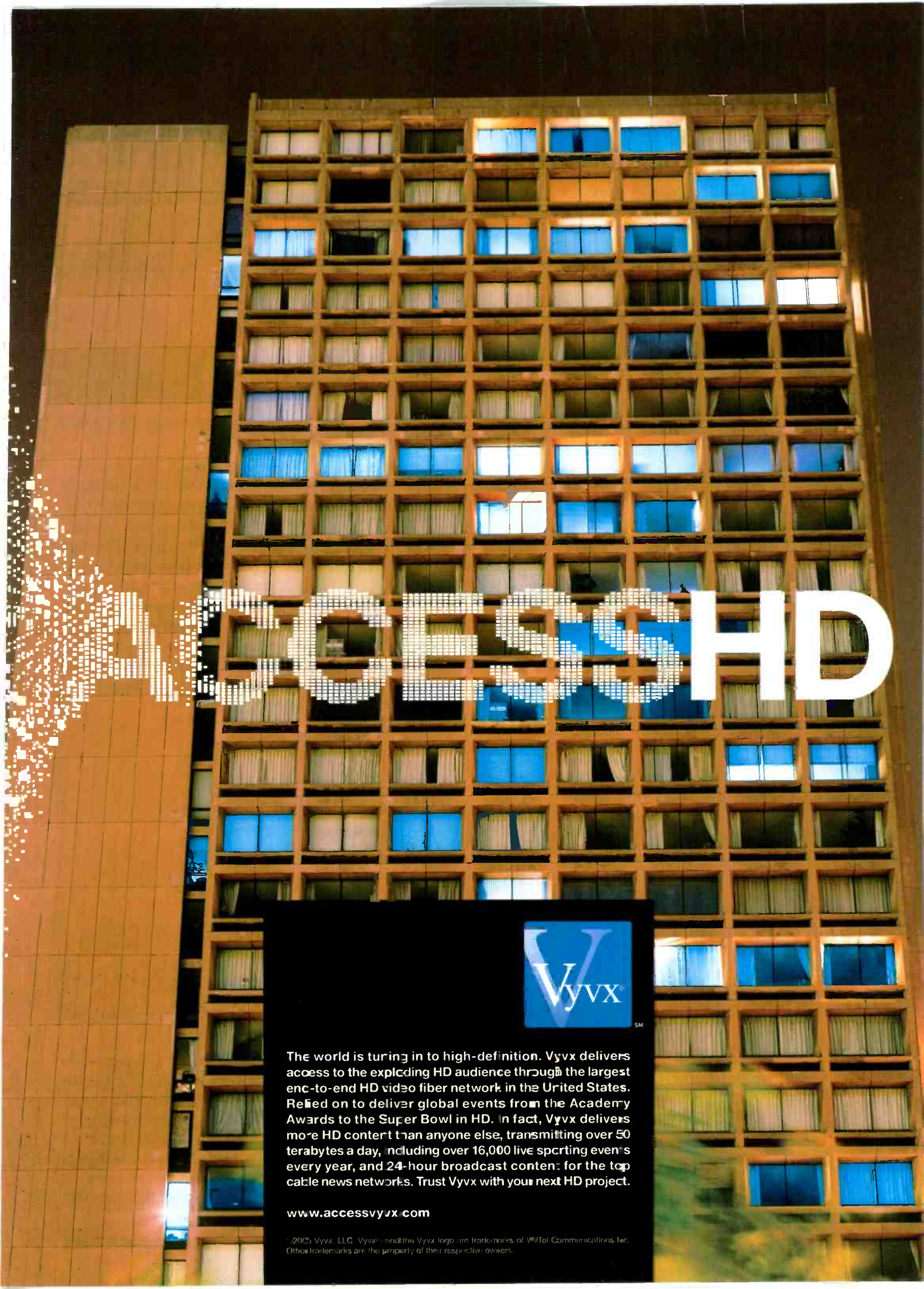
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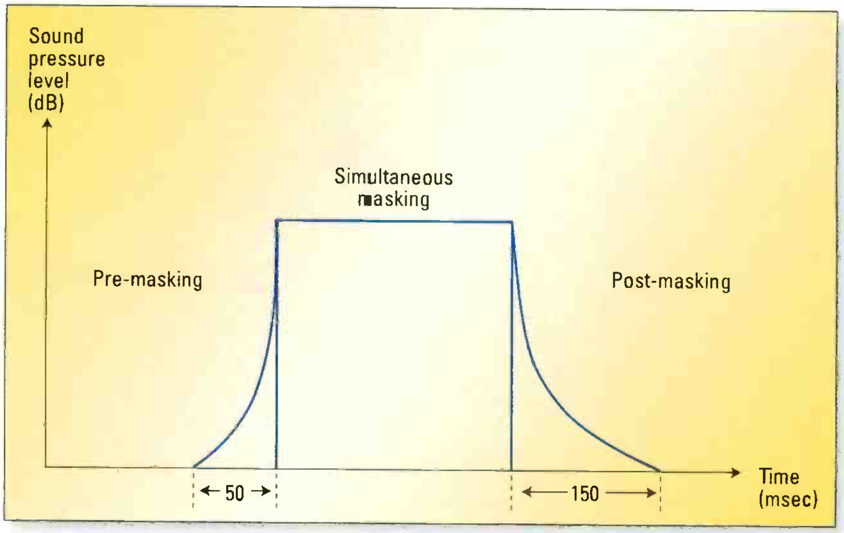


Figure 1. Temporal masking

of other sounds, a process called auditory masking. A weaker sound is masked if it is made inaudible by the presence of a louder sound. There are two types of masking: temporal masking and frequency dependent masking.

As shown in Figure 1, temporal masking results in a delay in the perception of a sound (premasking) and a slow decay in its perception (post masking). While the sound is maintained, other sounds of lower amplitude are masked.

Figure 2 shows that the threshold of hearing is also frequency-dependent. A sound close in frequency to another sound is more easily masked than if it is far apart in frequency. The continuous curve represents the HAS threshold of hearing. Sounds at various frequencies with SPL levels below this curve are inaudible. The dash-outlined curve shows how a 1kHz sound raises the threshold of hearing and effectively masks lower amplitude sounds of neighboring frequencies. Simultaneous frequency domain masking results in raising the perception threshold of sounds whose frequencies are in the vicinity of a higher amplitude sound.

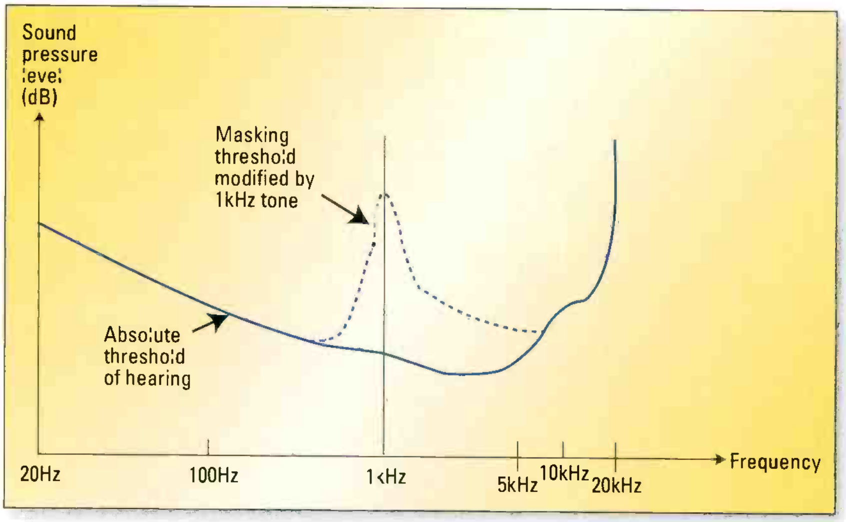


Figure 2. Simultaneous masking

In the presence of a complex audio spectrum, such as music, the threshold is raised at all frequencies. The beneficial effect is the masking of background noise during the reproduction of music. The parts of the signal that are masked are referred to as irrelevant. The parts of the signal that

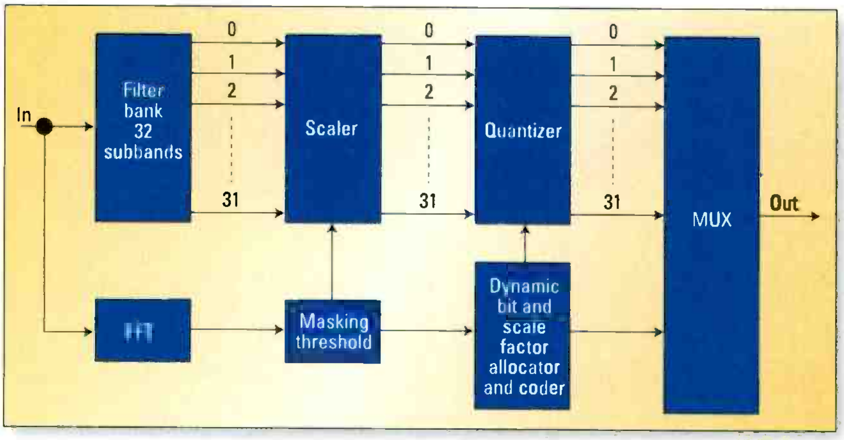


Figure 3. Simplified block diagram of MPEG audio encoder

are removed by a source encoder are referred to as redundant. In order to remove the irrelevancies in the audio signal, the encoder contains a psychoacoustic model. It analyzes the input signal in consecutive time blocks and determines for each block the spectral components of the input signal by applying a frequency transform.

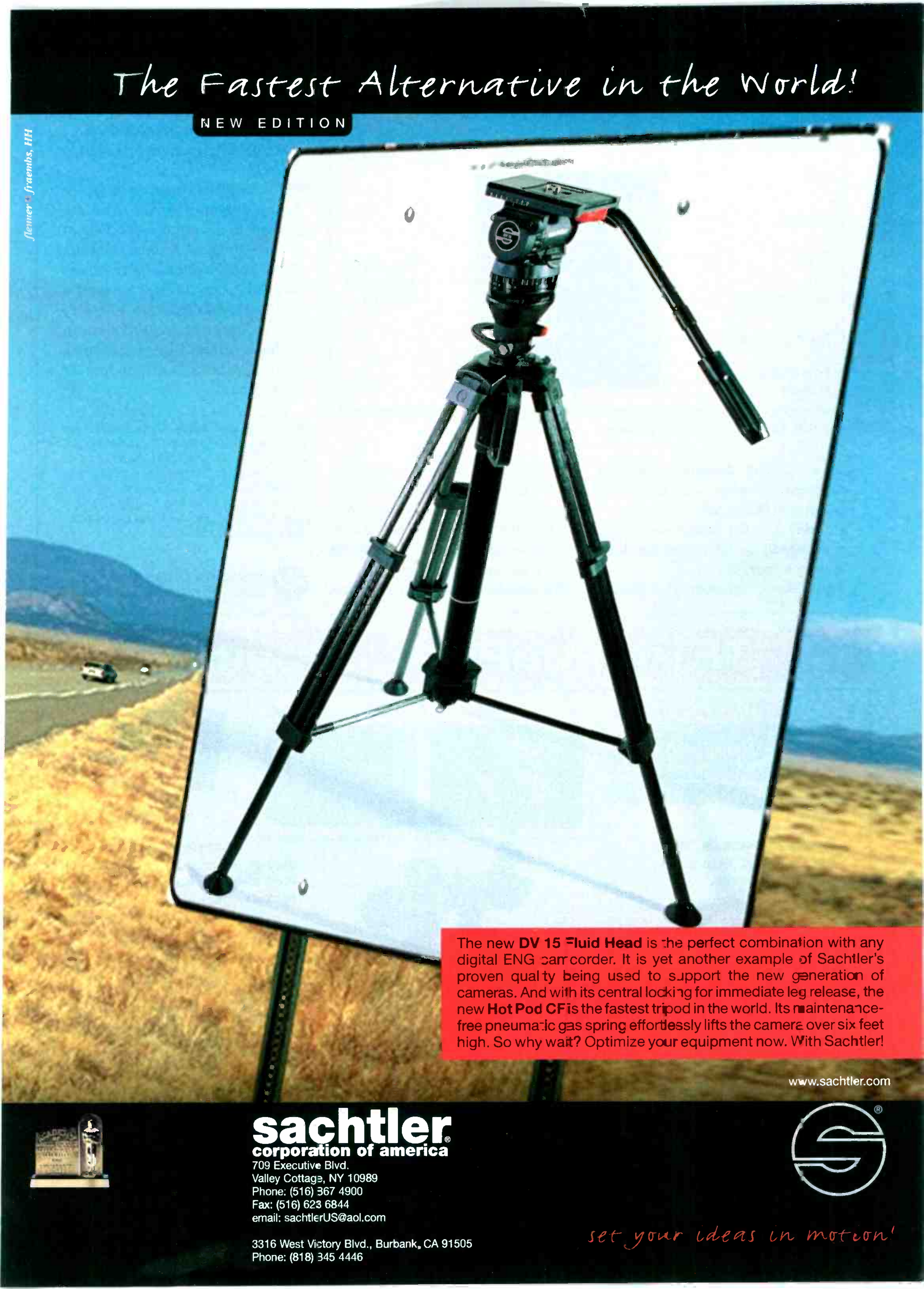
The psychoacoustic model provides for high-quality loss signal compression by describing which part of a given audio signal can be removed, or aggressively compressed, without a significant loss in the quality of the sound. Essentially, low-amplitude signals are either suppressed, if they are below the threshold of audibility, or given few bits, because the resulting quantizing noise is below the perception level. Such types of compression are a feature of all modern audio compression formats.

The MPEG approach

Figure 3 shows a simplified block diagram of an MPEG encoder:

• *Filter bank:* A filter bank splits the input signal into 32 sub bands in an essentially lossless and reversible manner similar to the HAS process. Bands in which there is little energy result in small signal amplitudes that can be transmitted with short word lengths (few bits per sample). Thus, each band results in variable length samples, but the sum of all the sample word lengths is less than that of the initial PCM. Therefore, a coding gain can be obtained.

• *Fast Fourier transform (FFT):* An FFT of the audio is used as the input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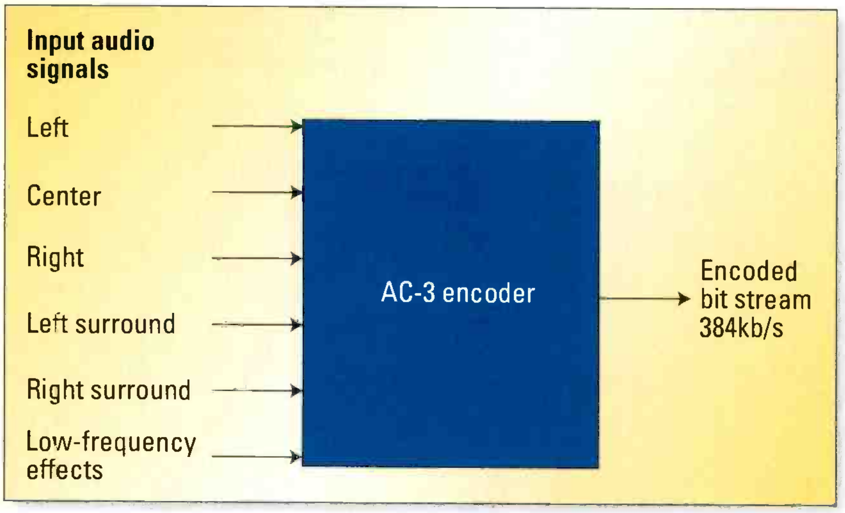

Figure 4. Example of an ATSC encoder

to a masking threshold algorithm to determine what scale factor and quantizing level to use.

- *Scaler:* A scaler boosts low-amplitude signals as far above the noise level as is possible.
- *Quantizer:* A quantizer allocates the available number of bits in a way that meets both the bit rate and the masking requirements. The information on how the bits are distributed over the spectrum is contained in the bit stream as side information.

The decoder is less complex because it does not require a psychoacoustic model and bit allocation procedure.

ATSC applications

Figure 4 shows a typical ATSC application. In this example, a 5.1 channel audio program is converted from a PCM representation requiring more than 5Mb/s (six channels x 48kHz x 18 bits = 5.184Mb/s) into a 384kb/s serial bit stream by an AC-3 encoder. All this is achieved by transforming irrelevant audio information into inaudible noise. **BE**

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

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Network protocols

BY BRAD GILMER

It would be hard to work for long in this industry without running into the term *protocol*. A protocol is a set of agreements that govern communications between two entities. The entities can be VTRs, remote control units, computers, transmitters — almost anything that would need to talk to something else.

While ping can provide a quick check to verify that a computer is connected to a network, you should be aware that many servers do not respond to ping requests for security reasons.

The protocol helps define the interface. You can imagine that it would be a drawn-out process to start from scratch every time you wanted to get two devices to communicate; there can be literally thousands of decisions that have to be made before you are successful.

Many of these decisions are already made if you use common protocols. For example, if you know that you have a VTR and a remote control that speaks the Sony VTR control protocol over an RS-422 circuit, you know that an RS-422 electrical and physical interface will be used, and you know that the commands sent over the interface comply with the VTR protocol. Saying "Sony protocol over 422" defines the connector, the electrical coding on the wire, the command structure and more.

You are probably already familiar with the names of several Internet protocols, but you may not have thought of them in broadcast terms. Internet protocol (IP) is the most ubiquitous protocol in the computer environment. IP over Ethernet specifies a great number of things in a short phrase. It is actually saying something similar to Sony protocol over RS-422. It says, "Let's communicate using IP over an Ethernet electrical/physical connection."

It is a common practice to stack protocols on top of each other. (See Figure 1.) Perhaps you have heard of the term *protocol stack*. This practice allows systems designers and engineers flexibility in exchanging components in computer systems without having to rebuild the system from scratch.

One common example of this is TCP/IP. This combination of acronyms stands for transaction control protocol (TCP) over Internet protocol on Ethernet. The application talks to TCP, which then packetizes information according to IP rules and sends the communications over an Ethernet electrical and physical connection. There are many protocols in the computer world. For now, let's focus on the most important ones, the Internet core protocols.

Applications from the user world will interface to the network using either user datagram protocol (UDP) or TCP (in some cases, both) running over IP. If the system connects to both Ethernet and ATM networks, there will be two physical interfaces in the server, one for each network.

Internet control message protocol

Internet control message protocol (ICMP) is primarily used to signal problems on the network. You may have seen messages such as "Network unreachable" or "Destination network unknown." These messages are displayed as the result of conversations between network devices that use ICMP.

The most common use of ICMP is to ping another computer on the Internet. While ping can provide a quick check to verify that a computer is connected to a network, you should be aware that many servers do not respond to ping requests for security reasons. ICMP is also used to transfer information between routers and to provide initial network information to diskless devices on a network.

Internet Protocol

IP is truly a core protocol of the Internet. IP's job is to get datagrams from one device to another using the

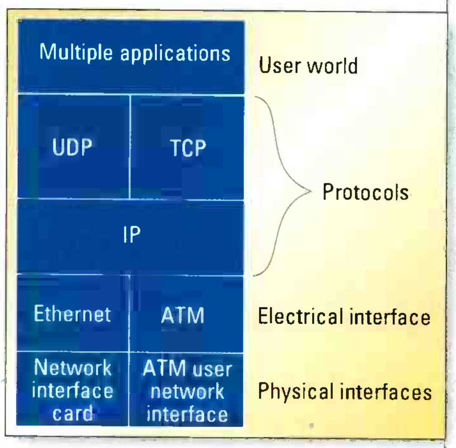


Figure 1. A typical protocol stack in a network server will contain both UDP and TCP running over IP.

addressing scheme for that physical network. It is the responsibility of other protocols to provide end-to-end routing information.

IP is low on the protocol stack, so it is closely related to the physical and

Protocol	Use
HTTP Hypertext transmission protocol	Used primarily by Web browsers, but increasingly used for the transmission and retrieval of files and other data
IGMP Internet group management protocol	Is the core multicasting protocol. Allows a single host to send out messages to multiple clients. Note that there are many other multicast protocols
POP Post office protocol	Check and retrieve mail on remote mail servers
SMTP Simple mail transfer protocol	Send mail through a mail server
SNMP Simple network monitoring protocol	Remotely monitor equipment on a network. May also be used to execute limited remote commands.
SSH Secure shell	Secure terminal emulation for use between clients (usually system administrators) and Internet servers
Telnet	A non-secure terminal emulation protocol for use between clients (usually system administrators) and Internet servers

Table 1. Common Internet core protocols

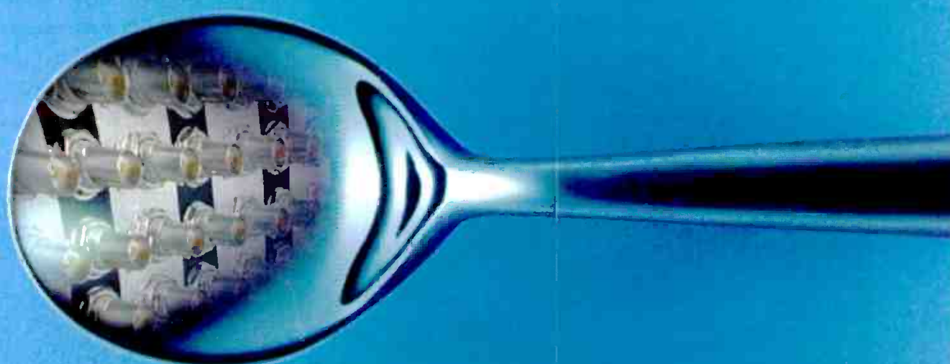
electrical media that will be used to carry the data. IP prepares data sent to it by higher protocols for transmission across a specific network, taking into account such things as the packet length, hardware addressing structure and how data should be split across multiple packets (if this is allowed).

