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THE JOURNAL OF DIGITAL TELEVISION

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MASTER CONTROL SYSTEMS

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A tutorial for engineers

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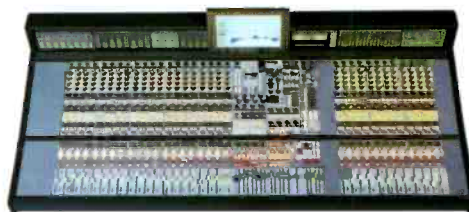
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CONTENTS

FEATURES

52 Master control systems

By John Luff

Master control design is undergoing dramatic changes. How will it affect your station?

60 The evolving master control

By Steve Sulte and Eric Goodmurphy

Master control has gone from monolithic boxes to modular and scalable systems.

67 Adopting an IT-based broadcast infrastructure

By Bruce Devlin

Want to go tapeless, share files, increase interoperability, and streamline workflow? See how it's done.



BEYOND THE HEADLINES

Download

14 A studio in a box?

FCC Update

20 DTV transition rules for translators and LPTV

DIGITAL HANDBOOK

Transition to Digital

24 Compression basics

Computers and Networks

30 Guaranteeing quality

Production Clips

34 Camera lens technology



ON THE COVER:
Modern master control rooms have different paradigms for monitoring and control. (Pictured: TNTinHD, courtesy Turner Broadcasting.)

(continued on page 8)

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CONTENTS

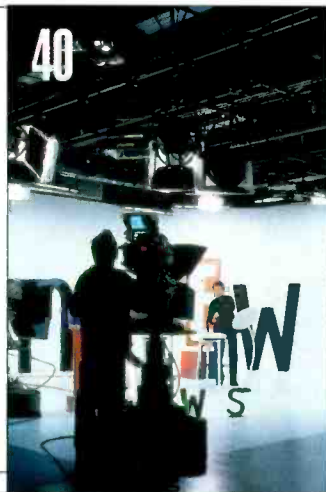
SYSTEMS DESIGN & INTEGRATION

Systems Design Showcase

40 HVAC for on-air facilities

Transmission & Distribution

48 Towers + lead paint = trouble



NEW PRODUCTS & REVIEWS

Applied Technology

72 Automating master control

Field Report

74 PrimeVision rethinks remote audio

Technology in Transition

76 Test and measurement

New Products

78 Proximity Artbox, plus other new products



DEPARTMENTS

10 Editorial

12 Reader Feedback

85 Classifieds

89 Advertisers Index

90 EOM

FreezeFrame



Name the product shown in the photo above. What year was it introduced?

Correct responses will be entered into a drawing for *Broadcast Engineering* T-shirts. Enter by e-mail. Title your entry "FreezeFrame-November" in the subject field and send it to: editor@primediabusiness.com. Correct answers received by Jan. 1, 2005, are eligible to win.



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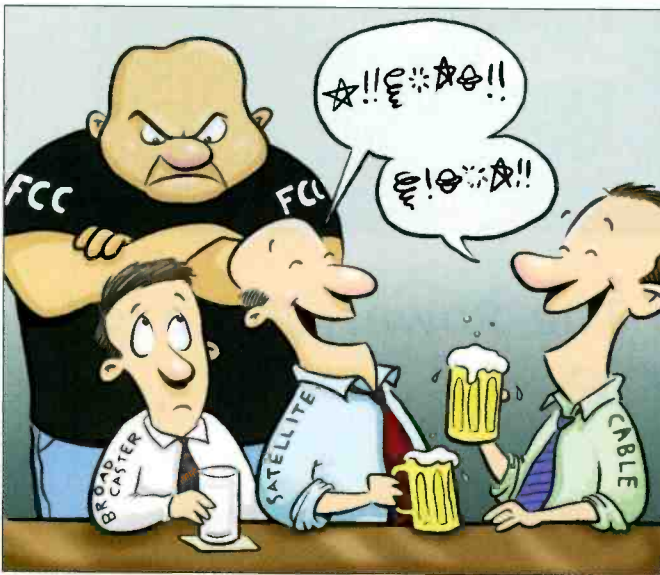
Recordable Media Data Storage Portable Energy Technological Partnerships



Profanity-free-TV

Broadcasters. We are such a dirty, foul-mouthed, obscene lot.

At least that's what you'd think by some of the news lately. It seems to have started with shock jock Howard Stern. Long known for pornographic radio (if that's possible) and foul language, Stern has always been in the sights of indecency groups and the FCC.



Following in his steps is the duo Opie and Anthony. They managed to cram more sex talk into radio, and a local church, than anyone thought possible. The FCC has reviewed and fined both radio shows. In the case of Stern, his network (Viacom) has paid millions of dollars in fines for foul and obscene language broadcasts. The last single fine of \$755,000 for sexually explicit content and other alleged indecency violations ended Stern's career at Viacom.

Television isn't far behind. Will we ever forget Janet Jackson's attempt to restart her career and promote her new CD by flopping her breast into the faces of an unsuspecting national TV audience during the Super Bowl half-time show? That incident really fired up the family viewing groups and, of course, those holier-than-thou types more commonly known as politicians.

While there have always been respectable people and certain groups that opposed what they define as indecent

broadcasts, today it's gotten entirely out of hand. Broadcasters may now have no choice but to implement a permanent broadcast delay on all live television.

A recent incident is a perfect example.

NBC was broadcasting live the EA Sports 500 at Talladega. In a post-race interview, race car driver Dale Earnhardt Jr. uttered (oh my gosh) the "s" word, saying, "this don't mean s..."

The uttering of that one word launched a series of complaints to the FCC from the Parents Television Council (PTC).

Laura Mahaney, PTC director of external affairs said, "I don't know why they [television broadcasters] haven't caught on yet that they need some kind of tape delay."

"Good grief," as the Peanuts character Lucy would say. I say, get a life!

It was one word — and a quite common one at that. What kid over the age of 24 hours hasn't heard it? Since when is one word such a big deal?

It seems the radio DJs and programmers have decided they would rather flee than fight. They are all moving to satellite, where the FCC, at least so far, doesn't give an "s" what programmers do. So we can have Howard Stern, Anthony and Opie, Dale Earnhardt and Joe from "The Sopranos" saying all the words they want without fear that the FCC will hunt them down. You see, it's satellite. It's not RF, or at least not the "public's spectrum," and besides you have to pay for it to get it.

What I can't figure out is this: Would it be okay for NBC and the other networks just to delay the over-the-air broadcasts and censor them, but let all the hells and damns and other words go out uncensored on cable and satellite?

After all, those are "paid" channels and that seems to be the FCC's criteria on regulation. Then Ms. Mahaney and her ilk could simply give up their cable and satellite systems and just watch OTA broadcast. Sure, they might go from having 200 channels to five, but heck, they'd have profanity-free-TV.

Broad Dick
editorial director

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



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Weather: Amsterdam

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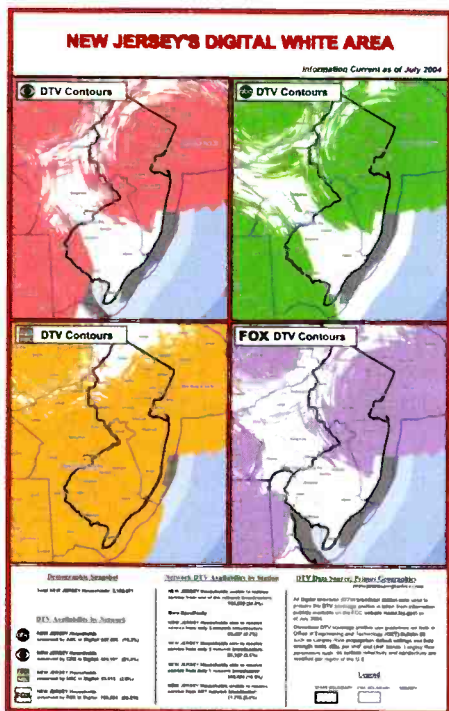


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DTV viewers

So, the Digital Transition Coalition says, "Thirty-nine million U.S. households can't get complete DTV service."

What is more important is that the "Digital Transition Coalition" can't even get their maps right. CBS and NBC national maps are swapped. And,

How can the DTC call itself a "group of consumer organizations," when we all know who is REALLY behind it?

it probably didn't really hurt their cause to completely omit NBC in the largest geographic market in the United States (Utah).

By the way, how can the DTC call itself a "group of consumer organizations," when we all know who is REALLY behind it, and what he wants to sell?

KEN W. ENGLISH
KSL-TV/KSL-DT

Editors' note: Additional information on this issue can be found in the Sept. 27 issue of "Beyond the Headlines," at broadcastengineering.com/newsletters/bth/20040927/dtv-service-incomplete/.