These days, Ethernet is the dominant electrical and physical networking technology. But when IP was developed, there were several different and competing technologies available. Some of these are still in use today. IP works just as well with token ring and ATM as it does with Ethernet. It is the IP layer that accounts for these differences.

Address resolution protocol

Address resolution protocol (ARP) associates a particular IP address (e.g., 192.168.30.20) with a specific piece of hardware. Behind the scenes, routers build ARP tables that contain the IP address of a device and the hardware address of the device.

For Ethernet networks, the hardware address is known as the media access control (MAC) address. While IP addresses can be assigned by anyone, MAC addresses are assigned by the equipment manufacturer and are unique. Once the router knows the unique hardware address for a given IP



address, it can transfer the data to the correct device.

User datagram protocol

UDP is used to send datagrams from one place to another. Dictionary.com defines a datagram as, "A self-contained, independent entity of data carrying sufficient information to be routed from the source to the destination computer without reliance on earlier exchanges between this source and destination computer and the transporting network."

There is one particularly important thing to know about UDP. Nothing in the protocol guarantees that packets sent across the network will reach the other end. In fact, UDP explicitly does not check to see that packets have been received. UDP is a fire and forget protocol. As such, it has extremely low overhead.

You might wonder why this protocol was developed. After all, the whole point of having a network is to move data from one place to another. There are some cases where checking on the delivery of each packet is not practical. One example: In a multicast service, a server may send data to hundreds, or perhaps thousands, of clients. Checking with each client to see that every packet has been received would be prohibitive.

You should be aware that UDP packet size can vary, and in some cases UDP packets can be large. This brings up the issue of fairness. Large UDP packets may hog more of the available bandwidth, causing other traffic to suffer. For this reason, and for other security reasons, some system administrators do not permit UDP traffic to cross their firewalls. This can cause headaches for broadcasters who are using UDP to distribute multicast video over the public Internet.

If the network is congested, FTP senses this and adjusts its rate — fairly drastically!

Transaction control protocol

TCP is also used to send datagrams from one place to another over a network. One of the biggest differences between TCP and UDP is that TCP guarantees delivery of the data. TCP stamps each datagram with a unique sequence number. It then looks for the receiver to acknowledge that it received the datagram. TCP also implements a number of rate control mechanisms to deal with rate limits imposed by the receiver and with congestion issues on the network.

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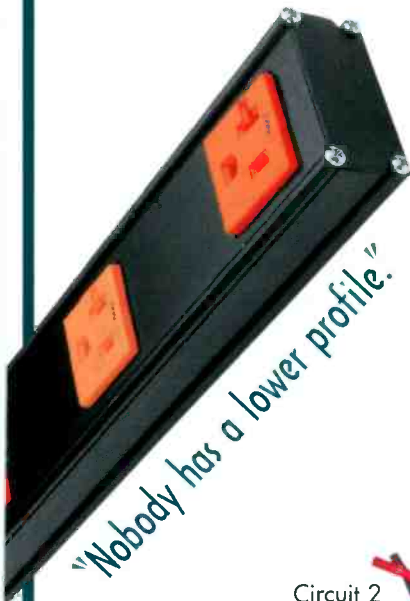

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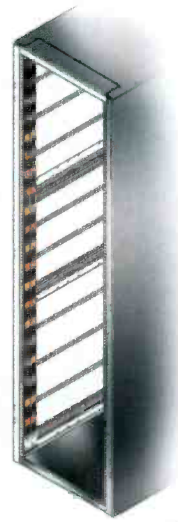

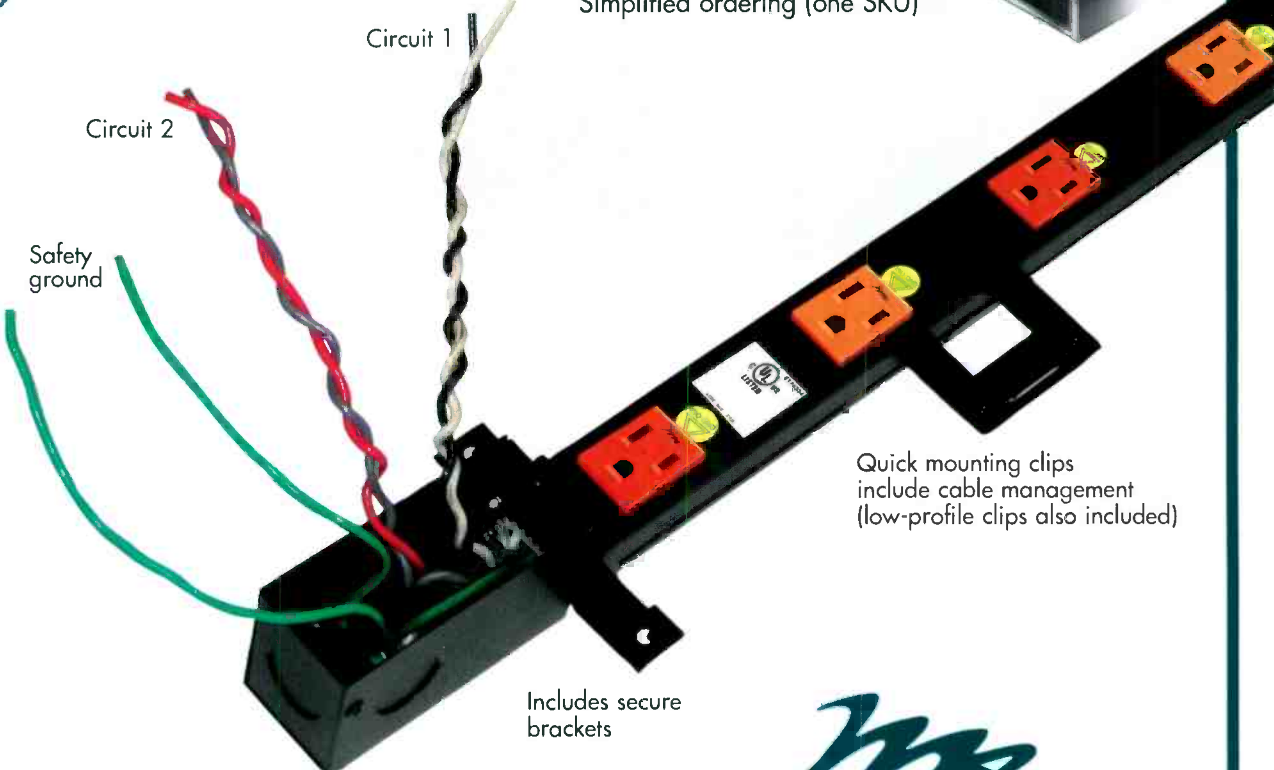

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TCP does one other unique thing besides handling lost packets. It reorders packets that have been received out of sequence. Remember that once a packet is launched onto the Internet, it is on its own, and there is no association between this packet and the one that comes before or after it. Packets can and do arrive in a different order from the order in which they were sent.

TCP almost always runs on top of IP, so the notation TCP/IP is common. Just bear in mind that TCP/IP specifies two separate protocols.

File transfer protocol

As the name implies, file transfer protocol (FTP) is used to transfer files across the Internet. FTP has some excellent features that make it an indispensable protocol. FTP handles lost packets and reordering. It also senses congestion on a link and employs automatic rate control to relieve the congestion.

That said, FTP has some characteristics that make it unsuitable for moving professional video files. First, many FTP applications have a file size limit of 2GB. Professional video files can be much larger than this, so this limitation can be a real problem. Second, FTP has rate control mechanisms that can interfere with transmission of large files.

If the network is congested, FTP senses this and adjusts its rate — fairly drastically! FTP responds to congestion by cutting its speed *in half.* If the congestion continues, FTP cuts its speed in half again. This continues until the transfer aborts due to timeout. If the session has not timed out and the congestion situation improves, FTP increases its speed, but it can take a long time (several tens of seconds) for FTP to get back to its initial speed. You can see this reduction in rate on a network traffic monitor as a stair step pattern. Unfortunately, in some cases, FTP's rate control mechanisms can limit throughput to a low level even though the available bandwidth is high and congestion does not exist.

Table 1 (on page 30) lists the acronyms and functions for some other common protocols you should be familiar with. Also, I strongly recommend that you read "Internet Core Protocols" by Eric A. Hall (O'Reilly). This is an excellent book on the subject and will give you much more detail on these protocols than I could possibly give you here. **BE**

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

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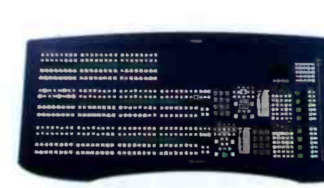

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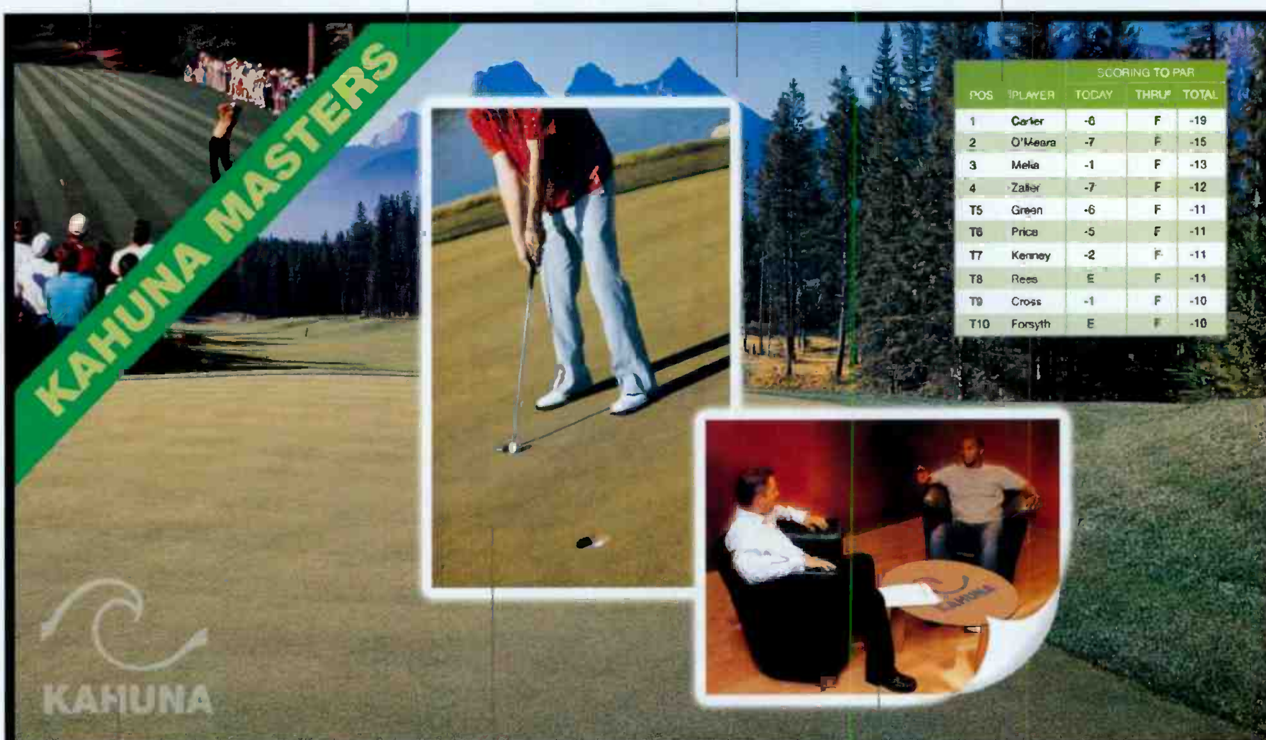
SD character generator output using FormatFusion and resize engine



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SD hand held camera shot using FormatFusion and resize engine

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Intelligent control systems

BY FRANÇOIS GOURVIL AND MARCEL SETIAWAN

In many television master control rooms and operating centers, operators are becoming overwhelmed with the quantity and variety of information they are exposed to. This is a direct result of having to control and monitor an increasing number of channels.

But it's not just a question of channel numbers. The content has also become richer, with more textual and graphical material. All these elements make the task of video monitoring more demanding.

The solution isn't simply adding more staff members. That's not a cost-effective answer. The solution lies in creating a more efficient, smarter control environment.

Broadcast equipment vendors have responded with radical new thinking about the role of the operator in today's mega-channel, content-rich environment. The solutions encompass both smarter control technology and new workflows. This fresh thinking is rapidly gaining ground and has proven especially appealing to the newer entrants to television playout from the telecoms sector.

Video monitoring and control over IP

One solution involves monitoring video images and signals over IP. In the past, some considered this method risky, even unreliable. Those concerns were based on the belief that packet networks were intended for data applications only. However, the increasing prevalence of IP, the reliability of high-speed IP backbones and the addition of IP connectivity to broadcast hardware is changing established views.

The growth of video monitoring over IP is driven by the reality that the technology can significantly reduce both infrastructure monitoring and operations costs, especially in distributed control environments.

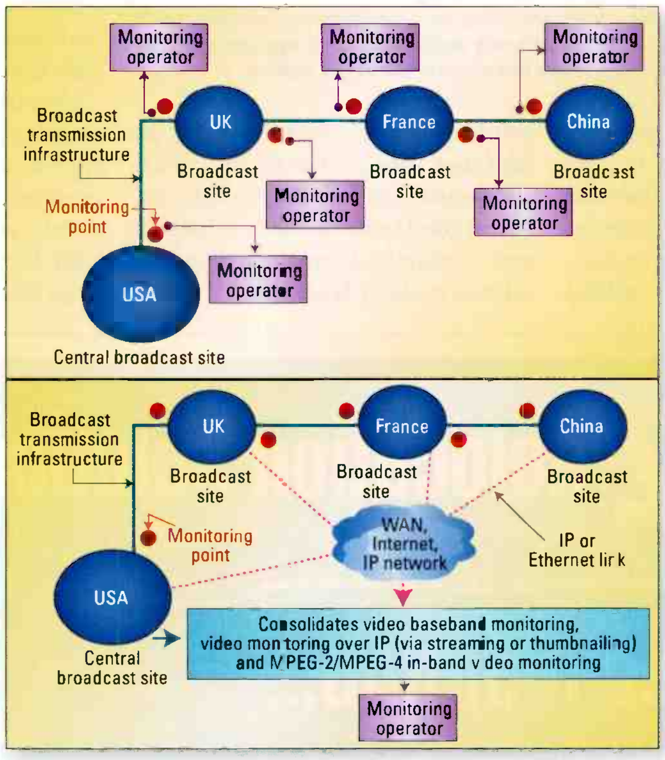

Figure 1. Monitoring over IP can eliminate infrastructure and staffing duplication.

Addressing the issues

Let's look at the problems inherent with traditional broadcast monitoring. In a typical environment, the control room operator monitors video images and signal parameters by directly tapping the video feeds at the baseband level, typically at the ingest or end points. These images are then displayed on a centralized video wall by multi-image display processors.

This approach makes sense when all the video feeds are located in the same facility. However, as the network grows, it becomes necessary to deploy these video monitoring facilities across multiple sites. This duplication means recurring investment in manpower, equipment and real estate. Furthermore, a distributed broadcasting environment requires tight coordination among all sites to solve problems in a timely manner.

Also, displaying all of the required video feeds simultaneously to all the facilities at the baseband level and duplicating network paths requires enormous transmission capacity. Therefore, this method is rarely used. This arrangement also prevents effective centralized system control and can make problem solving daunting and time-consuming, especially in larger systems.

In contrast, video monitoring over IP provides easy remote video monitoring in centralized and distributed broadcast environments. It avoids the need to duplicate technical monitoring personnel and equipment at each site, significantly reducing costs.

Using graphics-rich control systems

Another key aspect in improving network control systems has been the development of more visually rich control surfaces. Such displays provide an engaging and immediately familiar view of facilities, which allow easy tracking of signals throughout the playout path. These graphical views can be geographic, showing an overview facility status, or operational, providing more detailed information. In some new systems, 3-D graphics allow operators to navigate the facility as if they are walking around the equipment bays and review the system configuration from the desktop.

Streaming video of the signals at key stages provides operators with clear identification of video streams as they pass through the facility, which also assists with rapid fault diagnosis. Alarm conditions can be detailed and even customized based on operator skills or multiple languages.

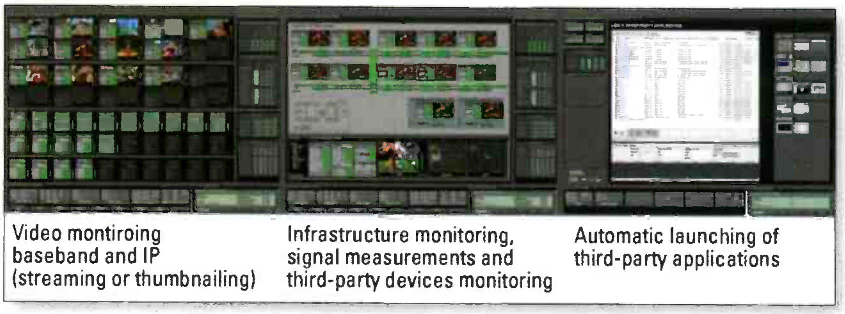

Figure 2. Integrated baseband and IP monitoring with third-party application integration can provide customized responses based on a variety of inputs.

Third-party integration

It is important to standardize control and monitoring interfaces so operators know what's happening and can appropriately respond. It's not efficient to have a desktop full of PCs, each controlling different devices. These need to be replaced by a single interface.

This interface should bring together multiple control solutions into one master environment. Control applications from multiple vendors are then hosted directly within this main control system. This allows a single keyboard and mouse to control multiple third-party applications.

More important, specific control applications can be triggered by alarms from an associated piece of broadcast equipment. The operator is immediately and automatically presented with the appropriate toolset to address that specific problem.

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Monitoring by exception is a method where ... the control room operator is alerted only if certain preset conditions are triggered.

Monitoring by exception

Perhaps even more radical is the concept of monitoring by exception. This style of operation was developed in response to the increasing size of playout systems.

In environments where the channel count is more than 50, the use of traditional monitoring schemes is not an effective way to accurately identify and correct signal faults. There are just too many channels for operators to keep track of. Asking operators to see and control more doesn't work.

Expanding television control rooms and operating centers to house wider and higher monitor walls with additional banks of computer monitors isn't the solution either. Experience shows that, beyond their attractiveness, large control rooms with displays conveying images and data from hundreds of TV signals typically lose their effectiveness because operators have difficulty assimilating all the information. With so many visual elements to monitor, they simply can't distinguish faulty signals from valid ones.

Even when errors are detected and acknowledged, the sheer complexity of the signal paths and the large number of possible sources or errors can result in embarrassing delays before a valid signal can be restored.

Monitoring by exception is a method where the monitoring system continuously monitors all video and audio signals and the control room operator is alerted only if certain preset conditions are triggered. The network operator can set up logical alarm groupings, alarm filtering and dynamic alarm profiling to define preset alarm conditions that offer maximum flexibility.

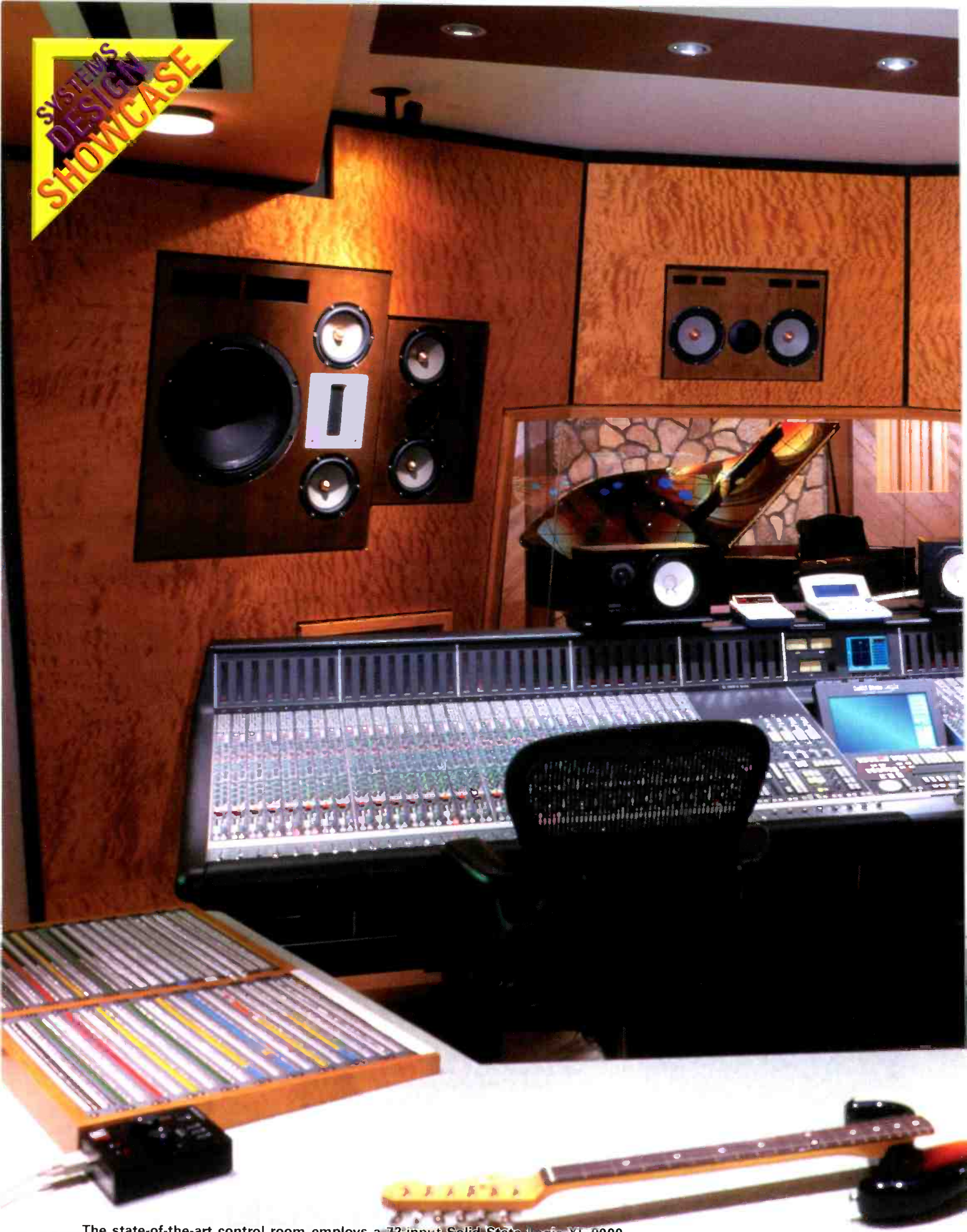
In essence, exception-based monitoring allows control room personnel to focus their attention on signals that require their input by filtering signals that are valid out of view. In addition, this scheme provides detailed end-to-end views of the signals that are in error so rapid resolutions are more likely.

While this concept is still relatively new to broadcasting, it has been used in areas as diverse as information technology, database management and business metrics, as well as in various industrial and security applications. Although diverse in nature, all these applications are similar in that the amount of data that must be monitored is large and that, in most cases, only a relatively small subset of elements will show errors or deviance from set thresholds at any one time.

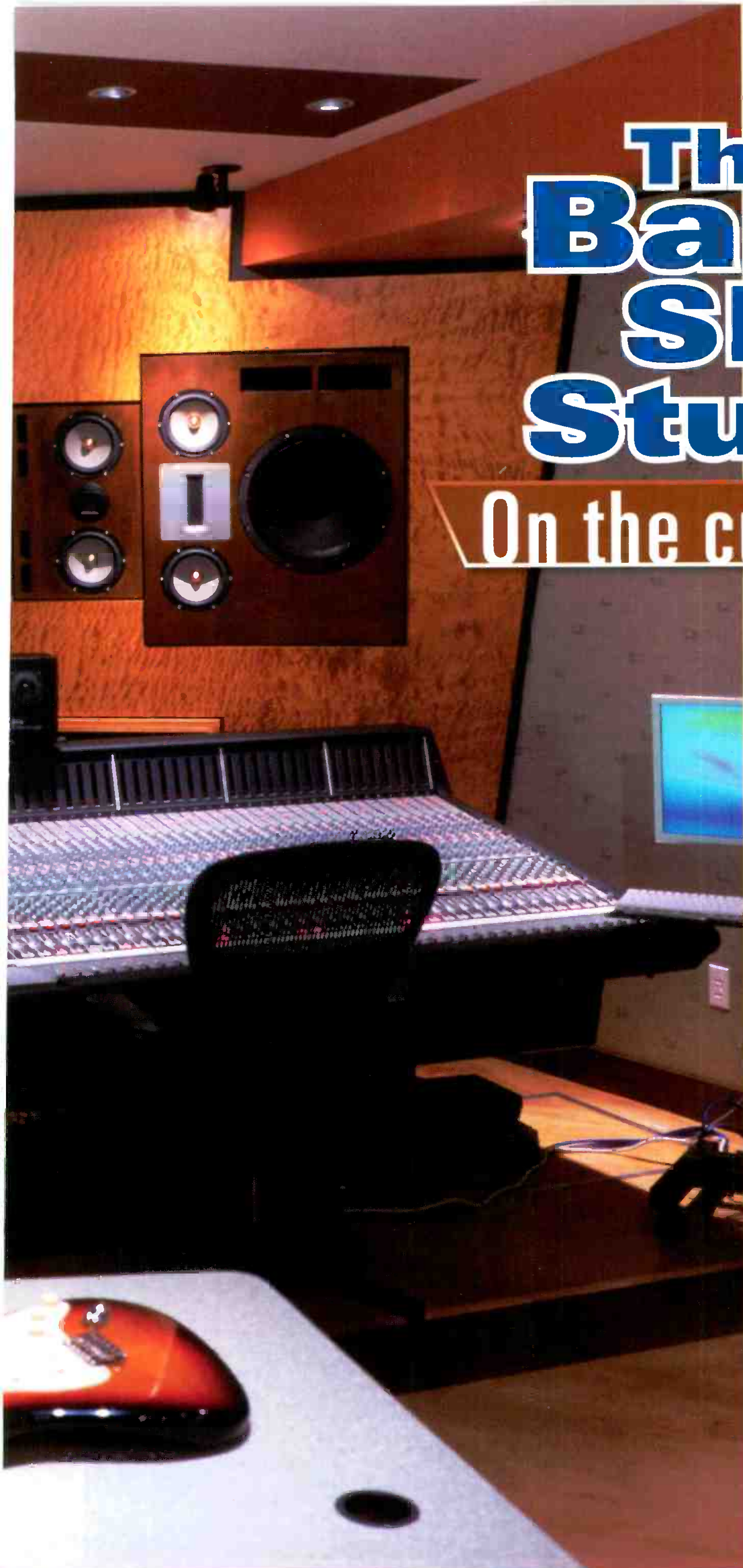
In a large-volume broadcast playout environment, this method has been proven to reduce the mean time to repair and assist in catching problems that would be missed using the traditional method of human visual monitoring.

Taken together, these new developments in control and monitoring can bring a much higher level of intelligence to the television station control system. Perhaps just as important, the technology brings real financial benefits to broadcasters as they further expand the number of channels their staffs must handle. BE

François Gourvil is product manager of monitoring, control and new media, and Marcel Setiawan is proposal and project manager for Miranda Technologies.



The state-of-the-art control room employs a 72-input Solid State Logic XL 9000 K Series SuperAnalogue console, custom Griffin loudspeakers and a Pro Tools|HD mix system. Photos courtesy George Roos Photography.



The Barber SHOP Studios:

On the cutting edge

BY SUSAN ANDERSON

Three years ago, Scott Barber and Mark Salamone were looking for a place to open The Barber Shop Studios, their recording and production facility. Location was important to them. Salamone wanted the studio to be located in a church, for the sound quality and vibe that churches offer. Barber was looking for a facility near a lake, which he felt would provide a relaxing and creative environment for recording artists.

In addition, they didn't want to go

> Their goal was to provide New York City service and style in a country setting.

into Manhattan, where it's crowded and space is at a premium. Their goal was to provide New York City service and style in a country setting.

After just three weeks, their search was over. They found an unoccupied stone church on the shore of Lake Hopatcong in New Jersey, just 45 minutes outside of New York City. Built in 1911, the church has undergone several changes. It first served as the town's church for 60 years, until the local congregation outgrew its size.

Next, it became a dinner theater,

where national entertainers such as Rodney Dangerfield performed. And finally, it was transformed into the Lighthouse Disco, where bands such as the Ramones, Cheap Trick and Twisted Sister played.

The church's unique history appealed to Barber and Salamone, and they were eager to continue its rich renaissance.

Out with the old, in with the new

But first, the building had to be renovated. Orchestrating the two-year process was acoustic design engineer Fran Manzella of Frances Manzella Design. Manzella gutted the interior down to the dirt floor and started from scratch.

The toughest obstacle was waterproofing. The walls in recording studios don't touch. So, in the case of The Barber Shop Studios, there is about a 4in gap between the stone and the first wall. If water gets in there, mold will start growing, and then the entire facility would have to be torn down. To overcome this, a giant trench had to be dug and cemented, and sump pumps were installed.

Once that hurdle was overcome, the rest of the renovation went smoothly. Manzella integrated cutting-edge equipment into the 100-year old building.

The first floor of the 6000sq ft facility boasts a reception area and lounge with a 5.1 sound system and a plasma screen TV. Also on the ground level are the machine room and Pro Tools 1, a 5.1 digital audio suite. The suite is built on a floating floor and features an isolation booth, HD rig and Genelec 8050A surround system.

The second floor includes a producer's lounge and the A Room, which is the main control room. Also built on a floating floor, the A Room features a 72-channel Solid State Logic XL 9000 K Series SuperAnalogue console, outfitted for surround sound mixing. The console was selected because it gives the studio the advantage it needed for 5.1/7.1 mixing, which is ideal for laying audio into a film. The room also includes a Pro Tools|HD mix system. Barber and Salamone were eager to integrate the analog console with the digital Pro Tools in order to provide "the best of both worlds."

A 52in flat screen rises up to the

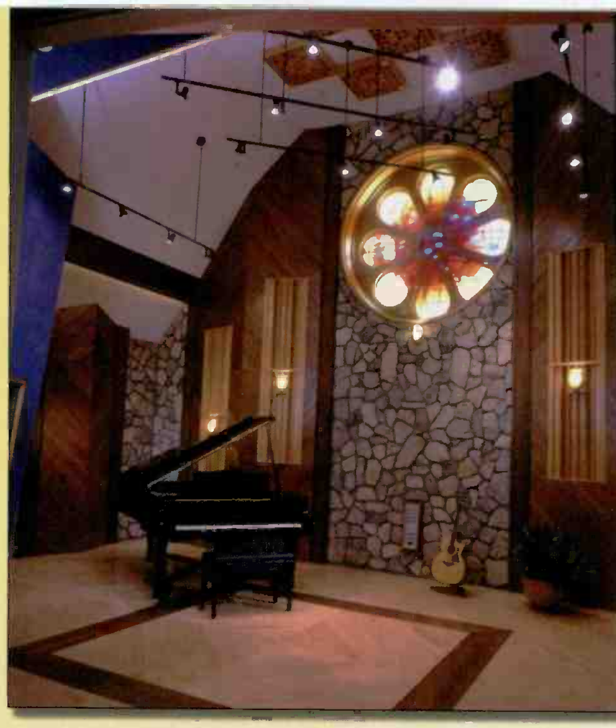
Technology at work

SSL XL 9000 K Series SuperAnalogue console
Griffin custom 5.1 monitors
Mid- and near-field monitors:
- Genelec 8050A
- Tannoy AMS-12
- Yamaha NS-10

Effects and plug-ins:
- Eventide
- Sony Oxford
- Waves

Recorders:
- HHB CDR 830 Plus CD recorder
- Mark Spits-modified ATR with Dolby SR
- Panasonic SV 3800 DAT recorder
- Pro Tools
- Studer A827 24-track

Microphones (almost 100):
- AKG
- Audio Technica
- Neumann
- Royer
- Sennheiser



The live room is built on a floating floor and features cathedral ceilings optimized for the best possible sonic performance.

back of the board at the touch of a button, so users can start mixing to a film and get the visual together. Other equipment that the A Room employs includes custom Griffin studio monitors and Griffin G2A 5.1 surrounds, as well as new and vintage mics and outboard gear.

The second floor also houses three isolation booths and a two-story live room. A live room was necessary in order to create orchestral music for film and had to be large enough to hold a 25-piece orchestra. Like the Pro Tools 1 and A Room, the live room is built on a floating floor.

The third floor is home to Waffle Makers Productions. Here, The Barber Shop offers artistic and creative development, audio and video production, and product promotion. Additional amenities include a full-service marina and Italian restaurant, so everything's in-house. Artists can enjoy a fine meal and relax by the lake and then return to editing or shooting a video.

Right on course

The Barber Shop Studios celebrated its grand opening on June 3. It provides full-service analog and digital recording and post-production, which includes 5.1 and 7.1 digital recording, editing, mixing and master services. Another renaissance of the 100-year-old stone church is now complete. **BE**

Susan Anderson is managing editor for Broadcast Engineering *and* Broadcast Engineering World *magazines.*

Design team

Fran Manzella, Francis Manzella Design
Jack Kennedy, wiring design
John Klett, wiring design
Pompton Mills, woodwork
Carroll Construction

SYSTEMS DESIGN SHOWCASE

CBC/Radio-Canada's MOVE TO CENTRALCASTING

BY CBC/RADIO-CANADA BROADCAST ENGINEERING GROUP

CBC/Radio-Canada is the national public television and radio broadcaster for Canada, transmitting programming in English, French and eight aboriginal languages to the country's 10 provinces and three territories. During the last 30 years, Télévision de Radio-Canada, the French television network of CBC/Radio-Canada, has employed automation systems to take advantage of the efficiencies they afford.

Télévision de Radio-Canada has expanded its television automation operations twice during this period to keep up with reconfigurations of the network. In 2004, as the network continued to evolve and serve the country's diverse French population, the television operation moved to centralize ingest, storage and transmission in Montreal and revamp its facility. Getting there has been an interesting journey.

Photo: The main network transmission control room at CBC/Radio-Canada is the hub for the centralcasting of content to be distributed to CBC-owned and operated stations and local affiliates spread across Canada. The group moved toward centralization in 2000 with the assistance of Encoda Systems, now Harris.

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CBC/Radio-Canada

TURNS TO CENTRALCASTING

The road to centralcasting

In 1975, CBC/Radio-Canada installed two three-channel automation systems from Ampex. The three original French channels were for the local Montreal transmitter and French Satellite Networks 1 and 2; the latter two covered the Eastern and Western Canadian provinces. The second system fed the local English transmitter and one satellite network.

At that time, CBC/Radio-Canada was one of the largest broadcasters in the world in terms of area covered and had a mandate to provide the country with local transmission in all towns and cities with populations of more than 500. This was, of course, the antithesis of centralcasting. Content was distributed to regions, each with its own master control and the ability to do local production insertions.

> The group saw its first tangible sign of centralcasting's benefits: an increase in efficiency.

In the mid-1990s, CBC/Radio-Canada opted for an automation system that would give greater flexibility and reliability from Montreal. In 1997, the Ampex system was replaced by Version 1 of Drake Automation's multi-channel automation system (D-MAS). That rough period of integration of a fairly young system provided many challenges, but with help from Drake's implementation team and the Acura Technology Group (which was Drake's local distributor at the time), the system was configured to meet the network's needs. This model remained in place until 2000 when the group decided to reconfigure the networks to broadcast all Western Canada's programming from Montreal via a centralcasting model.

After various channel shuffles, including the transfer of English services to a centralized system in Toronto, the D-MAS A7500 (Version 2) system controlled eight on-air channels: the three original French channels, ARTV (a 24-hour art and entertainment channel) and four channels for Western Canada delay. With this change, the group saw its first tangible sign of centralcasting's benefits: an increase in efficiency.

Then in 2002, the broadcaster decided it was time to fully centralize its programming and provide room for future expansion. A facility was built in Montreal to serve the entire country.

This new operation officially went online in December 2004, combining master control, ingest and playout in a single facility. The group found that 18 master control and on-air booth operators were able to handle the many scheduling tasks that had previously required 31 operators. There was no question that this was a far more efficient operating model.

More than familiar with the process of centralizing its facilities, CBC/Radio-Canada decided the time had come to find an automation system that would sustain the group for more than six years and have the capacity for at least 20 channels. In this upgrade, the broadcaster wanted a system that would offer further operating cost efficiencies as it continued to expand the automation of live and recorded programming on multiple channels. The group also needed continued integration with corporate traffic and advertising sales automation protocols as it aired programs and spots across the network and locally in each region. The group also wanted a solution that would provide HD transmission capability in the near future.

After looking at the difference in price and the man hours required to upgrade the existing automation system or to install a new system, the group decided to stay with Encoda Systems (which had purchased Drake and is now part of Harris). The transition to Version 3 of the system (now called the D-Series by Harris) proved to be much smoother than the previous migrations from the Ampex system to D-MAS Versions 1 and 2.

The first step was to migrate the fully playlist-driven channels to Version 3 software, then gradually migrate the live channels (i.e., local antenna and network channels) to the new system. In order to expand the channel count, Encoda took the ingest function out of the A7500 and added the A6800, a complete and separate ingest system. This left the A7500 as the dedicated playout automation system.

CBC/Radio-Canada is now operating a solid centralcasting operation, and the benefits can be seen in two areas: the increase in channel capacity and the need for only minor staffing additions. The network has expanded to 15 on-air channels,

The broadcater uses Harris automation computers (shown above). Content that is redistributed to regional local transmitters across the country contains local regional branding, logos and crawls, which are inserted from branding systems in Montreal.

including two new HD channels for Montreal and Toronto and integrated master control operations with the ingest functions. Even with

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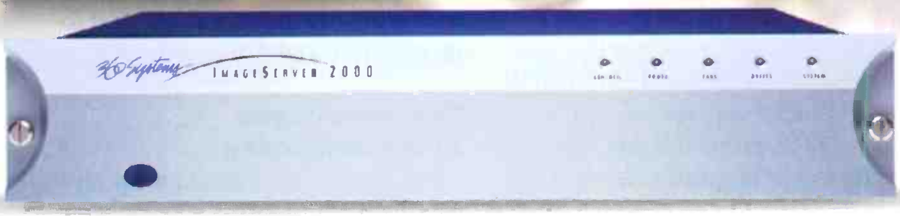

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this increase, the group believes the staffing level will be minimally impacted as it expands to more then 20 channels in the future.

How centralcasting works for content

In describing how the centralcasting model is most effective, let us look at the transmission of local news. Original content for the early evening new programs is produced by regional stations and fed back live to Montreal via CBC/Radio-Canada's proprietary satellite channels (with the exception of Quebec City, Moncton and Ottawa, which use land-based fiber lines). Local branding and interstitials are inserted in Montreal, and then programming is redistributed to regional local transmitters across the country.

The A6800 and A7500 shown here are part of the Harris D-Series automation system. The A7500 manages the insertion and playout of interstitial events, such as local commercials and CBC/Radio-Canada promos.

Equipment List

Grass Valley:
- 256x256 router
- M2100 switcher

Harris D-Series V3
ImageStore 2
Miranda Kaleido processor
Omneon server
Softel Swift TX
Sony:
- HDCAM
- IMX

Vertigo CG and XMedia Server

Regional promos and commercials are recorded on tape on any of six Sony VTRs prior to ingest. The tape is reviewed for quality and then digitized on the Omneon server via the A6800 ingest system. The insertion of all interstitial events, such as local commercials and CBC/Radio-Canada promos, are then managed by playlists residing on the A7500 system.

Local regional branding, logos and crawls are added using an image Store and Vertigo CG per channel via secondary event fields in each scheduled event. Once programming is aired, the system produces confirmation logs that are fed back to the broadcaster's proprietary traffic system.

The D-Series V3 automation system interfaces with an assortment of 38 Omneon server channels (for on-air and N+1 playout, confidence and utility), four Sony IMX SDI playout VTRs, six Sony IMX SDI ingest VTRs, two Sony HDCAM playout VTRs, 15 branding systems (ImageStore 2 and Vertigo CG), 15 channels of a Softel closed-captioning system, 32 virtual UMDs via Miranda Kaleido processors, and a Grass Valley 256x256 router and M2100 switcher. Later this year, the group plans to add a new HD server to feed the present two HD channels, as well as to provide capacity for future HD channels.

Within the same broadcast center, CBC/Radio-Canada also produces multiple live information and variety shows, as well as two daily newscasts and top-of-the-hour headline updates. This programming is fed to the regions with local commercials inserted. The approach is similar to that used for newscasts but with all content transmission originating in Montreal. The physical facility also houses production and broadcast studios for RDI, the French 24-hour news channel.

CBC/Radio-Canada chose its model for centralcasting after consideration of various scenarios. Due to the live-to-air nature of the news and variety operations, the group did not want to go with a store-and-forward model.

The advantages of centralcasting

The move to centralization has given CBC/Radio-Canada operations a

> Local branding and interstitials are inserted in Montreal, and then programming is redistributed to regional local transmitters across the country.

true schedule-driven centralized — but flexible — presentation operation that allows for synchronous regional breakaways. It is now better able to support multiple time zones from Newfoundland in the east to British Columbia in the west.

Through centralcasting, the group also improved broadcast quality and consistency across the various channels, as well as the capacity to apply uniform, high-level branding to CBC/Radio-Canada's national programming, while still allowing local branding initiatives. BE

The CBC/Radio-Canada broadcast engineering group in Montreal works to bring diverse regional and cultural perspective into the daily lives of Canadians.

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ENG central receive antennas

BY GEORGE MAIER

Regardless of what they are used for, antennas have a tendency to remain in place while the equipment at the other end of the transmission line changes several times over the life of the antenna. This has certainly been true in broadcast ENG, where the 2GHz relocation and the change to digital have suddenly put the spotlight on central receive antennas and their control systems, neither of which have changed substantially in the last decade.

While they continue to provide service in today's analog environment, the digital ENG environment of tomorrow is a new paradigm, with new rules. A surprising number of ENG receive sites have been in service for decades with the same antenna and LNA and have performed satisfactorily with occasional maintenance. Depending on their age and configuration, some of these existing antennas will require replacement, while others can, and will, be upgraded. With the first installation of new equipment about to begin, there is a fair amount of excitement about the new solutions that ENG antenna and controller upgrades and replacements will bring to broadcasters.

LNAs have improved

Beginning in 1999, when the first COFDM systems were being placed in service, a new set of operational problems began to unfold. When the AGC was peaked, the signal occasionally disappeared and a strong AGC was not always a predictor of good signal quality. These problems were traced to a need for new digital signal metrics and better LNAs.

A strong digital signal can cause a cascading set of problems, beginning with LNA overload. An analog signal may survive some amount of compression, but a digital signal cannot. In spite of robust error correction in COFDM systems, nonlinear amplifiers can cause bit errors beyond the demodulator's ability to correct them, which will cause decoding failure (e.g., fade to black). To an experienced analog ENG operator, it is completely counter-intuitive to think that a lower signal level will produce better results, which is exactly the case in this instance.