Defining "judder"

Dear Mr. Robin,

I recently ran across one of your past articles on the Internet and became interested in the section on temporal resolution. I'm not familiar with the term "movement judder," and I would like to learn more about it. Actually, I am interested in the whole subject of interline flicker and would appreciate any references you could provide.

SAM SCHWARTZ

Michael Robin responds:

The term "judder" is relatively recent and generally refers to the difficulty that film and television media have in portraying smooth and rapid motion. One old and still annoying example is the film "wagon wheel effect." Interlaced video suffers from interline flicker, most visible with synthetic video signals such as those produced by character generators. With the exception of such signals, interline flicker is relatively unnoticeable. The vertical resolution rarely exceeds 70

percent of the active video lines, and the watching distance is on the order of six times the picture height. This renders such artifacts invisible. A Google search will reveal a wealth of articles concerning movement judder. As far as interlace in general is concerned, I would refer you to classical television books, such as "Fundamentals of Television Engineering" by Glenn M. Glasford, published by McGraw-Hill in 1955 (!) and "Television Engineering Handbook" by Donald G. Fink published by McGraw-Hill in 1957 (!). Things have not changed much since these books were written.

July Freezeframe:

Q. In 1986, NHK announced a high-sensitivity camera pickup device called the HARP. It was updated to the Super-HARP in 2001. What does HARP stand for and how much more sensitive was each version than a conventional Saticon? **A.** HARP stands for High-gain Avalanche Rushing amorphous Photo-conductor. HARP was 10 times more sensitive, and the Super-HARP 100 times more sensitive, than a Saticon tube.

August Freezeframe:

Q. What do the following acronyms stand for? ACATS, DVD, MPEG, VADA, THX

A. **ACATS:** Advisory Committee on Advanced Television Service
DVD: Digital Versatile Disk
MPEG: Motion Picture Experts Group
VADA: Vertical Ancillary Data Area
THX: Tomlinson Holman's eXperiment or George Lucas' first film THX1138 (either is correct)

July Winners:

Patrick O'Brien, KATC-TV
Augusto Villasenor, Globecomm System
Fred van Let
Eddie H. Sills

August Winners:

The following people got four out of five correct:
Olumide Ojerinde
Mike Dunlap
Michael L. Scheumann, SCO ENGINEERING
Alex Oluchi
Mark Ferrell, Time Warner Cable

Test your knowledge!

See the Freezeframe question of the month on page 8 and enter to win a Broadcast Engineering T-shirt.
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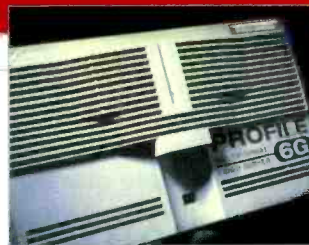
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A studio in a box?

BY CRAIG BIRKMAIER

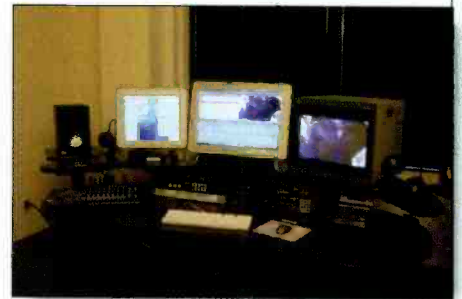
My how things have changed. Imagine what this column would be about if it had been written just a decade ago. How might one have described a TV studio in a box? The box could have been a remote truck or a bunch of travel cases, loaded with cameras, character generators, tape decks and other production components needed to produce a television program. For those applications needing only minimal audio and video mixing capabilities, you might even have found an all-in-one box that could get the job done. One thing that you would not have seen was a claim that a personal computer could be configured as a studio-in-a-box.

By the early '90s, PCs were making major inroads into audio production, and beginning to compete with dedicated systems for video paint and character generation applications. Nonlinear editing was beginning to emerge,

as an offline process to create edit decision lists. The ability to use a computer to produce a complete television program was predicted, but broadcasters and traditional video equipment suppliers were, shall we say, skeptical.

Some things have not changed as dramatically as some predicted. Broadcast-quality cameras and video recording systems are still big-ticket items from the handful of companies that remain standing. The introduction of DV camcorders has helped to democratize video production. However, until recently, those without the money to buy an expensive deck to play the tapes weren't able to capture clips for use as compressed video files. Composite, S-video, analog component video and SDI (SMPTE 259M/292M) still served as the interconnections for a professional video production system. This was true even in a one-man professional project studio — the equivalent of a studio-in-a-box.

Broadcast station infrastructures evolved down a uniquely broadcast-centric path, even as facilities upgraded from analog to digital. Crosspoint-oriented routing switchers



WealthTV, a high-definition network, uses Apple Final Cut Pro editing with Apple Xserve Raids. Photo courtesy A. F. Associates. Photo by Carmen Shettino.

emerged as the primary means of signal interconnection, with separate physical layers for switching audio and video streams. The notion of moving files between processing systems was for all intents and purposes meaningless. Broadcasters have built their digital infrastructures to mirror the analog infrastructures they were upgrading. The assumption behind this decision was that the purpose of a TV station was to deliver a single program stream to the transmitter.

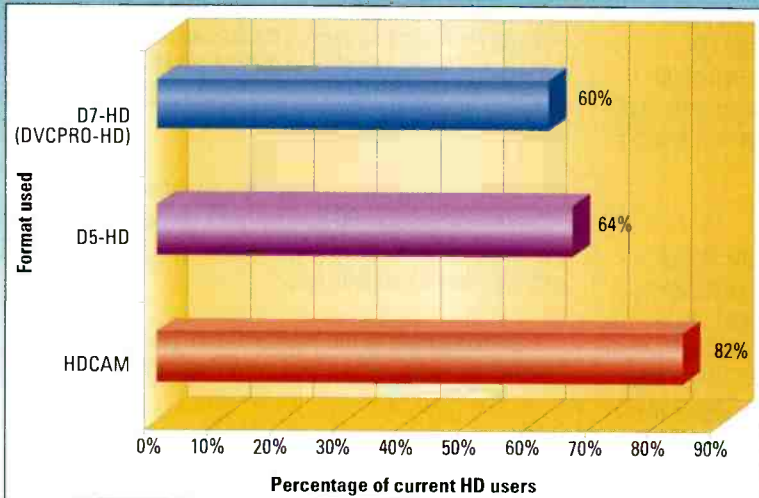
The philosophy behind this traditional view of television as a bunch of video streams was not fundamentally flawed. The fatal flaw was the notion that data networking and video networking would remain separate and unique.

The requirement to produce live broadcasts has driven the design of signal routing infrastructures for broadcast. Unfortunately, broadcasters have applied this philosophy to areas where switching and mixing baseband video/audio signals is not required. DTV master control is an excellent

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

One in five U.S. studios use HD in production

HDCAM takes the lead in HD formats most used



SOURCE: Trendwatch

www.trendwatch.com

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example. The rapid migration to video servers built from commodity IT components has helped to reveal the fundamental flaws in the traditional view of video system design.

A decade later, broadcasters and traditional equipment vendors are beginning finally to acknowledge the role of packet-based IT infrastructure in both traditional broadcast facilities and in new IT-based video production facilities.

Open Studio, or closed?

In the mid-90s, a new movement emerged called Open Studio. The initiative has had a profound impact on the evolution of video production. A series of open conference forums encouraged vendors of computer-based tools and traditional video production tools to work together to help facilitate the digital revolution. In the early years, these forums were quite entertaining as the two factions tore into one another, each claiming that the

predicted convergence of video and computing would never happen.

But it did happen. By 1995 the first nonlinear editing system with online-quality output reached the market. Due to increases in CPU speed, memory and storage, these systems soon evolved to handle uncompressed video streams and, more recently, both compressed and uncompressed HD production. In just a few years, online nonlinear editing has largely replaced tape-based online editing systems.

Rather than encouraging this convergence, however, most of the traditional video equipment vendors turned to a proprietary view of the future of television studio design.

In December of 1996 the first Open Studio Conference was held, with the goal of helping all parties work together to create the appropriate infrastructure for convergence of video and computing technologies. The conference succeeded in creating some lasting partnerships between traditional video equipment and computer technology vendors. Over the years, these partnerships have made advances that demonstrate the power of using commodity IT components to deliver digital, even HD, streams to end users in a variety of applications.