To combat this, newer LNAs have much higher third order intercept points (IP_3) that raise the compression point to extremely high input levels. RadioWaves, for example, offers a 2GHz LNA with an IP_3 of +37dBm.

With LNA linearity greatly improved, LNA gain control is the next issue — and another tool in avoiding overload. An ENG central receiver normally includes its own AGC system; how-

The digital ENG environment of tomorrow is a new paradigm, with new rules.

ever its effect is limited to the dynamic range of the receiver. Even though the LNA performance may be improved, too strong an incoming signal may still overload the receiver front end, unless some method of gain reduction can be easily accessed and adjusted.

Some real-world examples include NSI, which now offers its LNA with a continuously variable attenuator, and RadioWaves, which has an LNA that activates or deactivates amplifier stages in 5dB increments. Both MRC and Nucomm central receivers provide an AGC output voltage that may be used by the antenna controller to automate the gain adjustment process.

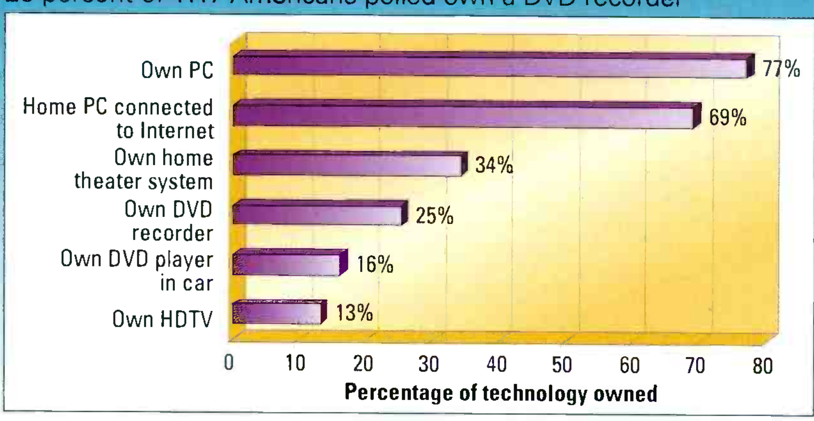
New filters and switching make the difference

The Nextel relocation philosophy is to have everyone in a given market upgrade or replace their equipment to meet the new 12MHz channel

FRAME GRAB A look at the consumer side of DTV

Movie consumption by technology in 2005

25 percent of 1117 Americans polled own a DVD recorder



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requirements and begin operation on the old band plan: "narrowed in place." During this phase, stations have an opportunity to check out their new gear on familiar turf with regard to frequencies. At some predetermined time, all stations in that market will change to the new band plan. The success of this phase is dependant on being able to switch in the correct filter combinations at the right time and keep them that way.

Most ENG antennas have a band filter or channel filter in front of the LNA to avoid out of band or adjacent channel interference. These will have to be replaced to meet the new plan; however, the existing band and channel filter capability must remain available until the changeover takes place. In addition, new PCS and AWS band stop filters must be added to further attenuate strong signals in adjacent bands that may be present at ENG sites as Nextel and others move into their new spectrum.

If the antenna is not being completely replaced, antenna vendors agree that it is more cost-effective to replace the entire feed, including filters, LNA and switches, rather than replace individual components while strapped to a tower leg. This assures that a complete, factory-tested subassembly will be put into service from the beginning.

With the improvement in LNA and receiver dynamics, channel filters may or may not continue to be used as much in the future. Given the complexity of switching multiple sets of channel filters, and given the improved signal handling capability of LNAs, it may be worth considering standard bandpass filters at the antenna, with switched accessory channel filters in the same rack as the receiver.

Solving many problems

New and updated ENG antennas, central receivers and their associated digital demodulation equipment require considerably more control sophistication than previous generations. In addition to supporting traditional functions, like panning, azimuth presets, receiver frequency and LNA functions, the new breed of controller must also support additional filter and LNA switching, digital diagnostics, decoder control and digital signal acquisition tools.

Several companies have given considerable thought to the myriad of combinations and permutations that must be accommodated to support customers who will mix and match antennas and receivers to suit their individual needs. Some microwave vendors have stayed with parallel control for basic receiver functions to remain backwards compatible with older controllers, while moving to a serial interface for new digital demodulation equipment. Others feature a full serial interface but offer a parallel conversion option if required. This is one area that all station engineers should research carefully before the quote process gets underway.

The biggest changes are in digital signal acquisition and quality monitoring.

The biggest changes are in digital signal acquisition and quality monitoring. As discussed earlier, the advent of COFDM brought with it a new set of problems with respect to aligning a D-ENG path for best video performance. Improvements in LNA and receiver technology do help, but are pieces of a larger puzzle.

Some microwave vendors have all developed their own unique set of digital signal metrics that can be displayed on ENG control screens. These metrics may include individual readouts of AGC, BER (pre- and post-Viterbi), MER and recovered SNR, plus a composite quality monitor that combines some or all of the individual metrics. Early users complained that the initial display implementations reacted too slowly to changing path conditions, but recent releases have solved the issues by using more real time information versus processed information.

In addition, several new tools have been added to augment the real time metrics. One is a spectrum analyzer display that monitors the ENG receiver, and the other is a histogram that provides a visual trend line with variable persistence.

Nucomm has integrated a spectrum analyzer display into its central receiver to allow a savvy operator to see the 2GHz band conditions as they exist on channel, as well as above and below the desired channel. MRC has announced a display option with similar capability in conjunction with the Troll Systems controller. Once a shot is set up, the spectrum can be constantly monitored to make sure that it stays clean as air-time approaches.

MRC's new histogram display provides a visual method of monitoring link confidence in an easy-to-interpret graph that combines multiple metrics on a weighted basis. The histogram sampling time can be easily adjusted to suit varying conditions.

For example, a 1-second refresh rate gives a news director the ability to see rapidly changing trends on an ENG path just before or during air-time. A longer sampling time can be used to provide insight into long-term trends for extended remotes. As time goes on, we can expect to see more developments in the way of digital tools.

When you are ready to gather quotes for your upgrades, it is clear that a greatly improved antenna system will be one of benefits of the 2GHz relocation process. Regardless of what you did in the past, it would wise to look at all of the new antennas, controllers, digital tools and interface options carefully before making a choice. Who knows how long these central receive antennas will have to function? BE

George Maier is the founder of Orion Broadcast Solutions.

MANAGING AUDIO LEVELS

BY JIM STARZYNSKI

Maintaining the accuracy of the original acoustic energy is critical to the recording and transmitting of audio signals. As this energy is transformed electrically and sampled digitally, the goal is to maintain the integrity and exactness of the audio in all of the forms it may take as it moves within a modern TV infrastructure.

Passive or active, analog or digital, today's audio devices all have a finite capability to handle the maximum amplitude of the audio signal. If this capacity is exceeded, the resulting audio — due to a failure of the electronics, current limitations of the circuit or exhaustion of available bits — will not match the original audio and will be distorted.

Establishing and maintaining the proper relationship of the signal amplitude to the minimum and maximum capabilities of the equipment and storage medium in every step of the signal chain is essential for quality audio. Maintaining accurate levels during A-to-D conversions and always tracking perceived loudness (and how it is affected by level changes) must be done to safeguard signal accuracy. Identifying the critical steps in the signal chain and employing proper signal measurement practices to mix and distribute program audio is key. Problems can arise when analog signals are used in a digital plant if the differences in level characteristic and scaling are misunderstood and enough care isn't taken to the process of handling both types of audio signals.

To master the challenges of today's hybrid analog-digital world, let's review the terms and explore the practices that are fundamental to maintaining a modern TV facility's audio.

The reference level establishes a nominal amount of signal at an understood calibration point that is well above the noise floor of the signal and well below the overload point. This is the comfort zone. This level and the amplitude just below is where the majority of the audio signal should be mixed, transmitted or recorded.

The area above the reference level but below the maximum amplitude or overload level is referred to as headroom and is needed to maintain undistorted recording or transmission of the fast peaks of the audio material.

The entire area from the noise floor to the recording or transmission overload level encompasses the dynamic range of the medium or electronics. Dynamic range is measured as a ratio in dB, and its span varies from system to system.

Measuring analog

Contemporary analog voltage measurement levels are in dBu. dBu is used when an audio voltage is connected to another circuit that does not reduce the voltage of the original signal. These bridging circuits are the opposite of older matching circuits that required a signal to be loaded down by the destination devices for proper level. Matching circuitry was given up for the most part in the '70s and '80s,

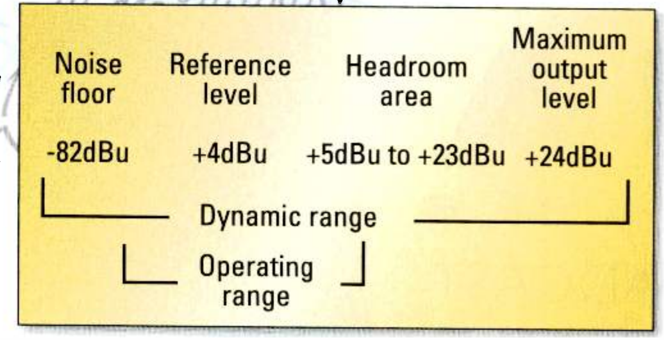

Figure 1. The typical levels in analog voltage measurement

giving way to the simplicity of bridging circuits that have low source impedances around 60Ω or less and high load impedances that are typically 10,000Ω or more. Maintaining a ratio 10 times or higher of load impedance to source impedance bridges and does not load down the circuit.

dBu represents the level compared with 0.775 volt RMS with an unloaded, open circuit source. (The "u" in dBu stands for unloaded or unterminate. It is a voltage that is not related to power by an impedance.)

dBm represents the power level compared with 1mW. This is a level compared to 0.775 volt RMS across a 600Ω load impedance.

Analog operating levels and the the VU meter

A typical noise floor measurement for a studio analog mixing console with a single channel routed to program out is about -82dBu or 86dB below the +4dBu operating level. We frequently use 0VU on the meter scale to actually mean +4dBu. (See Figure 1.)

John Woram's "Recording Studio Handbook" explains this as "A carry-over from the earlier days when meter construction was difficult and additional resistance was necessary for accuracy. This resistance loaded down the meter by 4dBm and therefore 0VU was actually +4dBm. Rather than redefine the zero reference level, it was considered expedient to leave 0dBm at 1mw across 600Ω, with the understanding that 4dBm above this value would correspond to a zero meter reading."

Many modern VU meters are adjustable but may read 0VU with a signal of +4dBu applied.

Broadcasters still use this convention today for analog circuits, including mixing consoles, distribution amps and many signals that interface with telephone company circuitry, even as carriers move from analog to digital. Analog inputs connecting to digital multiplexing devices frequently operate with a +4dBu reference level.

This audio signal, combined with video, feeds an encoder with A-D conversion, establishing an audio-video digital bitstream for carriage to the destination. This type of signal path is frequently used for studio-to-transmitter links as land-based fiber continues to be chosen over microwave for getting the studio's signal to the transmitter site.

Headroom's at the top

Headroom, as mentioned earlier, is defined as the amount of signal handling capacity above the reference level but below the specified level that causes overload distortion of the equipment or medium. Frequently, 20dB of available headroom is desirable for all equipment or storage media to handle the fast peaks an operator could not be expected to control. This provides a safety margin before the onset of distortion. Therefore, the maximum output level of a piece of broadcast gear using this example is +24dBu. (+4 = operating level plus an additional 20dB). Frequently, broadcast analog circuits have a greater margin and exceed this example by several dB.

Carrying over to digital

It's easy to understand a correlation of the analog signal level to the digital signal level by going number-by-number or level-by-level. See Figure 2 for a typical audio plant with a –20dBFS operating level calibrated to +4dBu analog.

Decibel full-scale (dBFS) is a unit of measure for the amplitude of digital audio signals. It is critical to understand that though digital and analog signals have similarities, their characteristics differ significantly. 0dBFS occurs when all the binary digits (bits) making up the digital signal are on, or read as 1s and not 0s in computer talk.

All of the bits available to make up the signal have been used at this finite point and no additional headroom exists. Trying to increase the level simply doesn't work and causes immediate distortion.

Analog signal level	= VU scale	= Digital signal level	
-7dBu	-11VU	-31dBFS	
-3dBu	-7VU	-27dBFS	← Typical dialnorm level
0dBu	-4VU	-24dBFS	
+4dBu	0VU	-20dBFS	← Reference level
+8dBu	+4VU	-16dBFS	
+12dBu	+8VU	-12dBFS	
+16dBu	+12VU	-8dBFS	
+20dBu	+16VU	-4dBFS	
+24dBu	+20VU	0dBFS	← Overload point

Figure 2. Analog operating levels and their relationship to the VU meter and digital signal levels

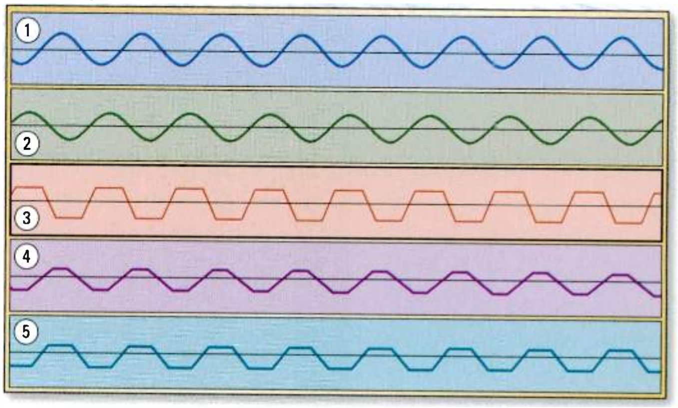

Figure 3: Top to bottom:

1. Original 1kHz source tone at 20dBFS/+4dBu reference level.

2. Same tone running through analog equipment attempting a gain increase 3dBu over the clipping point. Notice minor flattening of the waveform.

3. Same tone running through analog equipment attempting a gain increase of 6dBu over the clipping point. Notice more severe flattening of the waveform

4. Same tone running through digital equipment attempting a gain increase of 3dBu over the clipping point. Notice more severe flattening of the waveform than the analog signal at this level

5. Same tone running through digital equipment attempting a gain increase of 6dBu over the clipping point. Notice more severe flattening of the waveform.

Please note: These waveforms are intended for illustration purposes only.

The digital scale reads in negative numbers with louder, higher amplitude signals moving from a negative number closer to zero. This may be both confusing and helpful. However, if you think about the concept of a signal's headroom and apply a digital level reading to it, you can instantly determine the amount of headroom that's available for your measured digital signal. In fact, you are creating it. An example would be a digital level signal of -20dBFS. It has 20dB of headroom because digital overload occurs at 0dBFS, a signal 20db louder than -20dBFS and so on for -18dBFS, -16dBFS, -12dBFS, etc.

Another major difference that should be noted is at the point of digital signal overload at the 0dBFS level. Should an analog signal reach its maximum amplitude capacity (as illustrated in Figure 3), distortion will creep into the signal, most likely at a gradual and perhaps indistinguishable rate, until the distortion is audible after initial overload is reached and then exceeded. This process is different and more forgiving to the ear than reaching digital overload at 0dBFS.

When an unprocessed digital signal clips at this level, distortion is immediately apparent. Based on the 1kHz tone used in Figure 3, we can see an immediate distortion of the waveform that produced severe ringing of the audible signal. As we raised the digital signal in our tests even higher, it began to oscillate erratically as the circuit continued to fail. This may have been due to the specific characteristics of our digital workstation trying to operate at this level.

Digital signal processing circuitry may include analog saturation modeling, which is a form of processing that simulates the familiar analog clipping sound and is intended as a safeguard against ruinous digital clipping.

Although it varies from facility to facility, it's helpful to use digital scales when mixing and recording digital signals. This practice introduces and constantly reminds the engineer of a different digital — not analog — measurement standard and the different digital signal characteristic that accompanies it.

Just as critical as the digital scale is the proper meter that can quickly react to peaks and alert the operator to where the signal is in relation to 0dBFS. (See Figure 4 on page 68.)

U.S. broadcasters may typically use a digital reference level of -20dBFS as a plant standard and direct carryover from an analog reference level of +4dBu. This is a continuation of providing 20dB of headroom for the circuit with the reference 20dB below the system maximum as stated in SMPTE Recommended Practice -155-1997.

However, this may vary from facility to facility and especially so from country to country. European EBU Technical Recommendation R68-2000 states that an alignment level of -18dBFS is to be used for reference, a level 18dB below the maximum possible coding level.

Using reference tones facilitates the accurate transition from one standard to another. This practice enables setup of standard house levels and headroom in a plant — no matter what the origin of the signal or where the facility receiving the signal may be.

Most important is calibration all the way through the signal chain and the need to adhere to the identified reference, headroom and overload points and their indicators. Remember, the brick wall happens at 0dBFS no matter what, and distortion isn't pretty.

Enter DTV, DVD and Dolby Digital

Understanding dialog normalization (dialnorm) and how it works is critical for completing an explanation of digital audio levels in today's world of DTV and DVD.

Dialnorm is one of 29 metadata parameters that are part of the Dolby Digital bit stream required for all ATSC DTV streams and worldwide DVD audio. Dolby AC-3 is the term identifying the codec for this technology.

Dolby Digital's LM-100 loudness meter measures subjective loudness of dialog within programs.

Metadata is steering information that is encoded with the audio when it's bit-reduced by Dolby Digital. Metadata

is essential data that controls a home decoder to do many things, such as turn on the proper number of channels (e.g., 5.1 or two-channel), let the consumer pick a dynamic range from choices provided by the show's producer (e.g., wide, normal or narrow) and, for dialnorm, automatically adjust the perceived loudness from show to show, commercial to show and so on.

Using a device, such as Dolby LM-100 loudness meter, show audio is measured and dialnorm readings are created using the LEQ-A audio measurement practice that's part of Dolby's Dialog Intelligence. This provides a long-term A-weighted summation in real-time, yielding a figure for the perceived loudness of the audio within minutes. This practice (in conjunction with the proper and complete distribution of the metadata) has the capability to maintain the same perceived loudness for all show, commercial and promotional audio during all parts of a station's DTV broadcast day. Dialnorm is intended to eliminate the NTSC issue of inconsistent loudness during broadcasts.

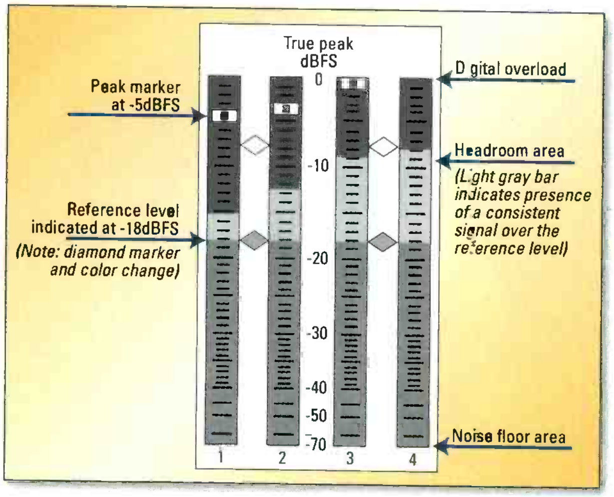

Figure 4: An audio signal as seen on a Tektronix 764 Digital Audio Monitor. Note the signal applied is peaking well into the headroom, and channel 3 is peaking at 0dBFS.

How it works: The audio engineer labels the program or commercial audio with a measured numeric value between -1 and -31 as indicated by an LM-100. This figure is entered as part of the overall metadata stream with a Dolby 570 authoring tool and muxed directly into the VANC of the HD-SDI stream or into the Dolby E metadata bit stream. Dolby E is used to pass multichannel audio and metadata through broadcast gear with limited audio channel capacity.

DTV stations can pass this compatible metadata to home decoders using their Dolby 569 AC-3 encoders, set up to receive the signal on their external metadata input. The audience's set-top boxes or home theater receivers extract the dialnorm metadata from the Dolby Digital bit stream transmitted from the station.

This information is used to dynamically adjust the perceived loudness for all audio to the same -31 level no matter the actual audio amplitude a show or commercial may have. With dialnorm, no limiting or compression is used and the audio maintains all of its dynamic range.

Moving from acoustic energy to electricity, analog to digital, digital to dialnorm, the modern mixing engineer has an arsenal of tools and established practices. Proper setup, use of headroom and measurement of perceived loudness all help to ensure the accuracy and consistency of the audio from its origin to delivery. The broadcaster's awareness and use of these practices will ensure that today's digital savvy home theater audiences receive the extraordinary sonic experience they now demand. **BE**

Jim Starzynski is principal engineer in advanced technology for NBC-Universal.


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StarCity Recording Company's "A" room, its surround mixing room, is outfitted with a Solid State Logic 9000 K console, Quested 412 monitors soffitted into the walls (five of them in surround fashion) and a Stewart Microperf screen.

Audio AND video:

A true partnership

BY CARL CADDEN-JAMES

The more things change, the more they stay the same. Take the motion picture industry, for example. Years ago, someone working as a projectionist in a high-quality cinema might be familiar with the following scene: a bright, steady lamp house; great optics; and a large concave screen. The visual product was gorgeous.

But the sound system ... yikes! Amps with wax capacitors melting from the heat of the glowing tubes of the amp below it, speakers that sounded like cardboard ... you get the picture. It was the perfect recipe for developing an imbalanced sense of quality — exceptional visuals

supported by a disproportionately lower standard of audio. That's a bit of an overstatement perhaps, but it's worth saying to make the point.

The HD viewing experience available from the networks and satellite providers on today's great display technology is jaw-dropping. It is obvious that a tremendous amount of care has gone into this consumer-level end product, as well as every step along the way: acquisition, post, output and broadcast. But has the audio component of these broadcasts kept pace? Does it matter?

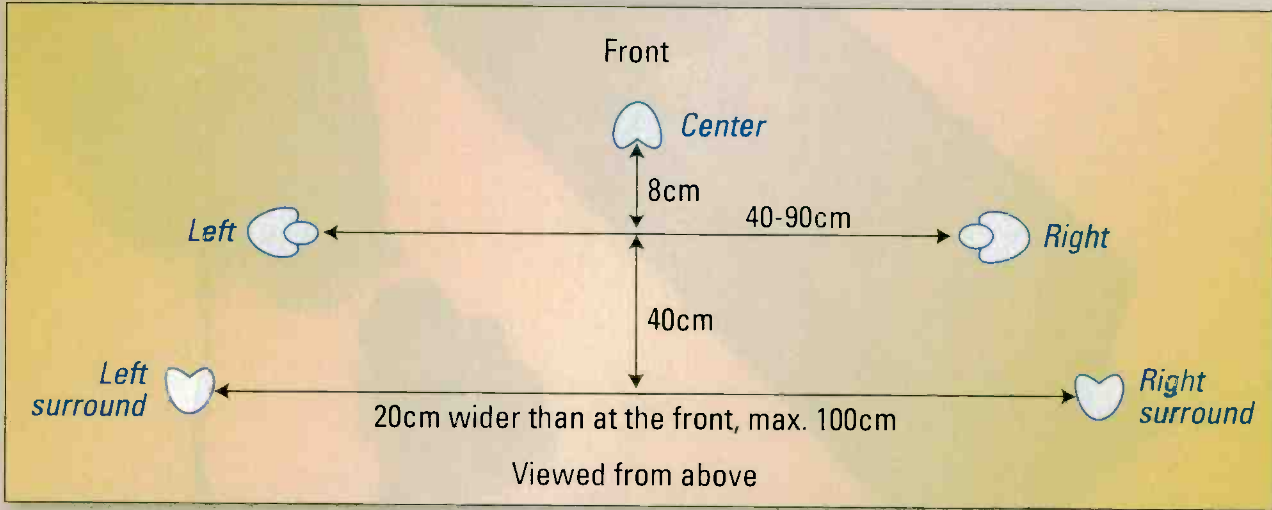


Figure 1. Shown here is the Optimized Cardioid Triangle surround technique.

Audio integral to broadcast quality

Helen Keller was once asked if she could have either her sight or her hearing restored, which would she choose? Without skipping a beat, she replied that she would want to hear. Worth pondering, isn't it? The audio portion of your broadcast is arguably 50 percent of the experience. In an effort to put forth an audio presentation as quality-driven as its aforementioned visual counterpart, audio budgets on any HD (or SD, for that matter) project should be comprehensive enough to include an adequate completion time figure, the right equipment, accurate acoustic environments and, most importantly, qualified engineering.

The first step toward problems within the audio realm starts at the budgetary and strategic planning stages of production and can carry through to completion. These problems are compounded by the less than perfect handling of project flow, asset complexity and client interferences.

Department heads take note: When it comes to audio, do not underestimate the importance of proper project planning and project management. In the line of fire of a complex production, nothing can derail your timetable and budget quicker than the chaos of mismanagement. Many ill-conceived, poorly managed projects are saved only through the heroic efforts of highly skilled audio professionals functioning much like military Special Forces — against the clock, no help from the chain of command and accomplishing mission objectives with only spit, duct tape and chewing gum.

When it comes to audio, do not underestimate the importance of proper project planning and project management.

Now, not all productions are as complex as, say, a motion picture, but the same tight planning and managing necessary for meeting budget/deadline/quality benchmarks on a motion picture benefit even the smallest project. Installing regulating systems at a time when things are simple provide stable management structure as your production house grows.

Proper equipment aids results

When handling acquisition, whether in the field, stage or studio, audio professionals hand-select specific microphones to successfully capture a particular instrument, voice or sound. A deep mic closet is hugely beneficial. Capturing audio in a live setting, as for an HD concert broadcast, requires an appropriate isolation of the instruments through stage set-up, mic selection and mic placement. Signal chains must be pristine; no extraneous noise should be induced. The listening environments must be quiet enough to hear the slightest hums, buzzes and noise floors.

The February 2005 issue of *Broadcast Engineering* featured an article titled "Monitoring Surround Sound Audio for Broadcast," which focused

primarily on phase issues that arise when down-mixing is performed on a 5.1 mix (as is often the case in the consumer environment). This is an important consideration both electronically (as in the interconnect scheme) and with the placement of the microphones. Phasing errors, at times barely audible when monitoring in surround, can become quite apparent when folded down. It takes trained critical listening skills to hear subtle phase issues.

Additionally, industry standards exist with regard to microphone technique in surround acquisition. One such example is the Optimized Cardioid Triangle surround technique, a methodology for acquiring true phase coherent surround field audio. (See Figure 1 on page 72.)

Having the right tools in place to perform down-mixing in adherence to consumer-based standards is important. For example, the Dolby 570 monitoring tool provides precise emulation of the Dolby decoded consumer environment. With this tool, all flavors of down-mixing are accounted for, as well as the effects of any compression profiles applied. This can be extremely helpful.

When producer Jeff Glixman worked on the surround remix of the Allman Brother's "Live at the Fillmore East" for Sony SACD release, he used the original multi-track transfers. Much care was taken to delay times on the open mics — especially the audience mics — so that under down-mix duress, the best phasing characteristics were achieved. Care was also taken when using mono-to-surround enhancement tools for the same reasons.

End product dependent on environment

Working in a facility dedicated to surround is a huge advantage. The structure, room design and speaker combination can provide a trustworthy acoustic environment. Problems present during track and mix are revealed. When you have a competent engineering staff paired with the hardware and software you need in order to work without restriction, you are in an optimal situation. In this environment, audio engineers are capable of producing the finest in audio quality. They are able to "paint" with

Having the right tools is essential to creating a high-quality audio experience. StarCity's "B" room, its primary lock to picture editing room, employs a Dolby 564 reference decoder, Dolby 570 monitor, Dolby 569 digital audio encoder, Brainstorm Electronics timecode distripalyzer and Eventide Orville digital effects processor.

this subtle shade or that stark color. They can experiment, invent and define. They can correct. There will be no surprises when the mix leaves their hands; the frequency spectrum balance and mix proportions translate well to any given consumer or professional environment. And, most importantly, they sound fun to listen to because the mixes achieve the intended sonic quality goals.

When you see incredible looking content from your cable or satellite provider, don't you want incredible sound as well? The best that HD video and HD surround sound has to offer, combined, results in an unparalleled experience. Audio matters as much as video. Period. Do not settle for anything less than the same super highly-detailed level of quality in the audio component of your productions as you insist upon for your video. BE

Carl Cadden-James is vice president of production and engineering for StarCity Recording Company.

Grass Valley's new Infinity production platform

BY MICHAEL GROTTICELLI

Having to choose between multiple recording formats has been the bane of broadcasters for many years. This choice was often based on a particular compression format and the resulting image quality, as well as whether the scheme fit into a station's existing infrastructure with the least amount of reconfiguration and picture degradation.

While the elusive universal standard continues to be out of reach, design engineers at Grass Valley have created a solution: the Infinity production platform. The platform allows a user to choose the removable recording media and compression format that best suits his needs at the moment.

Flexible storage

With Grass Valley's new Infinity series, consisting of a camcorder and a digital media player, users can select the storage medium based on the application. In the future, an edit system and server will be introduced to support the line. If this product catches on with broadcasters, the limitations of a single recording format and compression ratio will no longer be an obstacle.

Production crews can use a standard laptop equipped with an external REV drive, creating an HD preview station in the field, with complete VTR emulation.

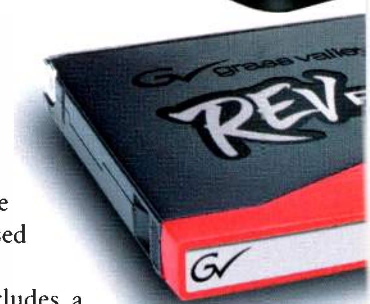
This flexibility of Infinity allows a station to record to an Iomega REV Pro disk one day and on solid-state flash memory the next. An ENG crew covering a press conference might use both, recording the entire event on a REV Pro disk while capturing a sound bite on pro-grade compact flash memory that gets handed off to a team member for immediate airing.

If the station wants to later cover the local college football game in HD, at bit rates of 25Mb/s, 50Mb/s, 75Mb/s or 100Mb/s, in either 720p or 1080i, the same equipment can be used.

Camera basics

The basic Infinity camera starts at $20,000 for an SD/HD version that records on four types of removable media: REV Pro, FireWire, USB and compact flash. It contains codecs for both DV and JPEG2000. The camera processes 1920x1080 HD images with 10-bit, 4:2:2 sampling using JPEG2000.

While some cameras include FireWire connectivity, typically you can't output a full-res file directly from the camcorder. Although some cameras provide tapeless storage, it's only in a single format. Then, there's the issue of having to standardize based on one brand.



The Infinity camcorder includes a color LCD monitor as well as SD audio and HD/SDI video connectors for real-time output. Also provided are Gigabit Ethernet and FireWire connectors. MPEG compression is available as an option.

In addition to serving as a playback and storage device, the Infinity digital media recorder (DMR) provides editing, file management and multichannel file distribution features. The player uses the same media as the camcorder and also provides full baseband video and IT connectivity. While MPEG-2 playback is standard for the DMR, an optional encoder is required to record the format.

The disk cartridges come with 35GB of storage capacity. This provides about 45 minutes of 1080i HD at 75Mb/s and more than two hours of 25Mb/s HDV. For a detailed look into the disk cartridge's technology, see "Iomega's REV Drive" in the July issue of *Broadcast Engineering* magazine.

The pro version of the cartridge will cost about $70. It's

based on the existing REV drive technology from Iomega, but the professional disk provides increased bandwidth to support multistream operation. The disks are also attractive for archival applications.

Production applications

Using the DMR or the camcorder's internal REV Pro disk drive, a station could record a 50Mb/s stream and simultaneously play out another stream. The player can also play out material recorded onto standard REV disks, but that material cannot be streamed and recoded at the same time.

Production crews can use a standard laptop equipped with an external REV drive, creating an HD preview station in the field, with complete VTR emulation. Grass Valley also plans to offer free logging and trimming software tools, either loaded onto every REV Pro disk or as a separate application disk that can be loaded onto a PC.

Features

There are two versions of compact flash memory cards that can be used for the Infinity camcorder, all made by SanDisk. They include the Extreme-III, which comes in sizes up to 4GB for high bit rate HD, and the Ultra-II in sizes up to 8GB for SD and 25Mb/s to 50Mb/s for HD. This form of recording is ideal in harsh weather conditions or in applications where extreme vibration might affect image acquisition. Currently, an Extreme-III card from SanDisk costs about $350.

USB memory sticks are also compatible with the Grass Valley Infinity camcorder and DMR. USB sticks offer less storage capacity than CompactFlash, thus less video record time.

The quickly emerging JPEG2000 compression scheme is designed to be scalable and allows users to encode a file once and decode multiple resolutions for different distribution platforms. Unlike other tapeless systems, which record both a low-res and high-res HD image onto a disk or solid-state memory card, the Infinity camcorder records a single HD file and then, using JPEG2000 compression, decodes at least three lower resolution versions in real time. This conserves space on the storage media.

Another advantage of JPEG2000 is its ability to support the full raster 1920x1080 image, versus the common technique of subsampling horizontal resolution, resulting in 1440x1080-size images being used prior to compression.

In addition, because JPEG2000 is wavelet-based — as opposed to the DCT scheme for MPEG-2 — there are no blocking artifacts. Artifacts from JPEG2000 appear as a blurring of the image, which Grass Valley says is more acceptable to the human eye. That can be a big benefit when working with lower bit rate material. JPEG2000 also offers true random access to every frame with synchronized digital audio.

Accommodating change

In designing the camcorder and media player, which will be available in early 2006, Grass Valley was careful not to give users too much choice; otherwise, they'd need a master's degree in computer programming to use them. With this in mind, the company is anxious to get the camcorder into users' hands.

Those that have previewed it have been suitably impressed with the camera's flexibility and ability to evolve as broadcasters' needs change. **BE**

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

HDTV lens design:

Management of chromatic aberrations

BY LARRY THORPE AND GORDON TUBBS

In the last article of this series, optical aberrations that are independent of wavelength were reviewed. In addition to these monochromatic aberrations, there are a variety of additional aberrations associated with colored light. They are, in other words, wavelength-dependent. They result from fundamental optical properties that vary with wavelength. All transparent materials exhibit this phenomenon. There are no exceptions.

Chromatic aberrations are the nemesis of the HDTV lens — especially in its small 2/3in image format embodiment. The real mischief ensues, however, when these chromatic aberrations are transformed into wideband electronic signals in the HDTV camera and traverse sophisticated digital processing circuits. As mentioned in the last article, the HD camera is a fixed and disciplined system. There is not much it can do if the lens is the cause of mistimed RGB video signals, and the many RGB digital processes then have to contend with this stark reality.

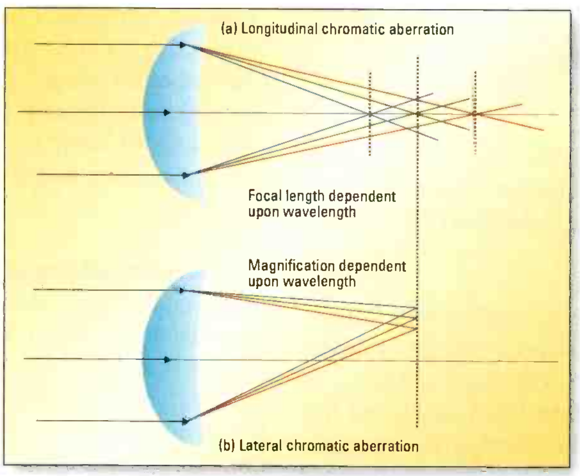


Figure 1. The two chromatic aberrations (in exaggerated form for visibility) for selected RGB wavelengths

The greatest HDTV lens design challenge: Chromatic aberrations

Different wavelengths of light encounter a different index of refraction within a given optical material. Nature was not kind here. The refractive index of *all* transparent media varies with color wavelength. The phenomenon is referred to as dispersion. A single lens element will accordingly form a number of images — one for each and every color present in the light beam. These are technically described by two separately defined, but physically related, aberrations:

1) *Longitudinal chromatic aberration* — meaning different focus planes for each constituent

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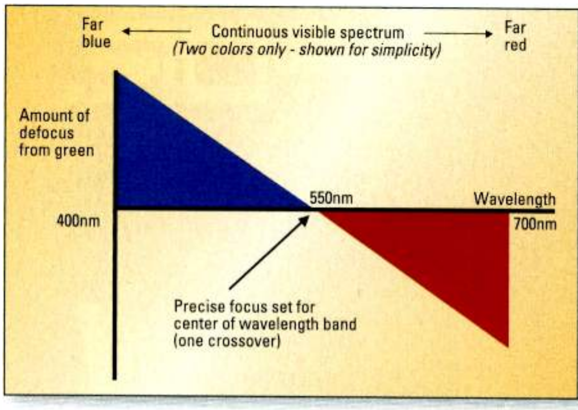


Figure 2. The primary chromatic aberration, where the chromatic lens is focused for the central green portion of the spectrum, and the opposite ends of the visible spectrum defocus differentially

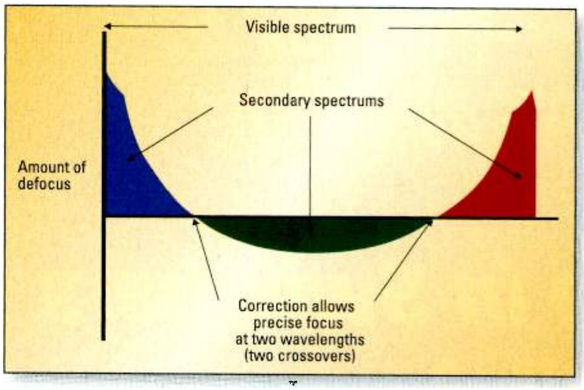


Figure 3. The effect of a compensating doublet having two distinct dispersion properties, allowing focus correction at two wavelengths.

color within the visible light spectrum.

2) *Lateral chromatic aberration* — the fact that the focal length of colored light rays varies, causing an associated variation in the lateral magnification. This in turn produces an effective misregistration between the constituent colored images.

Figure 1 (on page 78) illustrates the creation of these two chromatic aberrations in a simplistic form.

Longitudinal chromatic aberration

When white light passes through a lens element, the component wavelengths are refracted according to their frequency. This will result in a different focal plane for all of the different colors throughout the visible spectrum. Figure 1 illustrates this for three selected RGB colors within this continuous spectrum. For a subject point on the central optical axis, the various colors are also on that same axis, but different wavelengths come into focus at different points along that axis. Typically, the refractive index is greater for the shorter blue wavelength. Consequently, a single lens element acts like a prism in a sense and brings the blue end of the spectrum to a focus nearest to the lens.

Longitudinal aberration is, in essence, a tracking error. When the lens is focused for the green wavelength, the blue and red ends of the visible light spectrum become defocused as a result of this aberration. (See Figure 2.) This causes blurring on associated color details in the scene and a loss of sharpness in sharp luminance transitions. If the green ray is focused on the camera image sensor, then a circle of confusion will exist for both the red and the blue image. This is referred to as the *primary spectrum*. An uncorrected lens element is called a *chromatic design*.

Pairing lens elements made of different optical materials having equal and opposite dispersions is the most commonly used technique to reduce this phenomenon. Such a lens doublet allows two selected wavelengths to be brought into focus. (See Figure 3.) This arrangement is termed an *achromatic doublet*.

Having implemented this first order correction for two wavelengths, the residual is called the *secondary color spectrum*. (See Figure 3.) Here, the green center of the visible spectrum is behaving quite differently to the red and blue extremes. The longer the focal length and the higher the aperture, the greater the image impairment due to the secondary color spectrum.

Effective management of the lens chromatic aberrations calls for higher levels of correction. The use of three-group lens elements having different dispersion properties is called an *apochromatic lens group*. The number of corrections can even be raised to four — a system termed the *superachromat*. But, it is less important to achieve an increased number of zero crossovers (two are shown in Figure 3), as it is to manage the deviations of the colors between these crossovers. Controlling the secondary color spectrum to an acceptable level entails the use of special optical materials. A fluorite lens element combined with a wide-dispersion element can effect a useful degree of control over the central green spectrum — and today there are other options with new glass materials.

Following all optimization of the correction strategies, the residual longitudinal chromatic aberration unfortunately varies with focal length. This is a tribulation of *all* zoom lenses. A typical high-performance HDTV studio lens design goes to considerable technological lengths to ensure this variation is well controlled at the shorter focal lengths — but it becomes more difficult to curtail at the longer focal lengths. (See Figure 4.)

Lateral chromatic aberration

Dispersion also causes the image magnification to be a function of wavelength. This produces color fringing around sharply detailed edges and a degradation of the luminance Modulation Transfer Function (MTF) that impairs overall picture sharpness. It produces in effect a registration error — as depicted in Figure 1(b) (on page 78). Minimizing this aberration constitutes the most difficult design challenge of all in an HDTV zoom lens.

Lateral chromatic aberration also produces a primary and secondary spectrum. Multi-element groups and use of special materials are deployed to control the secondary spectrum. Overall management of the simultaneous optimization of both longitudinal and lateral chromatic aberration in a modern zoom lens is a

HDTV lens design:

Management of chromatic aberrations

technological saga in itself.

Typically, from the viewpoint of the camera-output HD video, lateral chromatic effects are subjectively more visible than longitudinal chromatic aberration because of secondary effects stimulated within the camera RGB video processing system.

Lateral chromatic aberration increases from the image center toward the outer extremities. It is typically measured at a selected 3.3mm image height. (See Figure 5.)

Of all the lens aberrations, lateral chromatic is the most unforgiving. The problem is that it can subjectively be a visible impairment even with the tight tolerances achievable today. Some sense of the rigor of the specification for lateral chromatic aberration in a contemporary 2/3in HDTV studio lens is shown in Figure 6 (on page 82).

It is an especially difficult aberration to manage when lens elements are moving — as in zooming and focusing. Lateral chromatic aberration varies with focal length as the glass elements physically move during a zoom operation. (See Figure 7 on page 82.) The aberration is generally greatest at wide-angle settings.

Chromatic aberration and the lens-camera system

It has long been recognized that the lens and the camera prism optics constitute a quite complex optical system. Fortunately for HDTV, this complexity was dealt with in an extremely timely manner before the 2/3in 16:9 image format became the mainstream optical format for HDTV cameras and camcorders. In addition to considerations of lens-camera resolution and color reproduction, it was fully recognized by all of the camera and lens manufacturers that chromatic aberrations were a regrettable impairment that could never be totally eliminated. The camera manufacturers and optical manufacturers worked within the Broadcast Technology Association (BTA) in the late 1980s to address all aspects of the 2/3in HDTV camera and lens interface — optical, mechanical and electrical. The studies included grappling with the issue of longitudinal and lateral chromatic aberration and its variances with focal length.