Several days after the 1996 Open Studio Conference, a meeting of the Society of Motion Picture and Television Engineers set the stage for the formation of the SMPTE/EBU Task Force for Harmonized Standards for the Exchange of Program Material as Bit Streams. Their first report outlined five areas of investigation: compression, physical link and transport layers for networks, wrappers and file formats, metadata, and file transfer protocols. (See Web links for a PDF version of the report.)

The final report of the task force was issued in 1998 (see Web links for URL). At this year's NAB, the SMPTE and Pro MPEG Forum celebrated the completion of some of the work called for in the SMPTE/EBU task force report. This includes the Media Exchange Format (MXF) and the Advanced Authoring Format (AAF). These new SMPTE standards tie together with the development of a Metadata Dictionary and SMPTE registry for metadata terms. Along the way the SMPTE also developed the SDDI standard, which allows the transport of packet data over a SMPTE 259M SDI link.

During the seven years that the SMPTE worked on these standards, the world did not stand still. While the Pro

Web links

SMPTE/EBU task force user requirements:
www.smppte.org/engineering_committees/pdf/tfhs_out.pdf

SMPTE/EBU task force final report:
www.smppte.org/engineering_committees/pdf/tf rpt2w6.pdf

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MPEG Forum held numerous interoperability demonstrations, the traditional video equipment vendors did little to make their products interoperate. Meanwhile, IT-based solutions have come to dominate the infrastructure used in many non-broadcast video production facilities. Standardized IT solutions including the

various flavors of Ethernet (10/100/1000BaseT), IEEE 1394 and Fibre Channel provide the interconnection infrastructure used for PCs and packet data routing systems. DVI provides the display interconnect needed to deliver uncompressed HDTV rasters to computer (and consumer) HD-capable displays. In the place of tape and optical-

disk-based video recording systems, many programs are now recorded directly to magnetic hard disk arrays.

Postmortem

The Open Studio initiative was quietly retired by the dawn of the new millennium. Not because of the quality of work done by SMPTE or any other standards group. The simple truth is that it was no longer needed. Computer-based video production systems have won the day — all that is left is for the technology to trickle down to the holdouts, those who bought into the video-centric view of studio infrastructures. Open Studio has given way to OpenDTV, where there is still much work to be done. Does anyone really know when the analog TV transmitters will finally be turned off?

Thus the following announcement (as reported by *Broadcast Engineering*) at the recent IBC Exhibition and Conference comes as no surprise. It came in the context of a SMPTE IBC tutorial on the standards they have spent the past seven years developing.

Given the rapid uptake of IT technology by the television industry, the adoption of digital content delivery and the associated desire to protect content through encryption schemes, the need has never been greater for standards and procedures to assist in the transition from a linear world to an IT-centric environment.

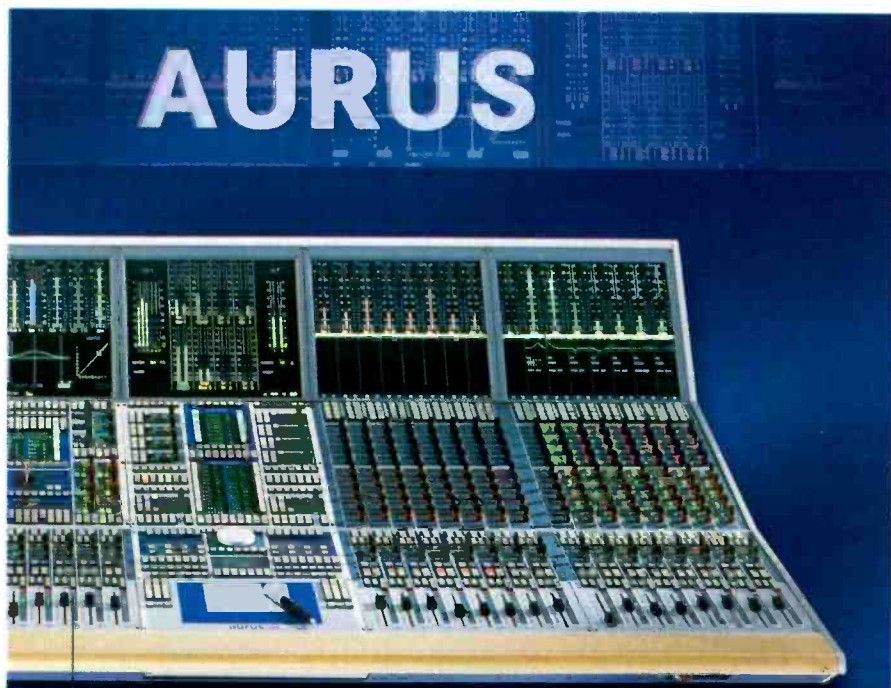
Speaking during IBC2004, SMPTE President Gavin Schutz emphasized that the society and other organizations must address networking technology and its ramifications on workflow. Those working in the industry increasingly must re-educate and re-train to transition from the old to the new, he said.

Maybe we are finally beginning to make some progress in the real DTV transition. **BE**

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



Send questions and comments to:
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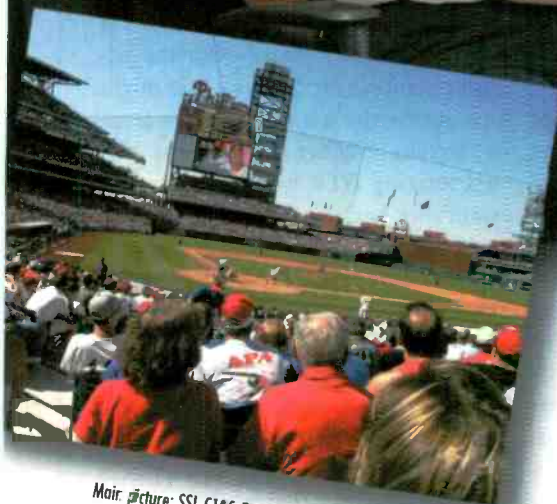
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C100

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

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DTV transition rules for translators and LPTV

BY HARRY C. MARTIN



The FCC has established rules for converting low-power television (LPTV), translator and Class A TV stations to DTV. From the FCC's viewpoint, there is no reason for so-called "secondary" television services to continue broadcasting in analog once full-service stations have completed the jump to digital.

Some central features of the regulatory future of these non-full-service television services follows:

- Current LPTV and TV translator license holders will be given two options. They can either "flash cut" to digital broadcasting on their currently authorized channels or temporarily operate on two channels —

Dateline

Television, LPTV and TV translator stations in Alabama and Georgia must file their renewal applications, biennial ownership reports and EEO program reports with the FCC on or before Dec. 1.

Television stations in Arkansas, Louisiana and Mississippi must begin their renewal pre-filing announcements on Dec. 1.

TV stations with at least one in-core channel must file their DTV channel election forms (FCC Form 382) in mid-December 2004. (The options under this form include (1) which in-core channel the licensee/permittee elects (for those with two in-core channels); (2) whether it will select its one in-core channel (for those with only one in-core channel); or (3) whether it will release the in-core channel(s) it has in order to make an election of a new in-core channel in a subsequent round.

their current analog channel and a to-be-assigned digital companion channel (if one is available).

- As long as they broadcast a stream of free over-the-air programming, LPTV and TV translator stations will be allowed to offer ancillary services (such as pay-per-view, Internet access, etc.) in any extra bandwidth.
- No firm date has been set for final conversion of LPTV, translator and Class A stations to digital and turn-off of all analog broadcasting. However, the commission has made it clear that the final date will be as soon as possible after the full-service cutoff.
- Conflicting applications for new digital channel authorizations will be subject to auction.
- Contour protection methodology for predicting interference between analog LPTV and TV translator stations will be replaced with DTV interference prediction methodology.
- After the current license holders have received authorizations to convert, the FCC will open the process up to the public for any left-over channels and areas not served.

There is a possible fly in the ointment. LPTV and TV translator stations by nature fit into the interstitial spectrum between full-service television station allotments. But the allotments for full-service stations are still in a state of flux. A complicated multi-round process was just announced by the FCC for the "repacking" of all full-service stations into channels 2 through 51. Channels 52 through 69, previously available for broadcast use, will be used for commercial wireless and public safety uses instead. This will displace some LPTV

and translator stations and limit the DTV options of many others.

Will there be any space left over for LPTV and translators? It's too early to tell, and it's premature for LPTV or translator licensees to panic. Realistically, it will be a year or two before the FCC finalizes plans for LPTV and translators, let alone implements them. January 2006 is the expected date for the third and final round of full-service station channel selections. The FCC cannot make any final plans for LPTV and translator station channels before then.