A key element within this standard was the agreement on a precision Flange Back dimension of 48mm (de-

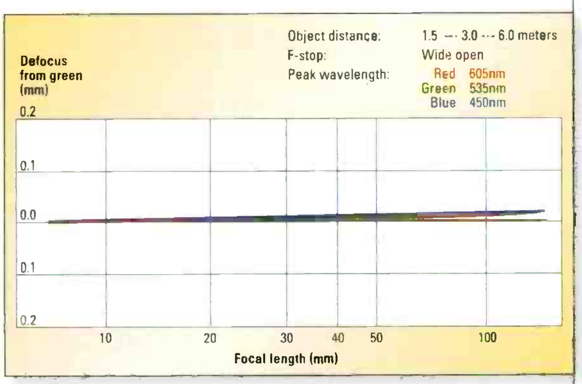


Figure 4. Longitudinal chromatic aberration changes of red and blue wavelengths (with respect to green) with focal length in an HDTV zoom lens — error typically being greatest at telephoto setting

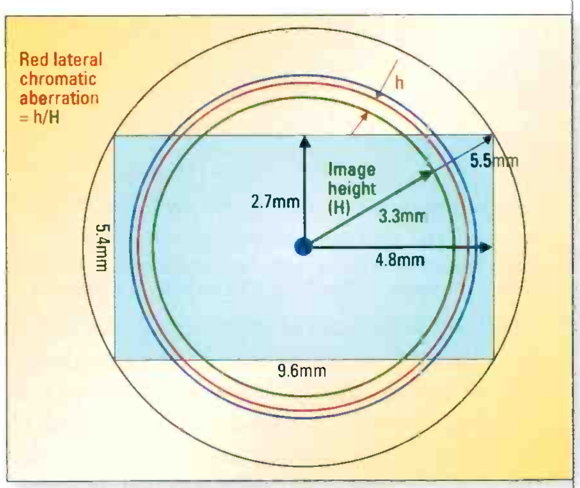


Figure 5. Lateral chromatic aberration (exaggerated here for visibility) is measured at a specific image height of 3.3mm within the 2/3-inch 16:9 image format

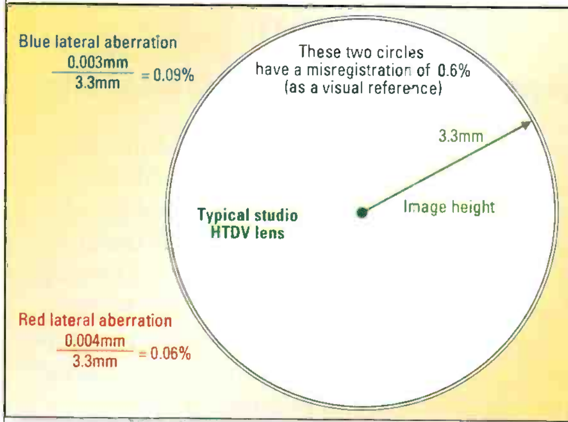


Figure 6. The two circles are intended as a 0.6 percent reference to convey a sense of the magnitude of lateral chromatic aberration in a contemporary HDTV studio lens. The actual red and blue aberrations are shown calculated.

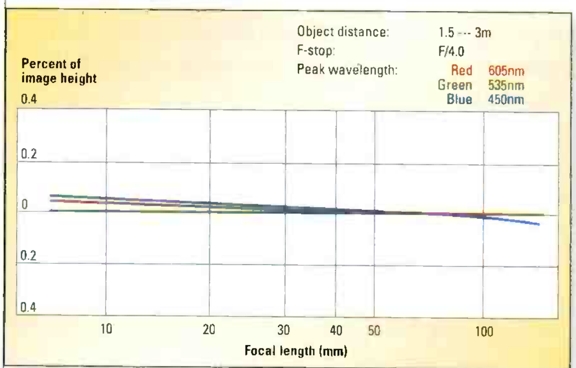


Figure 7. Shown here are lateral chromatic aberration changes with focal length in an HDTV studio zoom lens. This error is typically greatest at the wide-angle setting.

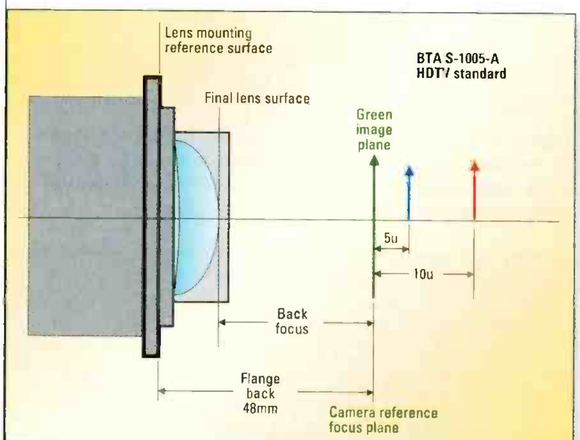


Figure 8. The physical offset of the red and blue image sensors that have been standardized for all 2/3in HDTV cameras — the 1994 BTA S-1005-A standard

signed to accommodate future advances in prism optics). Another was the offset of the path lengths of the red (10 micrometers) and blue (5 micrometers) image sensors relative to that of the green imager. (See Figure 8.) These particular numbers emerged as a compromise between the different design aspirations of the various optical manufacturers, following a protracted examination of the many variables. While not a perfect solution, it has helped to alleviate the chromatic aberration challenge, to a degree, for all. This compromise was a key element in achieving the interchangeability of all HD lenses on all HDTV cameras (regardless of manufacturer) on the 2/3in image platform.

Lateral chromatic aberration and HDTV camera processing

The truly insidious aspect of lateral chromatic aberration arises because of what it can stimulate in the RGB video processing system of the HD camera. Lateral chromatic aberration from the lens means that the precision mounted imagers will create three video signals that have associated differential timing errors. It is a differential RGB timing error that the digital HDTV camera can inadvertently compound under certain conditions.

A sense of the artifact is illustrated in Figure 9. Assume the lens-camera is imaging a white background on which a small black patch is positioned near the image extremity where lateral chromatic aberration will generally manifest itself. Because of the increasing magnification of red and blue wavelengths relative to green, all of the optical transitions between white and black will be affected. The resultant mistimed optical output of the lens will now be transformed to a digital representation by the RGB image sensors of the camera.

HDTV lens design:
Management of chromatic aberrations

A single scan line through that patch as shown in Figure 9(a) will produce a video representation in the form of a horizontal white-to-black transition followed by a black-to-white transition as shown in Figure 9(b).

On the assumption that the aberration is progressively increasing toward the image edge, the delays on the second black-to-white transition will be slightly greater. When the three RGB video components are later matrixed to form a Luma Y signal, the white-black-white transitions will be colored in the manner shown — having a blue-magenta leading transition and a green-yellow trailing transition. In practice, because the transitions will actually have finite rise times (increased by the limited bandwidth of the digital video system), the edges will include more colors. Now, the meaning of the secondary color spectrum visibly manifests itself — as a color fringing contamination of that desired luminance reproduction of the original white-black-white scene.

The situation can be worsened by the fact that there are a variety of video processes that take place in the digital RGB processing system that are sensitive to any such differential timings between these three video signals. These are circuits that may be adding or subtracting these three signals from each other. They include linear matricing (for colorimetric control), image detail (for sharpness enhancement) and differential digital filtering (when Y, R-Y and B-Y components are formulated). Unfortunately, the associated mistiming is present in both the horizontal and the vertical domain (where different RGB processes occur). *It must be emphasized that the HDTV camera is not originating these errors.* The lens is doing that. The camera is, however, inadvertently *transforming* the differential errors presented by the lens. The magnitude and subjective visibility of the various color fringing effects that can result is a complex combination of the original lens error that stimulates these camera circuits — and the particular settings and adjustments in the camera proper. The visibility is highly dependent upon picture content.

Happily, based upon extensive experience, most scenes are benign in terms of their content. It is rare that chromatic aberrations become subjectively apparent on HDTV video originated in studio settings (although this can sometimes occur). While the chromatic aberration may indeed be present, it is generally invisible to the human eye even on a large HDTV screen. Outdoor shooting at wide angles, on the other hand, will occasionally encounter high contrast scene content, where the aberration becomes distinctly visible on the HDTV monitor. It is one of the realities of the small 2/3in HDTV image format that these impairments will statistically surface from time to time, and there is little that can be done to eliminate them. Lens manufacturers relentlessly continue to wrestle with this challenge in an unceasing quest to tame this optical shrew. BE

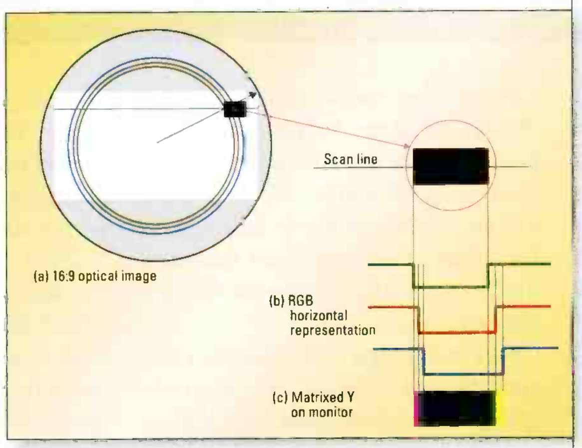
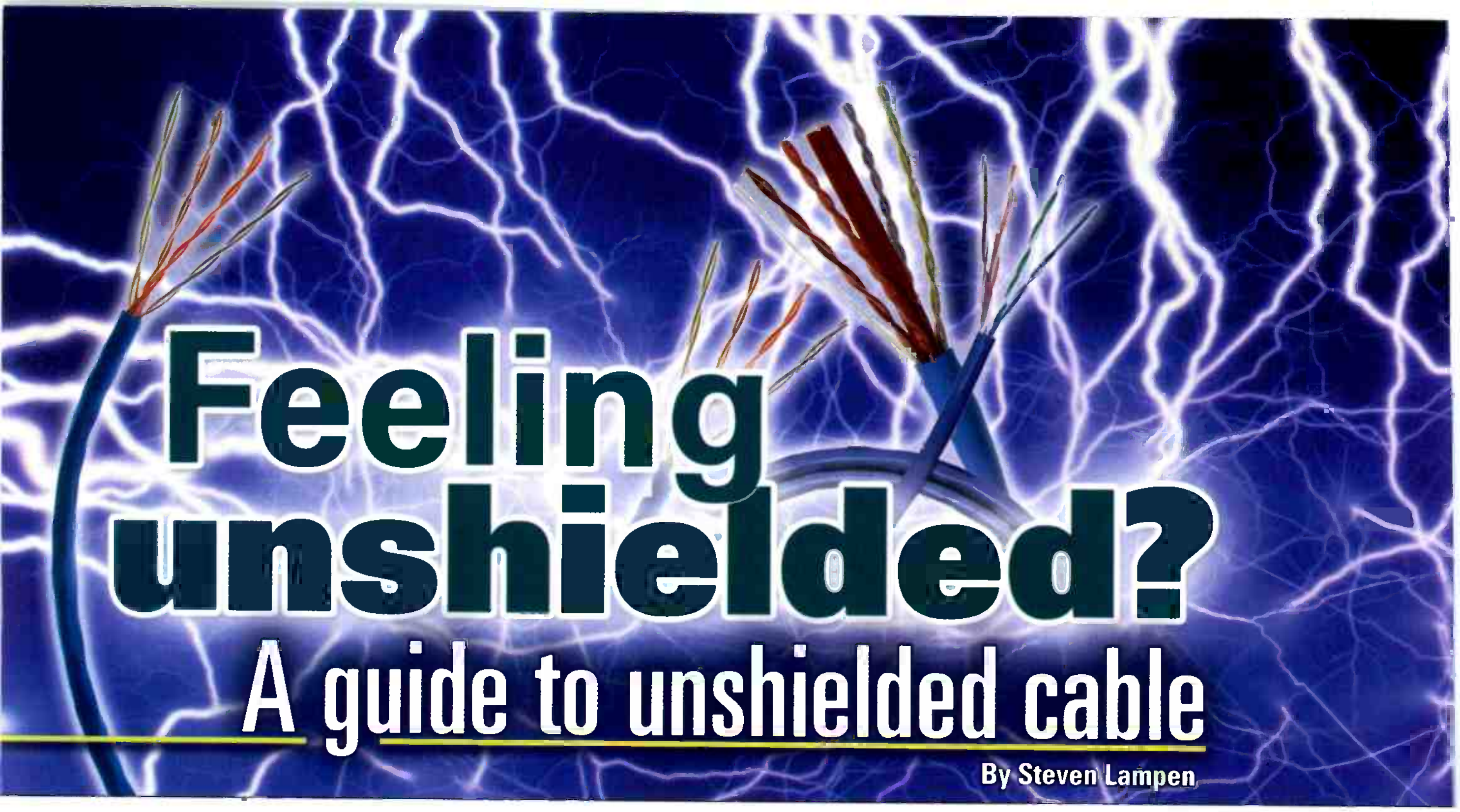


Figure 9. The creation of color fringing around a white-to-black followed by a black-to-white transition (in exaggerated form for visibility)

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



Feeling unshielded?

A guide to unshielded cable

By Steven Lampen

If you're an old geezer like me, the idea of using unshielded cable to run audio is still a pretty new idea. Sure, those IT people who installed your computer network have been using unshielded twisted pairs (UTP) for over a decade, but that's computer data, not audio. And now there are other crazy people telling you to run video on UTP. What's with that?

If you attend NAB, AES, SMPTE or other professional audio or video tradeshows, you'll notice a lot of Category data cable everywhere. But that's probably machine control stuff, right? Just design engineers taking advantage of Ethernet that's a lot cheaper and easier to install than the RS-232 or 422 that you're used to.

But, wait a minute. There's a guy running four channels of analog audio down a CAT-5E or CAT-6. Is that possible? And there's a pile of surveillance stuff, cameras and controllers wired with RJ-45 connectors — the same connector as UTP.

And then there are the balun manufacturers. They make little black boxes that convert *bal*anced twisted pairs to *un*balanced devices. And they have dozens of applications: analog audio, digital audio, analog video, digital video, RGB, VGA and so on. Have they all gone off the deep end?

Before you throw yourself across the high voltage in your transmitter, things are not that bad. And this stuff actually works. All you need to know is how it works and why. Is UTP better than coax? Not necessarily. The secret is in those unshielded twisted pairs.

Back at the dawn of time (20 years ago), twisted pairs were pretty crude things. Sure, there were impedance-specific twisted pairs, called Twinax, but they were big and expensive, and you probably didn't even know they existed. About 15 years ago, people began to play with UTP. First they put it in levels (invented by the distributor Anixter), then the standards group EIA/TIA 568 put them in categories, such as CAT-3 and CAT-4. (The only one of those still in the standard is CAT-3. The FCC made it the standard for telephone wiring.) Then along came CAT-5. And this was the cable that made everyone sit up and take notice. For one thing, it had a bandwidth of 100MHz to carry Ethernet. They called the signal 100baseT. (The T stands for twisted pair.)

Right away there were improved versions — some with the pairs spread out for ultra-low pair-to-pair crosstalk and some with bonded pairs for excellent impedance stability. But even the standard generic CAT-5 was pretty amazing, and some people started to look at it for non-data applications. So, 10 years ago at Belden, we ran some tests. Yes, 10 years ago!

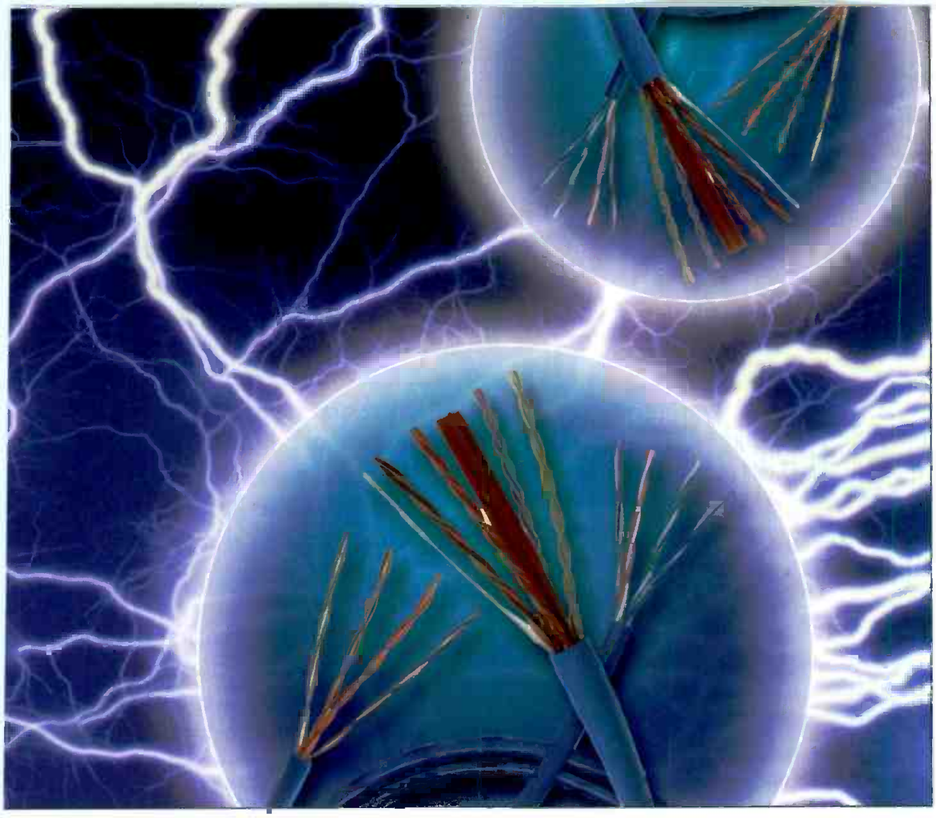
Figure 1 (on page 85) is a test of crosstalk done on stranded Belden CAT-5 patch cable 1752A (even worse than standard solid CAT-5 cable) at audio frequencies. Shown is the average of all pair combinations showing crosstalk from 1kHz to 50kHz.

You can see the worst case is around 45kHz, where the crosstalk is just a bit better than -95dB. In the human ear range, the worst case is around -97dB, and for much of the range it's -100dB or better. A 100dB crosstalk? Hey, what's the trick?

Well, those of you who knew something about data cable probably noticed it said FEXT above Figure 1. FEXT stands for far-end crosstalk. That's where the signal is the weakest, at the far end of the cable. Therefore, the other end, where the signals are strongest, has probably really bad crosstalk. Figure 2 (on page 86) shows NEXT, or near-end crosstalk, on the same cable.

Braid and foil

So why didn't we use unshielded pairs before? And why all that shielding, braid and foil? Well, the phone



companies have been using unshielded pairs since they began. And they could easily deliver -60dB SNR at 15kHz, as anyone who rented a line could tell you.

And shields? Well, there are two kinds of shields: braid and foil. Braid shields are good at low frequencies (up to around 10MHz); foil sheilds are good at high frequencies (10MHz on up). So all those foil pairs were really just giving you RF protection. And no shield has much effect below 1000Hz.

So what got rid of the noise? It was the twisting of the pair. It was the balanced line! And the better the balance of the source and destination devices, the more noise was rejected. That's called common-mode rejection ratio (CMRR), something the phone company already knew about. Poorly

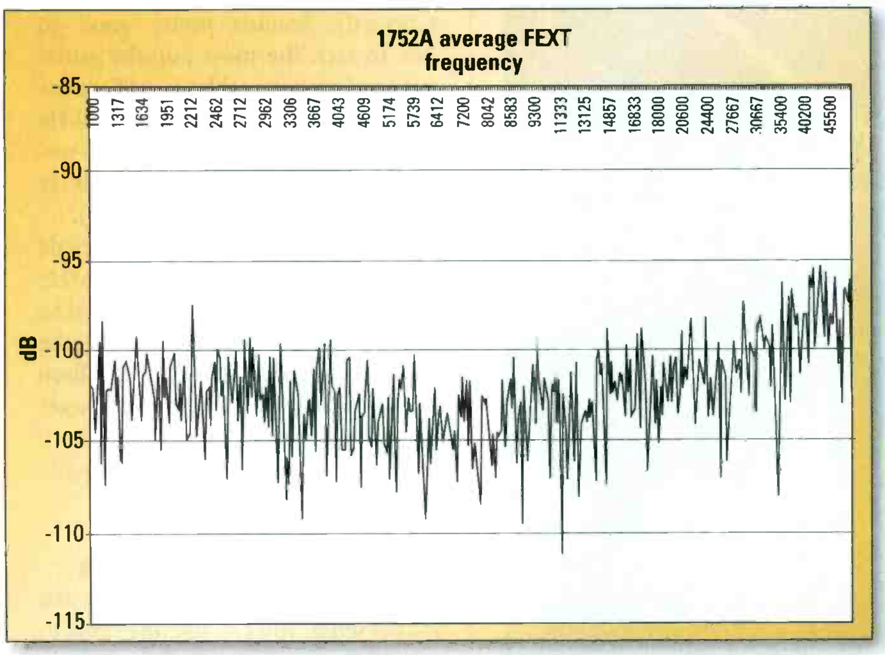


Figure 1. This test of far-end crosstalk on stranded Belden CAT-5 patch cable 1752A at audio frequencies shows the average of all pair combinations with crosstalk from 1kHz to 50kHz.