Finally, the commission declined to establish digital TV booster licenses. Boosters are transmitters on the same channel that fill in areas within the primary station's service area that might not receive the station's signal because of terrain or other obstructions. Not authorizing DTV boosters is understandable, because there will soon be a new fast-track proceeding at the FCC to allow full-service TV stations to use distributive transmission systems (DTS) technology. Near the end of its recent periodic full-service DTV order, the commission announced that it was approving the use of DTS technology "in principle." DTS technology replaces the primary transmitter with a number of smaller synchronized transmitters placed throughout the station's service area (think cell phone technology). As a result, it is the equivalent of many booster stations.

BE

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



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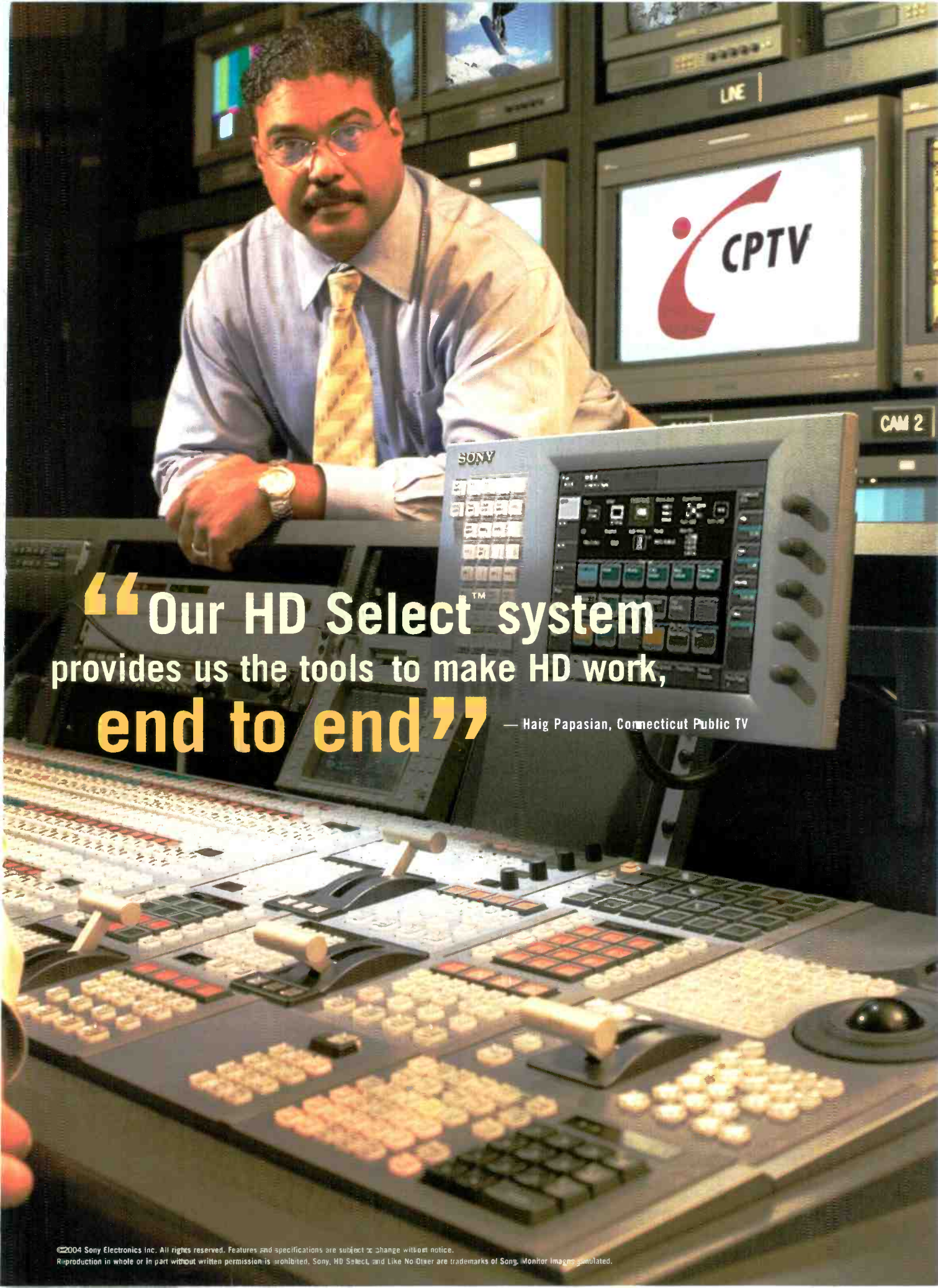
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Compression basics

BY MICHAEL ROBIN



The goal of video compression is to represent an image with as few bits as possible. Compression is achieved by removing the redundancies in the video signal. This article will deal with the MPEG-2 video compression concepts.

The MPEG-2 standard was developed for the delivery of compressed television for home entertainment. It is a set of defined compression and systemization algorithms and techniques with well-defined rules and guidelines allowing variations in the values assigned to many of the parameters and providing for a broad range of products and interoperability. They are integrated into an MPEG "toolkit" or syntax, which addresses a variety of

cost versus performance standards described in Levels and Profiles.

A further extension of MPEG-2, called the 4:2:2 profile, has been developed to record and transmit studio-quality video.

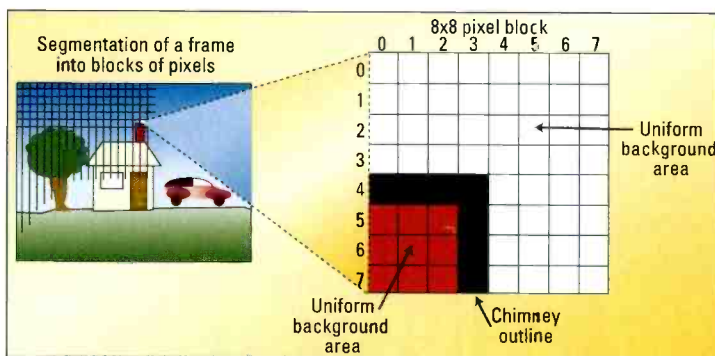


Figure 1. Formation of an 8x8 block

The MPEG tools

MPEG is best described as a collection of bit-rate reduction and compression methods that are available to the designer. These tools are:

• **Discrete cosine transform (DCT):** DCT is a lossless, reversible mathematical process that converts spatial amplitude data into spatial frequency data. As shown in Figure 1, the image is divided into blocks of eight horizontal pixels by eight vertical pixels (8x8 block) of luminance (Y) and corresponding color-difference (C_B and C_R) samples. A block of 8x8 pixels is transformed into a block of 8x8 coefficients describing the amplitude at a particular frequency. The upper left corner represents the DC component.

Moving across the top row, the horizontal spatial frequency increases; moving down the left column, the vertical spatial frequency increases.

Essentially, the signal is converted into one value for the DC component and 63 values for 63 frequencies, a process equivalent to a spectrum analysis. The video signal has most of its energy concentrated at DC and the lower frequencies of the spectrum.

The DCT process results in zero or low-level values for some or many of the higher spatial frequency coefficients. It in itself does not result in a bit-rate reduction. The DCT process merely converts the source pixels into a form that allows an easier compression. The coefficients are read out in a zigzag fashion, starting with a DC and ending with the highest frequency.

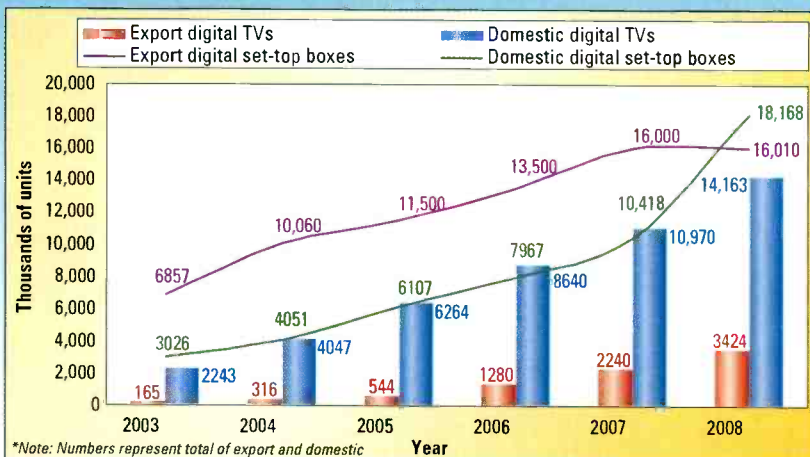
• **Quantizing:** This lossy process assigns more bits to low-frequency coefficients and less bits to high-frequency coefficients. In addition, it can be used to maintain a constant bit rate if necessary.

FRAME GRAB

A look at tomorrow's technology

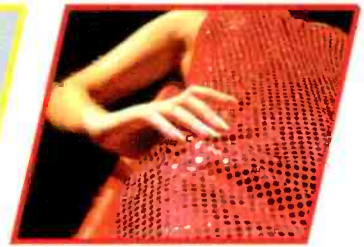
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- **Run length coding (RLC):** The process of quantizing results in non-zero coefficients followed by a string of zero values. The RLC transforms this sequence by sending a unique code word instead of a long string of zeros, thus reducing the bit rate.

- **Variable length coding (VLC):** This process allocates short code words to frequently occurring values and long code words to infrequently occurring values.

- **Buffer:** The buffer helps achieve a

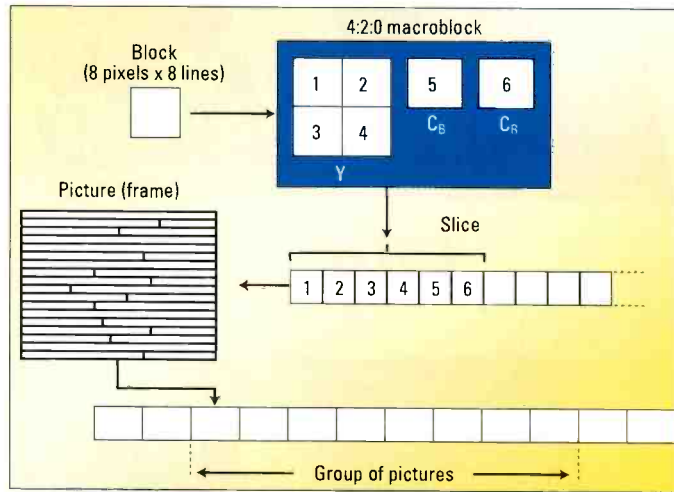


Figure 2. MPEG-2 4:2:0 video data stream architecture

needed by the decoder.

- **Group of pictures (GOP):** A GOP is made up of a sequence of various combinations of pictures.

MPEG picture types

The MPEG compression scheme results in three types of compressed pictures:

- **The intraframe coded picture (I):** An I picture does not depend on information from other pictures. Only the spatial redundancies are removed. I pictures provide only moderate amounts of compression.

Figure 3 shows a conceptual block diagram of an I compression scheme.

- **The interframe coded picture (P):** The interframe compression reduces both the spatial and the temporal redundancies to increase the efficiency of the data compression. Figure 4 shows a conceptual diagram of an I/P compression scheme. The output of the spatial coder feeds a spatial decoder, which consists of an inverse REQ (IREQ) and an inverse DCT (IDCT), which reconstruct the predicted (past or I) picture. A fixed store memorizes and delays the I picture and feeds the motion estimator. The motion estimator compares the I picture with the present picture to create forward motion vectors. The I picture is shifted by these vectors to generate a predicted P picture. The predicted P picture is subtracted from the real (present) picture

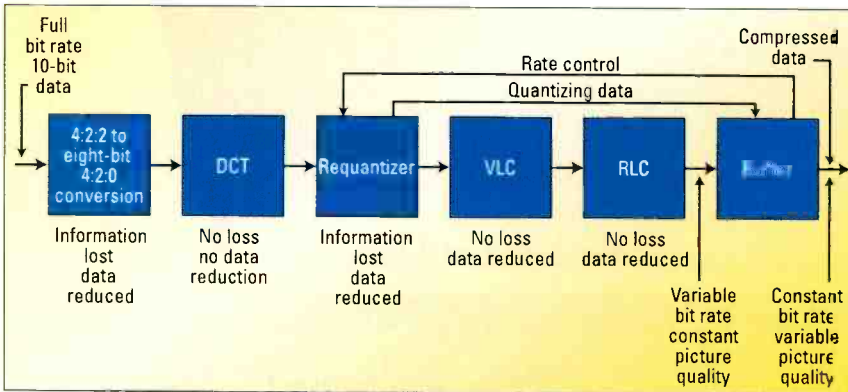


Figure 3. Conceptual block diagram of an intraframe (spatial) coder

constant bit rate, as required by recording and transmission of data.

Video stream data hierarchies

The MPEG-2 data structure is made up of six hierarchical layers:

- **Block:** Luminance and chrominance data are separated in 8x8 blocks of Y, C_B and C_R values.

- **Macroblock:** A macroblock consists of four blocks of 8x8 values in a window of 16x16 pixels of the original picture and their associated C_B and C_R values. The number of chroma blocks in the macroblock depends on the sampling structure (4:4:4, 4:2:2 or 4:2:0).

- **Slice:** A slice is made up of several contiguous macroblocks.

- **Picture:** A picture consists of a group of slices and contains information

- **Video sequence:** A video sequence includes a sequence header, one or more GOPs and an end-of-sequence code. Figure 2 shows the makeup of a video sequence.

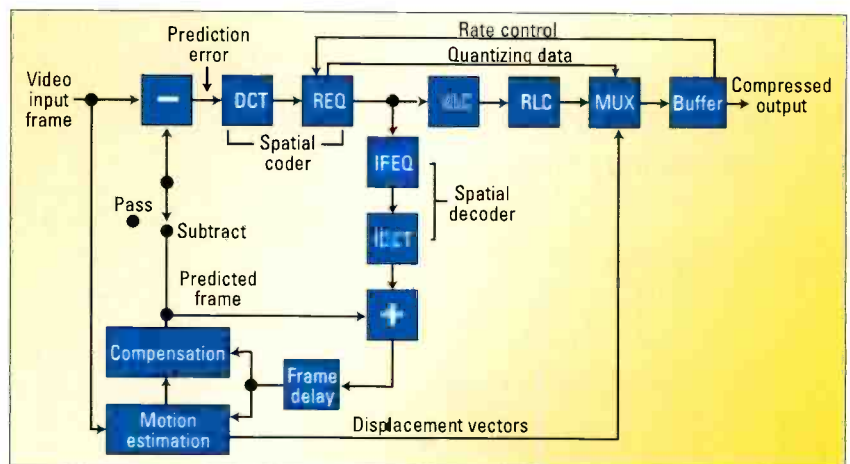


Figure 4. Conceptual block diagram of an interframe I/P encoder with motion compensation

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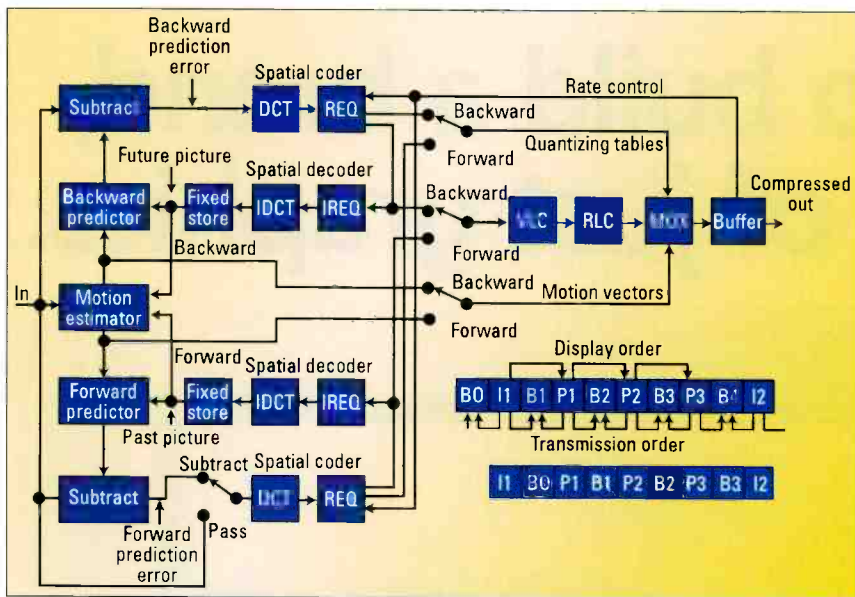


Figure 5. Conceptual block diagram of an IPB encoder

an I picture, followed by a sequence of P and B pictures. The P pictures are formed using previous I or P pictures as a reference. The B pictures use both past and future pictures as a reference. The MPEG algorithm allows the encoder to choose the frequency and location of I pictures.

In applications where random access is important, I pictures are used twice every second. The encoder also chooses the number of B pictures between any pair of I or P pictures. A GOP is no more than 15 pictures long, starting with an I picture and finishing with a B picture. A typical arrangement of I, P and B pictures is shown in Figure 5 in the order in which they are displayed. The MPEG encoder reorders the pictures in the video stream to present the pictures to the decoder in the most efficient sequence.