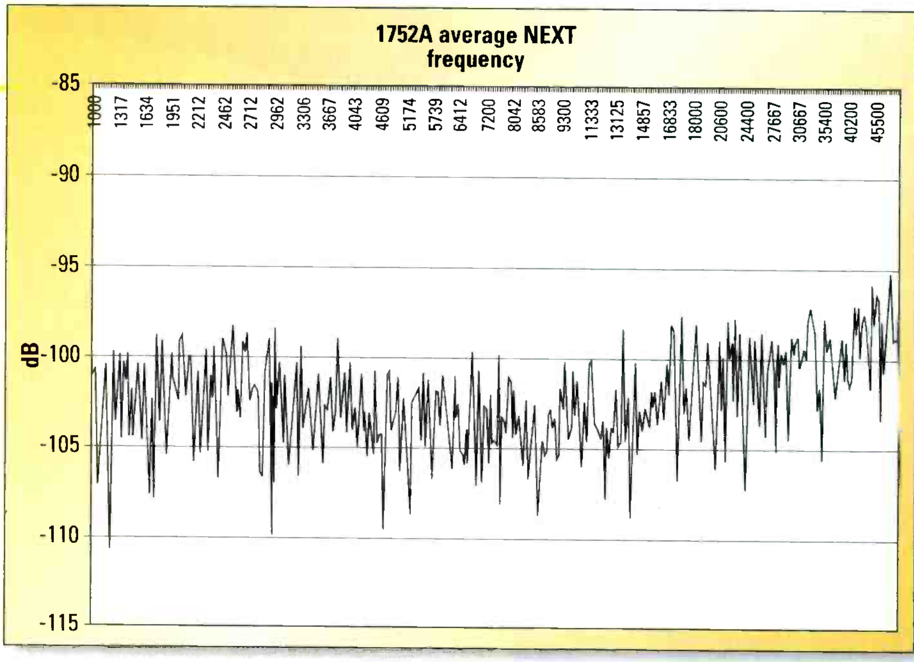


Figure 2. This test of near-end crosstalk on stranded Belden CAT-5 patch cable 1752A at audio frequencies shows the average of all pair combinations with crosstalk from 1kHz to 50kHz.

balanced (or worse, unbalanced) pairs pick up noise or radiate their signal. Good balance would reject almost anything — 60Hz, RF — you name it. Instead of putting a Band-Aid (shield) around a poor pair, we fixed the pair.

So then we tested some super-CAT-5 with bonded spread-out pairs (Belden 1872A MediaTwist). The lab technician was crying on the phone because he couldn't provide the test data. Why? Because he couldn't read it! The crosstalk was below the noise floor of the $60,000 network analyzer. And what was the noise floor? -110dB! The average pair-to-pair crosstalk at analog audio frequencies on a really good cable (such as today's CAT-6) is unreadable.

Cable for digital

Brave souls, or those who wanted a cheap way to send such audio as background music, immediately jumped on UTP. And slowly, some professionals have moved that way as well. Then along came digital audio.

Now AES digital is different from analog. It has cable specs, for one thing: shielded pairs with an impedance of 110Ω. Obviously, if you have to meet the spec, then you can't use UTP. But if you're the keeper of the spec or if your only question is "Will it work?" then we can take a look.

Category cables are all 100Ω impedance. Is that close enough? If you calculate the mismatch, it comes out to a return loss of -26dB and a match of 99.75 percent (i.e., 0.25 percent reflected). Sounds pretty good to me. In fact, the most popular audio use for Category cables is AES audio. The highest sampling rate is 192kHz (24.576MHz bandwidth), but it's unlikely you'll be running past 48kHz sampling (6.144MHz bandwidth).

And, since this CAT-5 or 5E cable is made to run 100MHz, then 6MHz or 25MHz is easy. CAT-6 is tested to 250MHz, so it's easier still. And, by the way, even though there are a billion feet of installed CAT-5, it's no longer part of the standard, so CAT-5 is hard to buy these days. You'll have to settle for 5E (enhanced 5) or CAT-6.

Double-, triple-duty cable

And, when you think about it, it just makes sense. You can use one cable to run all the computer stuff (and there are computers galore in any broadcast facility), and then you use the same

The Pair Splitter from ETS breaks out each pair in a four-pair UTP run to a single pair in separate RJ45 jacks.

cable to run all the digital audio. Hey, if you're brave enough, it can run the analog audio. And while you're at it, you can run the phone, fax and modem down the same stuff, too.

So now we have vendors selling us on audio running down CAT-5E or 6 as an Ethernet bit stream. Peak Audio has CobraNet, which can run 128 channels down a piece of CAT-5. Digigram has EtherSound. And now everyone is getting into the act. At Gibson, the guitar folks have maGIC, which will do 32 channels of audio. And if you run 1000baseT (Gigabit Ethernet), then it'll carry 320 channels. How big was your facility, again?

Then we have the Telos folks and their Axia networked audio. They just convert everything — mic level, line level, control — to 100baseT, and away you go.

And the really cool part of all this 100baseT is that the routers and other gear are cheap, off the shelf and at your local electronics store. Easy? You bet! So what's the downside? There must be a downside.

The downside: If you're running analog audio, the four-pair format of data cable does not lend itself gracefully to single-channel stuff. Often, you will waste three of the pairs to get a signal going. There is two-pair cable, but it's hard to find.

However, there is a cool little box made by ETS, one of those balun manufacturers. I call it the pet rock of the electronics industry because there is nothing inside except wire.

Each of the four jacks has one live pair. And there's a single jack on the other side where all four pairs are combined. Then you can run four signals down four pairs, even when they didn't start that way.

So, I hear you asking, "What about video?" Well, I've run out of time and space, so we'll have to continue next month with a second installment about UTP. And we'll look at more than just video. How about RGBHV, VGA, broadband/CATV or SDI/601? We'll look at all these and much more. BE

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

Terayon's compressed domain master control switching

BY MICHAEL ADAMS

Compressed digital video used to be considered a novelty in the television industry. But numerous technology advances, not to mention the FCC mandate for digital terrestrial service and increasing consumer demand for high-quality images, have made it a must-have for broadcasters.

Processing compressed video, however, still presents a number of challenges. This is why it is typically decoded to baseband, processed and then re-encoded. In fact, by the time it is ready to air, some footage has been encoded and decoded so many times that the original quality has been significantly degraded. This is an expensive solution, especially in a high-definition or multichannel environment.

What, then, are broadcasters to do when confronted with multiple video sources all compressed to different bit rates, particularly if they wish to place their own stamp on this programming without further degrading the quality with yet another decode/re-encode cycle? Is there a way in which revenue-generating services, such as ad-insertion, interactive metadata and graphical overlays, can be added to compressed bit streams at master control?

Finally, the answer is yes. A number of new technologies developed over the past several years have come together to provide seamless integration of video and audio processing elements into compressed digital bit streams. These new technologies solve the problem of switching between compressed feeds, in various formats and bit rates, which would otherwise overload the decoder buffer, causing picture freezes, glitches and audio popping. The result of combining these technologies is the Terayon BP-5100 broadcast platform.

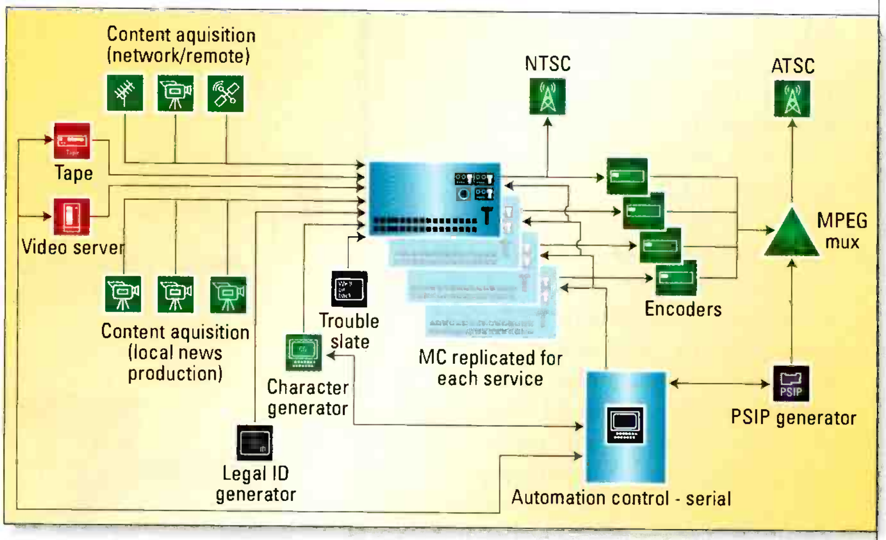


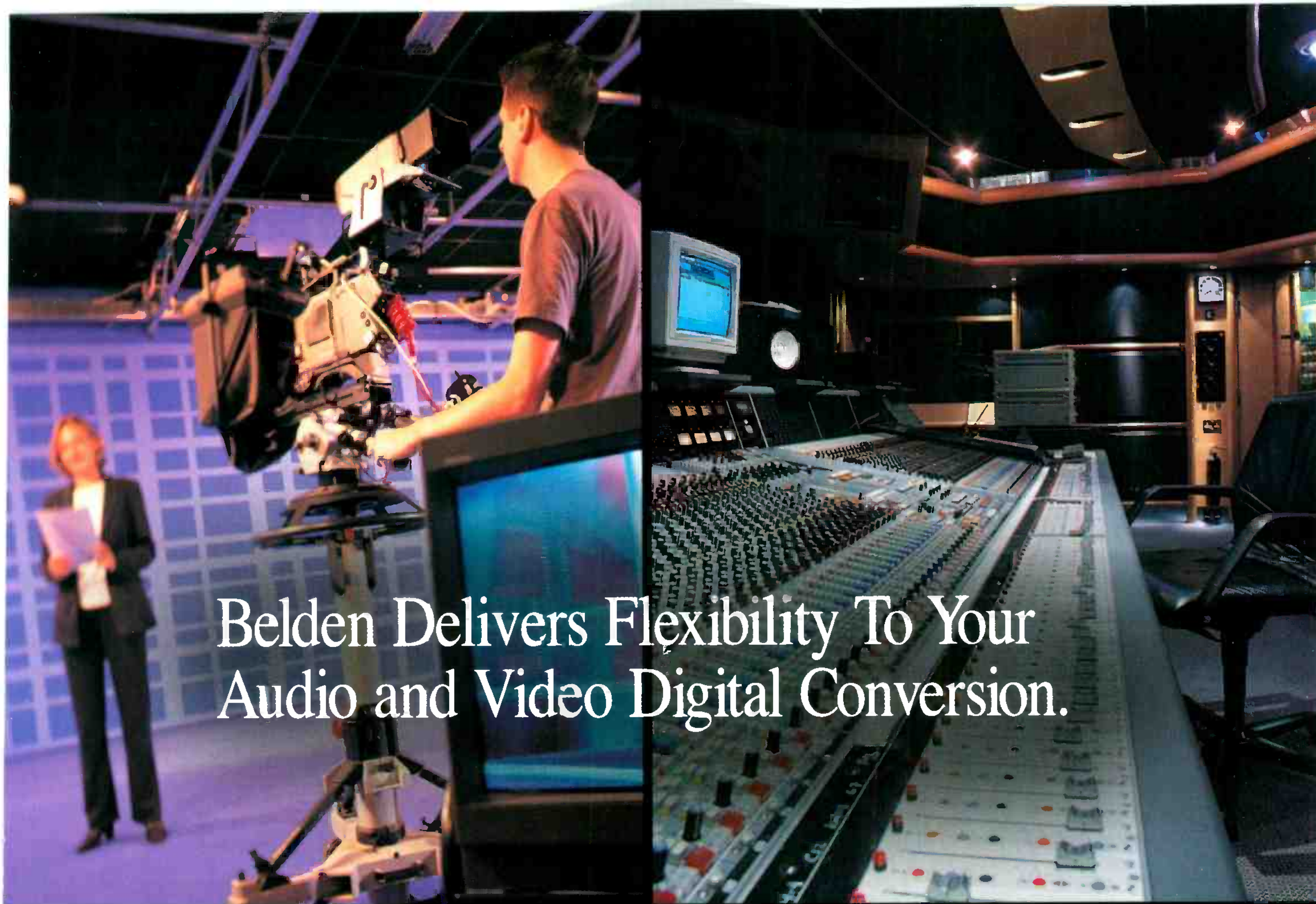
Figure 1. A typical master control system today. Note the presence of numerous encoders and decoders in an environment.

One of the key technologies is statistical re-multiplexing, which requires expertise in rateshaping. This technology grew out of the cable industry's need to take existing compressed satellite feeds and recombine them to serve different multiplexes on their networks. Rateshaping is the ability to intelligently change the bit rate of the compressed feed without noticeably altering the picture quality. A 4Mb/s feed could be scaled down to 3.5Mb/s without much difficulty, and the extra bandwidth could then be devoted to another bit stream that may require more data at any given moment. But more significantly, rateshaping can be used to maintain the MPEG reference decoder model to ensure that either an underflow or overflow to the decoder buffer does not occur. This is a crucial function if broadcasters wish to alter incoming feeds at master control in the compressed domain.

Several other technologies also play a part in compressed domain master control. The ability to switch between MPEG streams plays a crucial role through the use of advanced predictive techniques that identify the correct I-frames to allow the new stream to be inserted in a single cut. This avoids the blockiness, latency and black frames that occur when cuts are attempted to a B- or P-frame.

Also vital was the development of a new keying technique based on selective decoding/re-encoding. Only a small portion of a frame is decompressed to add a graphic or logo without degrading overall picture quality.

How does all of this work in practice? Quite smoothly. Let's take the example of digital program insertion. Because we can now perform this operation on the elementary stream level for both audio and video, we can



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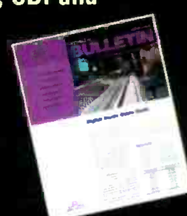

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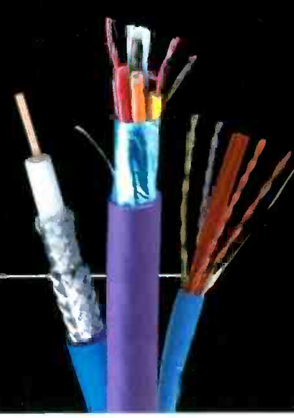

insert interstitial video seamlessly in the compressed domain. The SCTE 30 digital program standards specify the interface between the video server and the splicing device, while the SCTE 35 digital cue messages allow precise control over where we insert video and for how long.

As long as the MPEG group of pictures sequence is conditioned properly, we can offer frame-accurate insertion. It is now possible to take an arbitrary slice of compressed video and seamlessly insert it into another slice with no visible artifacts.

There is little reason for broadcasters not to embrace compressed domain master control switching. It streamlines the on-air process by greatly reducing the number of encoders and decoders in a typical master control room, and it preserves picture quality by cutting the amount of processing required to get the signal to the home.

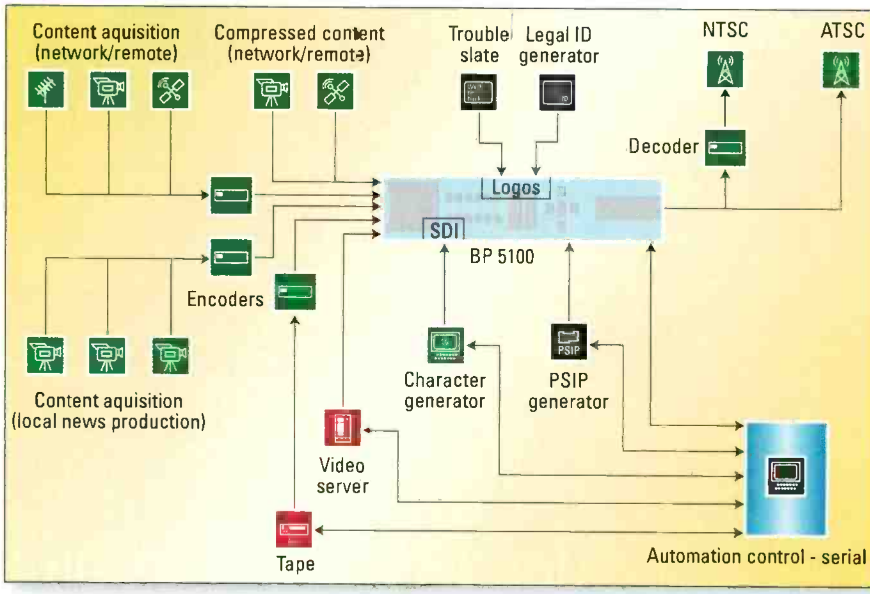

Figure 2. A compressed digital master control system affords a more streamlined approach to signal management.

Add in the facts that it promotes greater localization of network feeds and provides for smoother ad-insertion to boost local revenue, and the technology is a clear winner. **BE**

Michael Adams is the vice president of video architecture and technology at Terayon Communications Systems.

Routing switchers

BY JOHN LUFF

It might be hard to get too excited about routing switchers if it weren't for the fact that they often are at the core of interconnection for entire broadcast plants. Routing switchers evolved from good old-fashioned patch panels, probably from telco operations centers just as much as broadcast facilities. However, they provide much more than just the connection to the veins that run to all parts of the facility.

Routing switchers have become the hub of a facility because of the need to build complex and reliable facilities that can evolve over time as the mission of the facility changes. For instance, the types of signals handled in the '90s were often analog, but as the decade came to a close, the signals became increasingly digital. This presented a challenge to the cost of ownership, as a digital level would add significantly to the cost of an installation.

Good engineering has, however, found ways to allow routing systems to do double-duty, with internal conversion both from analog to digital and digital to analog. Implementing such a hybrid system for audio allows a migration from an all-analog audio facility to one that might be largely AES-based long into the future. At the same time, by putting conversion capability into an audio router, the need for stand-alone conversion products is minimized. This reduces the costs of the capital asset, installation and design. Less is done with wires and more is done with the keyboard on the control system, which ought to be a good thing these days.

Several manufacturers have introduced products of all scales that allow this capability — with block sizes as small as 16x16. Small block sizes allow migration plans to be funded efficiently, with expansion of the digital layer as needed. The downside is that as analog crosspoints become less of a necessity, and they surely will, the hardware becomes redundant, and the value of the investment is sometimes reduced.

Embedding conversion inside a routing system is not unique to audio, though with video, it is more difficult to do high-quality conversion inexpensively and in the limited space of a routing system's I/O. At the least, the current crop of converting video routers offers acceptable quality for most purposes, though stand-alone products can do a better job. That presupposes that the ultimate level of quality is important, which in many cases it is not.

The current crop of converting video routers offers acceptable quality for most purposes, though stand-alone products can do a better job.

Consider that much of the analog video in a plant is rapidly becoming the legacy signal and often is of lower quality. The other use of conversion — digital to analog — allows a router to provide feeds to analog monitors without the expense of external conversion, or at least at a lower cost per port.

When considering digital video routers, in addition to conversion options, it is important to think through the need to have wide bandwidth capability. Though perhaps not a universally valid assumption, it's fair to say that for at least broadcast and production plants, HDTV will replace SD applications over the next decade.

But that doesn't mean a routing switcher needs to be full of wide bandwidth crosspoints and I/O. For example, a 16x16 block of crosspoints might encompass two I/O modules and one crosspoint, which must be capable of 1.485Gb/s. But if you embed the same 16x16 block of signals in a 256x256 router, the number of I/O modules goes up to 32, and the number of crosspoints jumps from 232 to 65,536.

Unfortunately, each crosspoint costs money, and scaling up has a penalty. As with most things, size does matter, and you could be paying for a lot of unused capability. It is entirely valid to pick a total size, which allows for modest short-term growth, a frame size that will accommodate long-term growth projections and a WB count that doesn't break the bank. You can assume that manufacturers charge more for HDTV-capable signal processing than SDTV devices. Over time, the price differential has come down dramatically, and there will be a point in the future when it is more costly to support both SD and HD modules, with SD likely to be the more costly option. Eventually, that will be the case from a manufacturing standpoint.

While signal formats are important, so is the control system. From the standpoint of the operators, as well as the staff who maintains the control system, the panel interfaces and the method of programming the features of the router are critically important. It would be less than useful if the programming took skills beyond those commonly available on staff. As routing control has acquired more features, the programming of the system has become noticeably more complex. Engineers installing

As routing control has acquired more features, the programming of the system has become noticeably more complex.

new systems today would be well-advised to train on the full features of the system.

Reading a book in the heat of battle when programming needs to be done might not endear the maintenance technician to the news director. Many systems are now interconnected with garden-variety Ethernet carrying TCP/IP protocol control signals.

Installers should be fully familiar with networking. The SBE Broadcast Networking Technologist Certification or other professional training can be a valuable asset. Systems that use other control schemes can be just as valuable, but there is a synergy that can be gained when networking assets are fully used, including connections to automation and facilities management software.

One thing to keep in mind: Insist on a control system that allows the programming to be saved to a file as a protection against failure of a controller. There is no substitute for being able to upload a configuration saved to some non-volatile medium. Routing can be extremely reliable. Keep in mind that the life of the router might be longer than the employees trained to program and maintain it. Recurring training for new staff is good insurance.

Investigate your options carefully. Brand does matter, but less than most salespeople might tell you. Find a company that supports the features you need, can accommodate reasonable growth without breaking the bank and will be in business long enough for the warranty to expire, which can be 10 years these days. Focus on the company's ability to provide backup in the event of card failures or software bugs. You can bet both will happen at the most inopportune time, such as during election night coverage. **BE**

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

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

Mobile TV's 10HDX truck features PESA

BY PHIL GARVIN

The Mobile TV Group provides HD and SD production trailers throughout the United States. Our emphasis is on regional professional sports production, but we do all kinds of events, including national network, college sports and concerts.

The company launched in 1994 as Mountain Mobile TV. We built our first HD trailer in 2001 and now have six HD units. All of these are dual-feed-capable, which means they can produce two highly differentiated versions of the same event from the same mobile unit. This capability is important in allowing one mobile unit to provide feeds for different broadcasters or, for example, home (primary feed) and away (secondary feed) versions of one sports event. Fox Sports Net regional channels and Rainbow use this dual-feed feature extensively and with great success.

10HDX, the newest addition to our fleet, was built to fulfill our new contract with Fox Sports Net West in Southern California. The truck was designed and constructed by Colorado Studios and provides an array of equipment, including PESA's Cheetah routing system. The 53ft-long SD/HD unit expands to 13½ft-wide and features 11 cameras, numerous decks and replay/edit systems, as well as support for a broad range of incoming and outgoing feed formats.

A high-quality dual-feed HD production truck is extremely complex, and configuring the truck in a timely manner is a challenge. The routing in our 10HDX is complex and extensive, and PESA routers, including a 64x64 Cheetah HD router and a 128x256 Cheetah analog router, gave us the size, weight, efficiency, multi-level, quality and cost parameters we needed to route all the HD signals and a large number of analog paths for monitoring.

A key component to the success of the router is its 3500PRO control system. PESA has spent a considerable amount of time working with mobile truck users and understands the time constraints put on configuring and re-configuring production setups. The 3500PRO can be reconfigured quickly and makes it easy to load new setups or change them on the fly. Built-in diagnostics and Ethernet connectivity allow for simple adjustment and checking of critical signal paths, while the system's spreadsheet-style configuration setup provides time-saving, intuitive menus.

Much of the equipment incorporated in 10HDX is designed to provide the HD feeds increasingly in demand, while also satisfying the continued need for SD production. Although our newest truck is large, these hybrid solutions deliver valuable space and cost savings that help us put the most functionality into the smallest possible amount of space. They also give operators a new level of flexibility in working with different formats from a variety of sources.

In addition to our PESA gear, the 10HDX equipment list also includes 11 Grass Valley DK 6000 triax cameras (1080i or 720p switchable at the head), five EVS replay systems (including the HD SpotBox-XT), a Grass Valley Kalypso HD video production center, a dual-twin Abekas Dveous system, a Euphonix System 5 audio mixer with 96 inputs and 96 outputs, and two Chyron Duet character generators.

For storage and playout of video, we looked to EVS and its networked replay and edit systems. A 2RU EVS Xfile digital archive provides access to all images

recorded by our EVS LSM-XT and maXS servers. As clips are created on the HD server, a copy — pure data — is transferred automatically to the removable media inside the Xfile.

The Kalypso switcher installed in the truck has an internal still store and transform engines, and may be switched between 1080i or 720p formats. The switcher maintains the same user interface, feature set and effects-generation capability as the SD version while supporting either SD or HD programming. The dual-twin Dveous/MX universal-format DVE system, also designed for hybrid operations, lets operators create real-time video effects in SD or HD with just a quick setting change.

The visitor-feed side of 10HDX's dual-feed capability is the largest we've ever built, providing a robust production environment for the secondary broadcasts as well as the primary. It has a full 5RU-wide production wall that is as large as a straight-body truck. It runs with a 1-M/E panel from the Kalypso, which provides four keying layers, and operates along with a companion audio trailer equipped with a 32-input Soundcraft mixer.

Mobile production units have always been on the leading edge of SD and HDTV technology, and broadcasters and cable networks depend on these units to produce many of the high-profile events seen in HDTV today. Every piece of HD equipment selected must be dependable and reliable; failure is not an option when we're on the road. BE

Phil Garvin is the manager and co-owner of the Mobile TV Group, and owner and operator of systems integrator Colorado Studios.


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DEMO ROOM

AUTOMATION SYSTEM

Pro-Bel Morpheus: Manages everything from simple server playout to complex channels where schedules are changing regularly; at the core is Pro-Bel's Mediaball concept, a package of media and data elements that are brought together at transmission time; complex events can be easily constructed and played out using Mediaball; features multichannel playout and a scalable and flexible architecture.

631-549-5159; *www.pro-bel.com*

ELECTRO-OPTICAL SWITCH

Multidyne EOS-4000: A versatile, multipurpose, non-blocking, transparent, electro-optical switch; provides high-speed switching between ports with minimal effect on overall network latency; is capable of switching digital signals up to 4.25Gb/s with any of its 144 ports, in a compact 4U chassis.

516-671-7278; *www.multidyne.com*

ROUTING AND PRODUCTION SWITCHER LINK

PESA and Snell & Wilcox interface: Links the PESA 3500PRO router control system and the Snell & Wilcox Kahuna SD/HD production switcher; streamlines operations by giving the user access to any input of PESA's Cheetah multirate video router directly from the Kahuna control surface; router source names are transferred over to the production switcher control panel; a physical connection between the Kahuna processing unit and the Cheetah router allows for the passage of video in either SDI or HD-SDI format.

631-912-1301; *www.pesa.com*
212-481-2416; *www.snellwilcox.com*

STORAGE AREA NETWORK

Studio Network Solutions X-4: Includes 1.6TB of SATA storage in a 1U enclosure; contains a single RAID controller and two client licenses of SAN software; is based on the iSCSI protocol; offers more bandwidth and greater distance capabilities than USB or FireWire; can create a high-performance SAN using Ethernet components; is part of the globalSAN family.

877-537-2094; *www.studionetworksolutions.com*

LASER INFRARED THERMOMETER

Saelig Ki-111: Can reveal out-of-reach or unsafe hotspots; a 630nm red laser points to a target spot for reading temperatures with 0.25S response time from -30°C to +550°C or -22°F to +1022°F; has an auto data hold function, so the backlit LCD display can be read after the unit has been moved; reads maximum/minimum or high/low alarms; emissivity is adjustable from 0.1 to 1.00; reads an area with 100mm diameter at a range of 1m.

585-385-1750; *www.saelig.com*

DIGITAL VIDEO SWITCHER

FOR-A VPS-700 GINGA: Includes 2-D DVE for every input, up to 16 SD inputs and outputs, six keyers, six chroma keys and six channels of 2-D or 3-D DVE; offers optional 2-D DVE in every input; delivers up to 32 DVE channels; supports 525/60 and 625/50 SD formats; features eight standard inputs, each of which has a frame synchronizer and still store feature using the F/S freeze and eight standard outputs, which can be increased by increments of four up to 16 primary inputs, 16 outputs and six key layers (four keyers and two DSK).

714-894-3311; *www.for-a.com*

Chapters

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Help Wanted

MAINTENANCE SUPERVISOR

Maintenance Engineer -Supervisor, WYIN TV Merrillville/Chicago. Troubleshoot electronic equipment. Track and report on equipment, system repair and maintenance status. Minimum 2 years engineering or technical electronics school equivalent, with emphasis on broadcast systems. Prefer 5 years broadcast maintenance experience. Good troubleshooting and problem-solving skills. Solid understanding of cabling and cable management, digital theory, microprocessors, computer operations, solid state electronics, video/audio editing, IOT and solid state transmitters, microwave and satellite. Must be competent in the use of electronic test equipment. Must be able to EIC remote productions. Prefer experience Comark TX and DVCam cameras and VTR maintenance. Good communication and computer skills necessary.BE preferred.

Cover letter, resume and salary requirements to:
Henry Ruhwiedel, WYIN TV
8625 Indiana Place
Merrillville, IN 46410
Fax 219-755-4312
or employment@wyin.pbs.org.

Help Wanted

CHEIF ENGINEER

WGTU/WGTQ-TV Max Media of Traverse City LLC, seeks Chief Engineer. Position is responsible for ensuring station compliance with all Federal, State and Local regulations as well as operational, capital budgeting, planning, and acquisition of equipment purchases for the station. The Chief Engineer is responsible for all technical operations of the corporation's facilities including the maintenance and repair of all station equipment including transmitters, microwave and satellite systems, video servers, computers, and networking systems. BSEE or equivalent with at least 5 years in commercial broadcast engineering management. FCC and/or SBE certification is desirable.

Equal Opportunity Employer. No phone calls please - Resumes in confidence to:
President
Max Media of Traverse City LLC
WGTU/WGTQ-TV
201 E. Front Street
Traverse City, MI. 49684

Help Wanted

SYSTEMS DESIGN ENGINEER

Beck Associates, a premier national television systems integrator, is currently offering a position for a world-class systems design engineer. Potential candidates must have extensive experience in broadcast systems design applicable to projects such as television stations, network production and origination facilities, satellite uplink and downlink facilities, production houses, twenty-four hour news facilities, and mobile production units. We are a fast-paced, high-standards firm with multiple projects currently underway in all regions of the country. Potential applicants must be capable of large-scale systems design as well as effective project management. Position would require relocation to Austin, TX. We offer excellent health and retirement benefits.

Résumés may be forwarded to:
amy@becktv.com

SOFTWARE ENGINEER

Television Automation - Design and develope real-time software systems for television automation; develop algorithms for computer automation systems; develop hierarchical storage management system for digital video resident in caches and video file servers. Master's degree in Computer Science or a related field or foreign equivalent. Salry commensurate with exp. 40 hrs/wk, 8 AM - 5 PM, M-F.

Mail resume to:
Florical Systems, Inc.
4581 NW 6th Street
Gainesville, FL 32609

BROADCAST OPERATIONS - BROADCAST ENGINEER

Bloomberg TV has a challenging opportunity within the Broadcast Engineering Group. Responsibilities include but are not limited to:

- Coordinating and performing maintenance of equipment as needed to support live broadcast operations.
- Troubleshooting production/on-air issues.
- Updating transmitter/shift logs, conducting tests and diagnostics evaluations, and executing checklists to discover equipment and/or system anomalies.
- Coordinating and installing new components and systems, as well as creating and update engineering documents and diagrams.

The qualified applicant will have a minimum of 12-18 months experience in a Help Desk environment and must possess excellent communication skills. The ideal person should be a team player, calm under pressure, able to multi-task, have superior trouble-shooting skills and be customer focused.

Please apply online via the Bloomberg "Job Search" at careers.bloomberg.com.

Help Wanted

SOUND VIDEO AND COMMUNICATIONS SYSTEMS DESIGN POSITION AVAILABLE

Auerbach Pollock Friedlander seeks a qualified person with demonstrated experience in corporate, themed entertainment and/or theatre industry design of Sound Video and Communications Systems for full time positions in the San Francisco Office.

Applicants must demonstrate:

- Design experience with Sound Video and Communications Systems Design for large theatrical and/or entertainment industry projects.
- Knowledge of technical theatrical and building systems.
- CAD and technical architectural drawing skills.
- At least 5 years experience in the field

Project work includes new construction and renovation of major music venues, multipurpose performance halls, themed event venues, university performance and teaching facilities, community theatres, outdoor venues and media facilities.

Interested parties should send a letter of interest and resume via fax or email, no phone calls please.

Mike McMackin, ASTC
Auerbach Pollock Friedlander
225 Green Street
San Francisco, CA 94111
Fax: (415) 392-7530
e-mail: Manager@AuerbachConsultants.com
No telephone inquires please.
All inquiries will be kept confidential

Help Wanted

ENGINEERING

We are continuing TO GROW!

RF Engineer

In this role, you will be responsible for repairing, maintaining, and performing preventative maintenance and upgrades on all equipment associated with the Broadcast RF signal, to include Scientific-Atlanta encoding system, switching equipment, and fiber optics system. The candidate we seek will have an AS degree in Electronics. Experience may be substituted for a degree, 3 yrs. technical experience in Broadcast equipment maintenance, and significant experience with digital audio and video signals. Experience with Scientific-Atlanta encoding systems, Phillips/BTS switching systems, and fiber optics systems a plus. The ability to work nights, weekends and holidays is a must.

Qualified applicants should submit resume and cover letter to: **Jeanette Cooper, 6505 Blue Lagoon Drive, Miami, FL 33126; fax: 786-273-4883; e-mail: jeanette_cooper-cw@discovery.com.** EOE

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Discovery COMMUNICATIONS

TV TECHNICIAN

Madison Square Garden, The World's Most Famous Arena, has a unique growth opportunity for a Technical Maintenance Engineer to keep our sports broadcasts on the cutting edge of technology.

As a member of our Broadcast Maintenance Group, you will perform routine maintenance, trouble-shooting and repair of all systems within the facility to ensure consistent quality of broadcasts. Our maintenance group is also responsible for planning and integrating new technologies while providing technical support for all productions including outside clients.

The ideal candidate will have: BS/BA, Technical Degree or Military Training – with SBE Certification and/or FCC General Class License a plus; 3-5+ years of experience as a Technical Maintenance Engineer in a broadcast or cable production facility; component-level maintenance and repair experience on a variety of production equipment including Sony HDCam, Digibeta, Beta SP, production switchers & routers, GV Saturn MCS, Jupiter Control System, GV and BTS routing switchers, Chyron Infinit and Duet, Thomson Automation systems and Panasonic DVC Pro; thorough knowledge of Windows/Mac/Unix-based operating systems and LAN/WAN platforms; AutoCad proficiency; significant installation/project experience; ability to trouble-shoot and work around problems in a fast-paced live broadcast environment.

MSG Network is a union facility that operates 24 hours a day. Your work schedule will include nights and weekends. Madison Square Garden offers attractive compensation and benefits.

For immediate consideration, please send resume and salary requirements, to:

msghr@thegarden.com • Fax: 212-465-6026
Madison Square Garden, HR Department
Two Pennsylvania Plaza, 15th Floor
New York, NY 10121

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Help Wanted

CHIEF ENGINEER

$36,400/Yr

To maintain television, computer and networking equipment, multi-camera, audio-video equipment, media-video servers and video graphic editing equipment for a Christian Television Station in Chicago, Illinois. Must be fluent in Romanian, have a Bachelor's degree in Electrical Engineering and at least 2 years experience in Television Broadcasting.

fax resume: 773-267-0007

MANAGER, TECHNICAL SALES

Gainesville, FL - Oversee analysis of sales statistics and direction of sales efforts for manufacturer of television automation systems. 2 yrs exp. Salary commensurate with exp. 40 hrs/wk, 8 AM - 5 PM, M-F.

Mail resume to:
Florical Systems, Inc.
4581 NW 6th Street
Gainesville, FL 32609

MAINTENANCE ENGINEER

Needed for Albuquerque New Mexico. Must be an experienced Bench Tech with experience in Transmitters & Microwave. Some traveling required throughout the state. Experience with Thales Transmitters a Plus. Great Place to live and plenty of things to do.

Please fax your resume and cover letter to Anthony Liparoto at:
anthony.liparoto@newmexicoswb.com
505-797-1919

ELECTRONIC MAINTENANCE TECHNICIAN

WTTW11/Chicago, Chicago's Premier Public Television Station, is seeking an Electronic Maintenance Technician for our Sears Tower transmission facility and our North Side Chicago broadcast and production studio facility. As a member of our Electronic Maintenance team you will be performing routine maintenance and participating in numerous broadcast and production related construction projects at the studio and transmitter locations. The ideal candidate will have experience in maintaining high-powered UHF (DTV), VHF (Analog) and FM radio transmission systems, associated microwave equipment, and computerized remote control equipment. Experience working in a broadcast and production studio facility is a plus.

Submit resume and inquiries to:
Laura Backus, VP of Human Resources
Window to the World Communications Inc
5400 N. St. Louis Avenue
Chicago, Illinois, 60625
Fax: 773-509-5300
Email: jobs@networkchicago.com

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Help Wanted

Help Wanted

Production System Administrator/Media Manager

CBS News, NY seeks an experienced professional to perform maintenance on Avid production system, install software/hardware upgrades and interact with Avid support.

Ideal candidate will be self-motivated, focused, perform work well under pressure and across functional organizations in a project team environment, have 3+ years' experience with Avid Technology's Unity for News production system, specific knowledge of digital asset management and digital editing workflow. A B.S. Information Technology is preferred; IT certification/experience troubleshooting/resolving system level software/network issues is desirable; broadcasting experience/ACSR are a plus.

Enjoy a competitive salary/benefits package. Apply at: **www.cbscareers.com**. Include salary requirements and the referral source.

CBS

No company paid relocation.
CBS Broadcasting Inc. is an Equal Opportunity Employer/AA.

CHIEF ENGINEER

Paxson Communications is seeking a hands-on individual to manage the technical staff along with the design, installation, repair and operation of all technical systems and equipment at a TV station. Requires a minimum of three years managing a television engineering department, FCC license, SBE certification and valid driver's license. Submit resume with salary history to:

Paxson Communications Corporation
Ref: Chief Engineer-Milwaukee
601 Clearwater Park Road
West Palm Beach, FL 33401
Fax: (561) 655-7343
E-mail: employment@pax.net
EOE

BROADCAST ENGINEERING TECHNICIAN
MTV NETWORKS

Fast-paced 24/7 environment seeks candidates to maintain the technical integrity of the Network Operations Center. Candidates should have 5 to 7 years experience in broadcast TV with extensive maintenance experience on Tape (D-2 and Beta) and Server based video platforms, video switchers, video/data routers, servers and archives. A comprehensive background in Baseband Video/Audio and RF infrastructures is required. Additional industry knowledge of analog and digital audio technology, satellite RF technology and distribution methods, data networks, servers, archive, distribution systems, analog and SMPTE standards is desired. Certificates in Harris/Louth Automation, Sony VTR maintenance on DigiBeta VTRs, or SBE preferred.

Please email all resumes to nocstaffing@mtvstaff.com, or fax to 631-300-3259.

CHIEF ENGINEER

Reports to VP Operations.

Job Description:

- Hire and manage operations and transmission engineers
- Manage and maintain equipment and technical systems related to channel origination, linear edit rooms, studio production, digital archive system and inbound and outbound fiber circuits.
- Interface with systems integrator in initial facility installation.
- Plan, install and negotiate future equipment acquisitions.
- Service as primary liaison with network transmission vendor.
- Develop quality control standard and procedures.
- Oversee the training of studio technicians.
- Maintenance of system documentation, repair logs and equipment inventory.

Requirements:

- Strong management and communications skills.
- Minimum of 7 years experience with a TV station or broadcast/cable network.
- Significant experience with master control systems, Louth automation and linear edit rooms.
- Significant experience with server and IT technology.
- Solid knowledge of satellite and fiber transmission .
- Useful experience: Sports event production, HD, VOIP, digital archive systems.

Education:

- Four year degree in electronics, broadcast technology, or the equivalent.
- BE certification from the Soc. Of Broadcast Engineers or an equivalent organization.

Please email or fax coverletter, resume and salary history to:

Attn: HR
hr@thetennischannel.com
Fax: (310) 430-7562

Help Wanted

SNG / SATELLITE TRUCK OPERATOR

Satellite Technology Systems (STS) is seeking an experienced Satellite Truck/SNG operator to run one of our 3 midwest based satellite trucks.

Work with the best equipment and best people in the business. Highest pay in the industry, (Up to 100K+ depending on qualifications) plus 4 weeks vacation and medical benefits.

We would be especially interested in a candidate who could serve a dual role as a SNG engineer/Chief engineer.

Requires Illinois Class B or CDL drivers license. Must have excellent driving record and references.

Job requires flexible 24/7 on-call schedule, which includes nights/weekends, overtime and travel. Must proficient at manually locating/identifying satellites using a spectrum monitor. Must work well under pressure and tight deadlines.

(We are also accepting resumes for freelance SNG, freelance C-Band, and future full-time C-Band operator positions)

Please email your letter and resume to:
sts@mc.net
or fax to (815) 728-1208

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Keeping your toolbox busy

BY PAUL MCGOLDRICK

Imagine you are working on this year's major home project (not that you really have time for it), and you decide to make a habit of not putting your tools away every day. At the end of your project, you look around your garage to see what tools you *didn't* use. Do you get upset if you see a particular saw or clamp that didn't get a showing during the job? No, I'm sure you don't. Just because you didn't need the tools doesn't mean that they are redundant — they're just not relevant to what you were doing. So, then why are directors of motion pictures and television productions upset if they don't use every tool?

One of the worst toolkits we have been handed in recent years is the infamous Table 3 from the ATSC (*www.atsc.org/standards/a_63.pdf*). It offers three line standards (480, 720 and 1080) for DTV with six different frame rates (23.976Hz, 24Hz, 29.97Hz, 30Hz, 59.94Hz, 60Hz), the choice of progressive or interlace scanning and a choice of aspect ratio with square pixels (4:3 or 16:9). The result is an intense complication of native versus input formats for display, considerable complications for production standards and even claimed excuses for DTV standards that most engineers would find absurd. But the standards are the kind of compromise that has, unfortunately, become all too common because of legal threats by other interested parties.

I personally blame the FCC for its cowardly stance on AM stereo as a starting point for the scared approach to standards that we have seen since then. We have put ourselves 10 years behind the rest of the world in cellular telephone services because of infighting in standards, we have confused the public on DTV standards, and we cannot even agree on what sort of language we should use in selling display products. Compare this to Europe where, when a standard is agreed on at an engineering level, everybody shares intellectual property and fights in the market with pricing, size, look and delivery.

Speaking of production tools, many years ago, working on the original "Dr. Who" series at the BBC, we had some of the cheesiest special effects you could imagine. Spaceship props were $5 models, landing a craft involved nothing beyond what you might find in a child's art box, and audio was from primitive processing boxes. But it all worked really well because the storyline was so intense. We even coped with the incredible noise and microphonic interference to the cameras that the doctor's robot produced when it moved around.

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But when you watch a modern production involving high-speed movement, intense explosions and scene changes in a small number of frames, your mind becomes numb from it all. The worst example is "Star Wars: Episode III - Revenge of the Sith." I left the auditorium with a headache after enduring the strained exhibition of every single special effect that George Lucas could provide.

Each scene seemed to be continuity-linked by a vision of spacecraft moving somewhere in the Lucas universe. Then it transitioned to an action scene, always short, using one of Lucas' extraordinarily tacky 1960s wipes — that not even Dr. Who would have used — before activating every single computer graphic, and more, that was on his Marin-based hard drive.

The result is a nauseating 24fps motion-problematic movie that screams technology for technology's sake, with no real story line except to tie the ends together and make some kind of perverted sense of the original Episode IV. While you want to scream, "Get a life, George," you also know that this is but the prelude to a *special edition* to follow later when the technology has caught up to allow him to do the things he will declare he always wanted to do, but couldn't. But then you could always tell him that he needed to get someone else to write the script and direct the movie — something that made "The Empire Strikes Back" the only decent production in the whole series — but then that wouldn't be using his whole toolbox. **BE**

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