Profiles and levels

MPEG-2 offers a wide choice of parameters, resulting in millions of possible combinations. The concept of "profiles" and "levels" serves to restrict the choice of parameters. The restrictions affect the choice of the picture size (horizontal pixels x active lines), the frame structure (I,P,B), the maximum data rate and the sampling structure. The

and produces a forward prediction error, which feeds the spatial coder (DCT and REQ).

In the motion compensation block, vectors are calculated that best predict the present picture. Because frames may be different in various manners, the prediction may not be perfect. If there were no motion and no other changes, the present could be perfectly predicted and the difference frame output would be zero, which would be easy to compress. When the two frames are different, the difference frame can still have much less information and will be easier to compress.

The output of the spatial coder feeds the VLC and the RLC. A multiplexer (MUX) combines the compressed data with the motion vectors and feeds the buffer. The buffer generated rate control ensures that the bit rate at the REQ output will not cause buffer underflow or overflow. The REQ feeds the buffer with quantizing table information for use by the decoder. To create an I picture, the video input feeds the DCT directly. After the I picture is created, the DCT is fed the predicted frame.

• Bidirectional coded pictures (B): A new B picture from the input contains predictable information present in the I and P pictures, as well as unpredictable (discovered) information. Figure 5 shows a conceptual diagram of an IBP compression scheme. The motion compensator compares the B picture

with the preceding I or P picture and the P picture that follows it to obtain bidirectional vectors. Forward and backward motion is used to generate several predicted B pictures. These are subtracted from the current picture. The resulting forward and backward data are switch selected depending on which of the two are nearer to reality. The picture differences are spatially coded in the usual manner and feed the VLC, RLC and the buffer.

• The IPB sequence: The I, P, B frame coding results in a GOP starting with

Level	Profile					
	Simple I,P 4:2:0	Main I,P,B 4:2:0	4:2:2 I,P,B	SNR I,P,B 4:2:0	Spatial I,P,B 4:2:0	High I,B,P 4:2:0 or 4:2:2
High		1920x1152 60fps 80Mb/s				1920x1152 60fps 100Mb/s
High 1440		1440x1152 60fps 60Mb/s			1440x1152 60fps 60Mb/s	1440x1152 60fps 60Mb/s
Main	720x576 *30fps 15Mb/s	720x576 30fps 15Mb/s	720x608 30fps 15Mb/s	720x576 30fps 15Mb/s		720x576 30fps 20Mb/s
Low		352x288 30fps 4Mb/s		352x288 30fps 4Mb/s		

Table 1. Maximum constraint parameters for MPEG-2 levels and profiles (*frames per second)

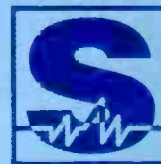
choices offered allow for standard-definition (720x576 or 720x480) as well as HDTV formats (1280x720 or 1920x1080). Table 1 summarizes the constrained parameters. **BE**

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

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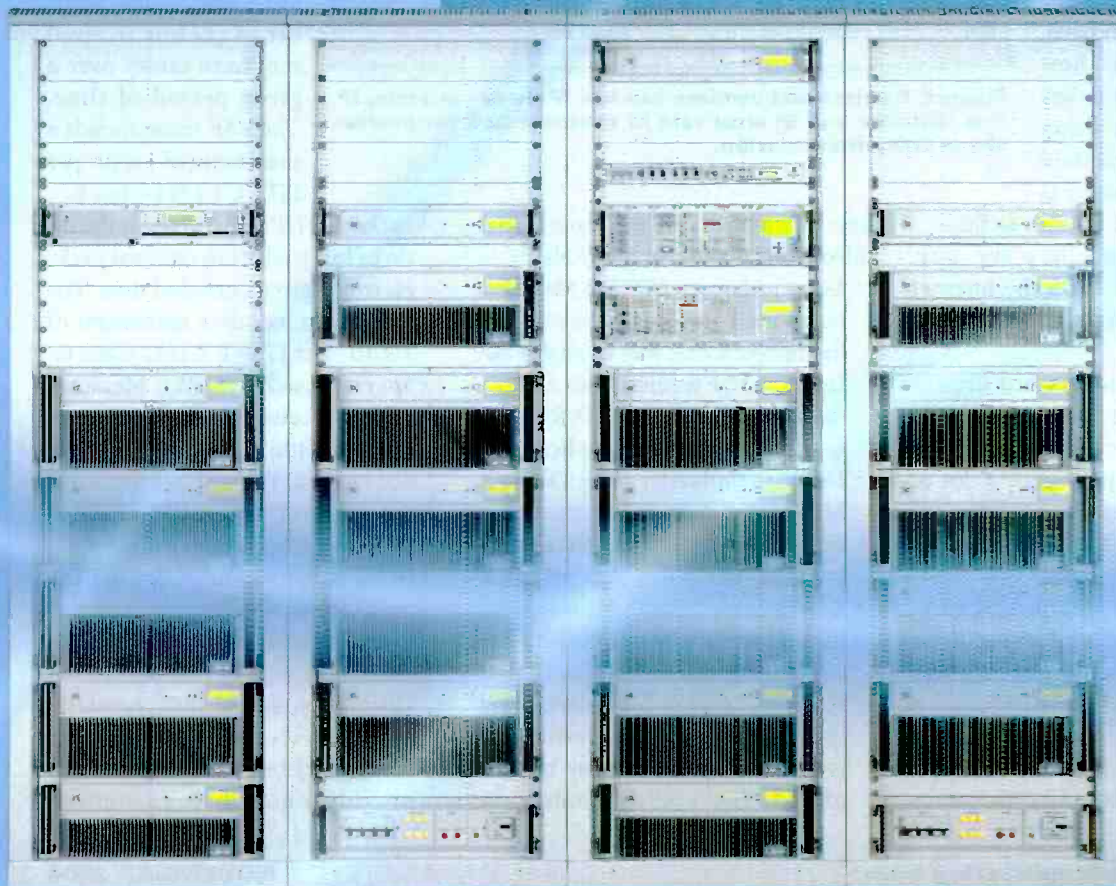
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Guaranteeing quality

BY BRAD GILMER

I have some bad news: The Internet is unreliable. It isn't just unreliable, it was designed to be that way. Internet Protocol (IP), the fundamental datagram transport protocol on the Internet, makes no guarantee that the information you send will ever get to its destination. Not only that, User Datagram Protocol (UDP), which carries quite a bit of Internet traffic (including many video applications), is also unreliable. Even Transmission Control Protocol (TCP) — which is supposed to take care of packets that are dropped, out of sequence or duplicated — is undependable. You might wonder how we have managed to get by all these years using this "best effort" method of delivery. The answer is that it's been good enough so far.

But, somewhere along the way, people began relying on the Internet to do things it was never intended to do reliably.

VoIP and professional video streaming have made the issue of quality of service (QoS) one of the top technical issues for service providers. A lot of good work has been done, and we are starting to see QoS solutions being deployed in the marketplace.

Several technical forums and standards bodies have been looking at the issue of QoS over wide-area networks (WANs). The ITU has developed a standard (*ITU-T Recommendation Y.1541*), that specifies a number of classes of service based on the needs

of different applications. The Video Services Forum (VSF) has been working on establishing a set of QoS parameters focused on transporting real-time professional video across WANs. This work is based, in part, on the findings of the Pro-MPEG Forum's WAN group. Use the following param-

eters to establish QoS for professional video transmission over WANs.

- *Delay or latency (IPTD)*: Measures how long it takes packets to cross the network one way (transfer delay). The VSF recommends a maximum of 100ms of IPTD for professional video WAN applications.
- *Delay variation or jitter (IPDV)*: Measures difference in arrival time between packets. The VSF recommends a maximum of 50ms.
- *Loss distance (IPLD)*: Measures the minimum number of packets between lost packets. This is a critical recommendation for determining the characteristics of any error-correction schemes that may be employed. The VSF recommends a minimum of 50, based on Internet Engineering Task Force (IETF) 3357 and the Pro-MPEG Forum Code of Practice number 3.
- *Loss period (IPLP)*: Measures the number of consecutive packets lost in a row. This is another critical recommendation for determining the characteristics of any error-correction schemes that may be employed. The VSF recommends a maximum of five, based on IETF 3357 and the Pro-MPEG Forum Code of Practice number 3.
- *Packet corruption (IPER)*: Measures the error rate — the number of packets received that have errors over a given period of time. The VSF recommends a maximum of 1×10^{-4} per ITU-T Y.1541 Class 0.

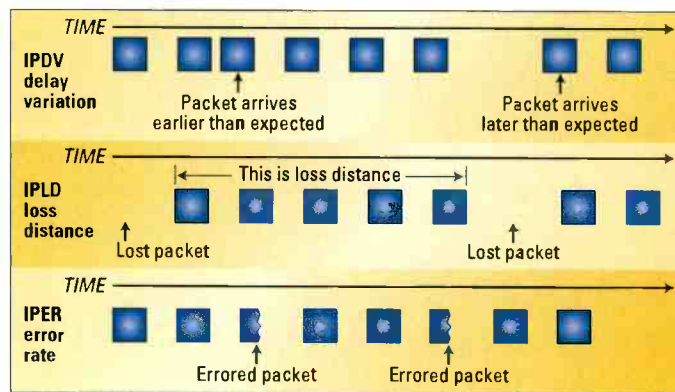


Figure 1. Carriers and vendors can use IP delay variation, IP loss distance and IP error rate to measure QoS for professional video transmission.

eters to establish QoS for professional video transmission over WANs.

- *Packet loss (IPLR)*: Measures the ratio of lost packets to received packets over a given period of time. The VSF recommends a maximum of 1×10^{-3} per ITU-T Y.1541 Class 0.
- *Spurious packet (SIPR)*: Measures packets received for which a corresponding transmitting packet was not created. The VSF recommends a maximum of 1×10^{-3} spurious packets per second.
- *Availability*: Measures uptime, expressed as network events per hour. There has been a lot of discussion regarding this parameter. Ultimately, availability translates into service-level agreements (contracts) between WAN service providers and their customers.



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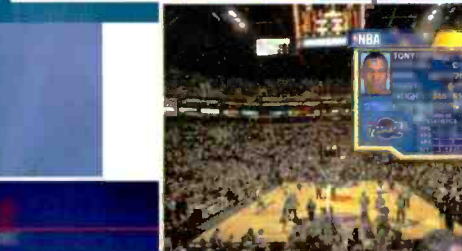


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The VSF has said that useful service quality categories for professional video with delivered bit rates from 1- to 400Mb/s would be: <.003 network event per hour, <.01 network event per hour, <.1 network event per hour and <1 network event per hour.

A network event is defined as a single occurrence of packet(s) loss in the network.

While work is ongoing, it is encouraging that the industry is reaching a consensus regarding the parameters and measurements that should be used to establish QoS for delivery of video over WANs.

Given a set of parameters, network engineers need a technical framework within which they can implement a given QoS. While exact details of QoS frameworks vary, these frameworks share some common elements:

- **Signaling and admission control:** Controls the amount of traffic that is allowed to enter the network.
- **Shaping:** Provides a way to smooth out the bursty nature of traffic.
- **Policing:** Involves enforcing policies and dropping traffic from the network if it does not conform to rules established to guarantee the QoS on the network.

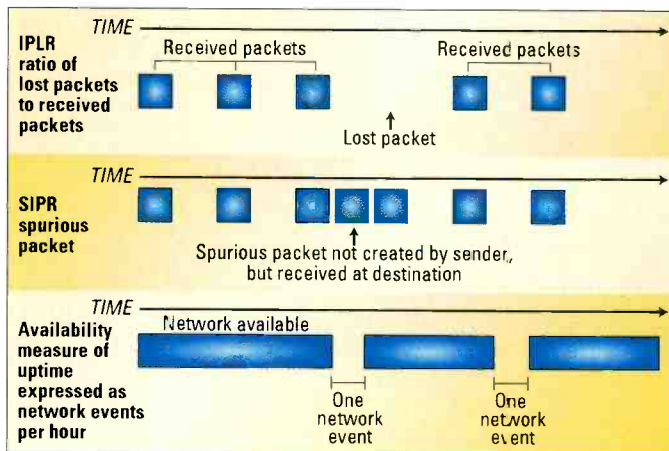


Figure 2. Concepts such as IP loss ratio, spurious packets and availability are also useful in determining the quality of service a network provides.

- **Routing:** Allows the network designer to establish routes that will guarantee a particular level of QoS and then mark packets so that they are sent across those routes.
- **Scheduling:** Used to ensure that high-priority traffic is passed through the network correctly while still allowing "mouse traffic" such as e-mail to get through.
- **Buffer management:** Provides techniques for metering traffic as it passes through routers on the Internet, keeping routes uncongested, and provides techniques for dropping low-priority traffic when buffers are in danger of being overloaded.
- **Traffic monitoring and feedback:** Provides network engineers with a way to monitor network activity.

While it is true that the core Internet may be unreliable, it's evident that several groups have done significant work to establish techniques, measurements and frameworks to establish the quality of service necessary to deliver real-time video over IP. **BE**

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

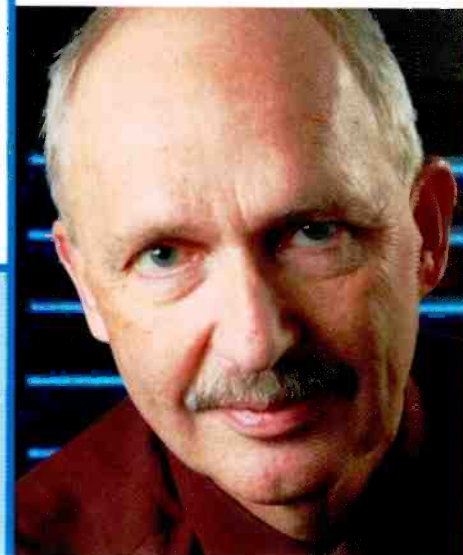
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Camera lens technology

BY LARRY THORPE AND GORDON TUBBS

Today's intense interest in digital imaging tends to overshadow an appreciation for the role and importance of lenses. There is, unfortunately, the perception that lenses merely prepare optical images before the digital camcorder records them onto digital media. In reality, however, lenses are where image creation first takes place. (See Figure 1.) Not only does the lens create the optical image for presentation to a camera, it also offers a powerful means of manipulating the image to enhance the art of storytelling.

The technically challenging role of the camera, meanwhile, is to transform the optical image faithfully into an electrical signal. Subsequent digital recording

professionals find themselves deciding which lens to purchase for new digital camera systems.

Choosing the right lens is difficult. First, there are many categories of lenses presently available in both the HDTV and SDTV domains. Secondly, high-end optical design is an extremely refined science with its own

much of a scene a lens can image. Technically, it is the limit within which the lens can image the scene in accordance with the lens' focal length and its image format size and shape.

- *Zooming:* This is a strictly optical phenomenon that emerged relatively recently in the history of lens development. It introduced the ability to

Lenses are a powerful means of manipulating images to enhance the art of storytelling.

peculiar technical terminology and descriptors, which are sometimes difficult to sort out and understand. And competing lens suppliers sometimes offer conflicting messages, further complicating the process.

So, to make an intelligent choice, it's necessary to first understand the basics of lenses and optical images. All images have a number of separately quantifiable attributes. It is the subjective aggregate of these attributes that produce the final aesthetic quality of the image. The lens' primary role is to shape most of these attributes. The lens also pre-determines important picture quality attributes. These attributes can be further modified by the camera, the recording system and, finally, by the display system.

make dynamic, real-time adjustments of the angle of view without moving the lens relative to the scene. It represents an artificial, yet powerful, augmentation of the imaging process. It presents an image in a way that the human visual system cannot.

• *Depth of field:* This is a fundamental optical constraint on a lens. The lens is focused on a particular subject in the scene, and the other objects in the image appear in focus within a limited distance in front and behind the subject on which the lens is focused. Depth of field varies with the lens' image diameter, its focal length and its aperture settings. Cinematographers creatively exploit depth of field by skillfully adjusting lighting and lens settings to present selected scene objects in sharp focus while simultaneously defocusing other portions of the scene. This helps portray a sense of depth to the two-dimensional optical image.

• *Perspective:* This is an essential attribute of any image representation (drawing or painting, film, or electronic image). It seeks to portray a 3-D representation in the same manner that the human visual system sees a live scene — with objects linearly diminishing in size as they recede from the position of the viewer.

Optical image attributes

Let's briefly examine each of the image's attributes from the standpoint of a lens' creative and technical capabilities:

- *Angle of view:* This attribute determines the essential framing of the image. Basically, it determines how

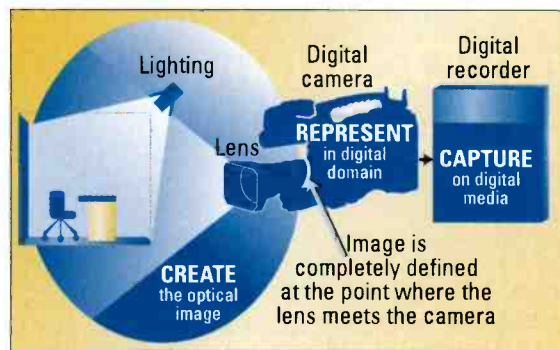


Figure 1. Lenses create the optical image for presentation to a video or film camera. Their primary role is to shape the attributes of the image that are reproduced from an object scene.

must likewise faithfully store the camera's digital reproduction.

The fact that the lens is the primary arbiter of final image quality — both aesthetically and creatively — does not in any way diminish the role of today's digital cameras or other systems for image storage. Major new trends in this area, such as DTV, HDTV and digital cinema, are changing the video acquisition landscape radically. Because of these changes, an increasing number of



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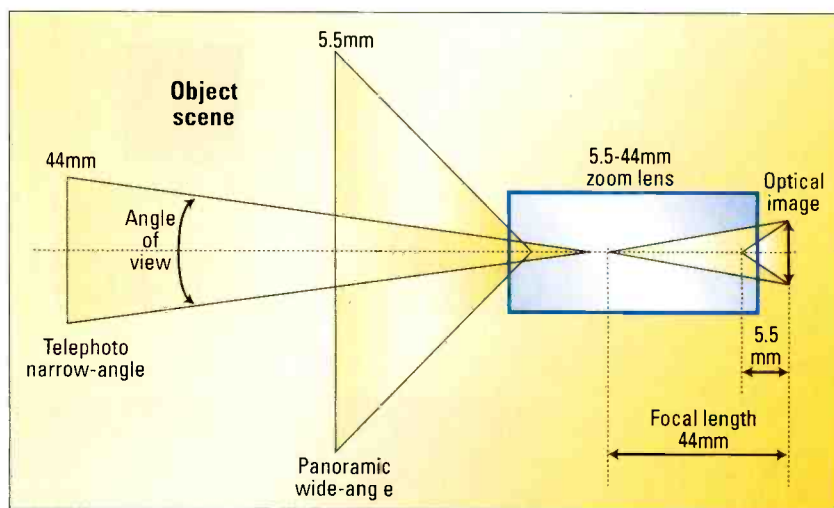


Figure 2. The angle of view is the limit within which the lens can image the scene in accordance with the lens' focal length, its image format size and its shape.

• *Aperture control:* The lens' iris allows the camera operator to manage a vast range of light levels. In that sense, the lens emulates the human eye's ability to control the amount of light to a level appropriate to the capabilities of the sensor (human retina, digital camera sensor or the chosen film stock).

• *Contrast or tonal reproduction:* This is a measure of the lens' ability to reproduce the full dynamic range of the light levels contained within the scene. It is a measure of the faithfulness with which the lens optics can distinguish the many brightness levels in the scene. A high-contrast lens is one that can distinguish the many levels of brightness within the high-brightness portions of the scene while simultaneously and clearly distinguishing the many lower levels of brightness in the shadowed areas of the scene.

• *Color reproduction:* This is an important attribute of the image that concerns the light transmission characteristics of the lens. The balance of colors of the light coming through a lens is expressed as a color temperature. In the case of the film camera, the lens design must take into account the colorimetric characteristics of the emulsions in the particular film being used. In the case of the digital video camera, the lens' spectral characteristic must be coupled to that of the light-splitting system in the camera and the colorimetric characteristics of the sensors employed.

• *Picture sharpness:* This is a measure of the response of the lens' optical system to the overall reproduction of contrast over a range of spatial frequencies. This is the most complex attribute of any image. Judging a lens' sharpness involves assessing the lens' resolving power and modulation transfer function (MTF) at a variety of points over the two-dimensional image. A reproduced image combines the sharpness of the lens, the capture media (film or video), and the reproducing medium (print, display or projection system). But it is the lens that primarily determines the final perceived picture sharpness.

A future look

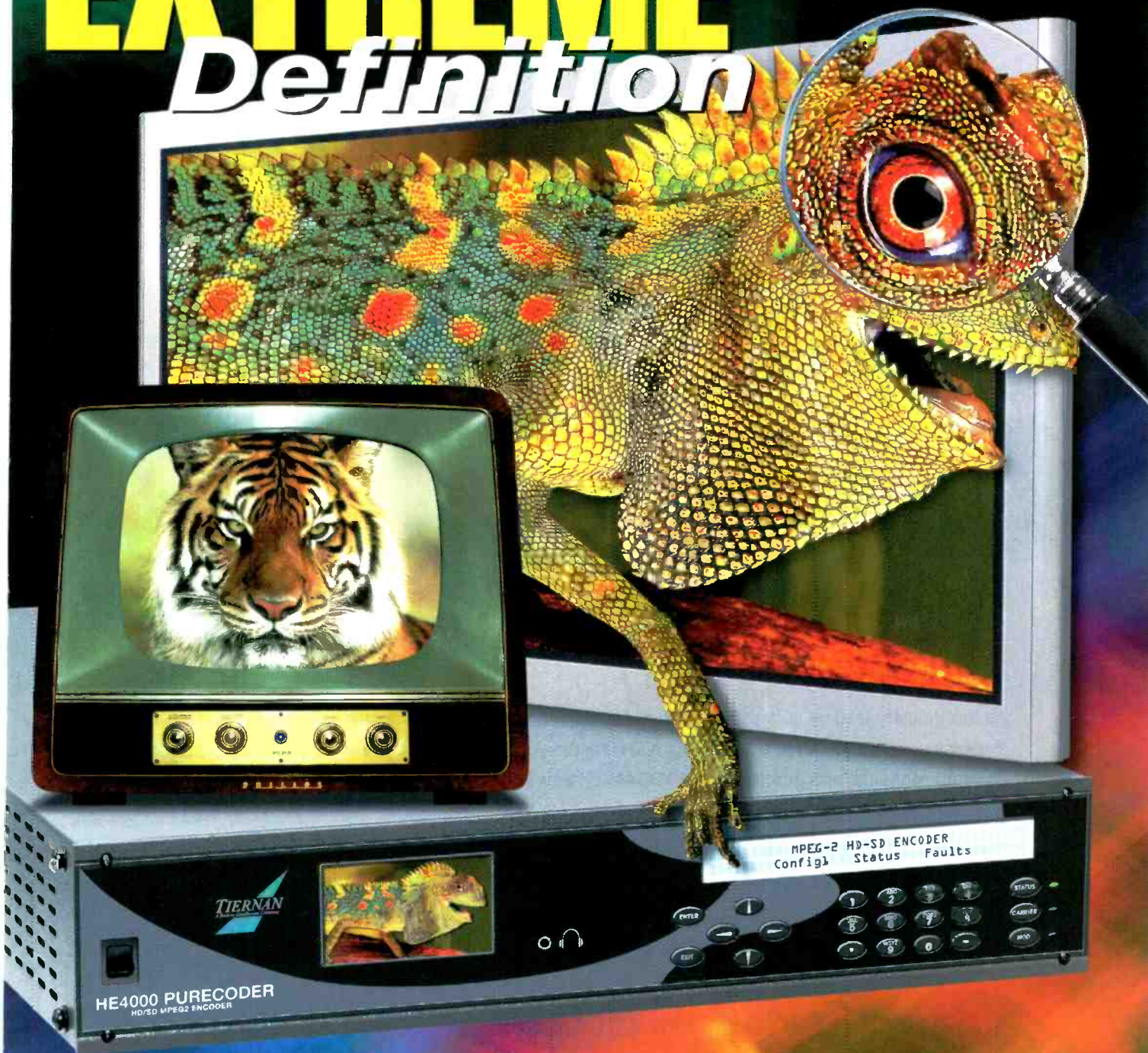
This look at optical image attributes sets the stage for a series of articles set to appear in *Broadcast Engineering* in 2005 that are designed help the reader appreciate the role that lenses play in creating an image. This tutorial will continue in the January issue with an in-depth examination of television studio lenses.

BE

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

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SYSTEMS
DESIGN
SHOWCASE

HVAC

for on-air facilities

By Charbel Farah and Hisham Barakat



Designing mechanical and electrical systems for live-audience television studios presents unique challenges. Such systems must meet stringent technical criteria for spatial function, noise

level, cooling, lighting flexibility, power quality, emergency power, system redundancy and isolation grounding. Moreover, they must provide comfort and safety for a large group of people.

Live-audience television broadcasting studios typically range in size from 2500- to 5000sq ft, and include a control room, audio room, video room, green rooms, machine rooms, and other support areas and amenities. The



E! Entertainment's **E!** News studio uses an overhead HVAC system with a tapered diffuser. Photos courtesy Syska Hennessey.

mechanical engineer must design a system that can provide 24-hour cooling for technical equipment, a comfortable environment for an audience ranging from 50 to 200 people, and be able to accommodate a significant

lighting load, all while meeting an NC rating of 25 or lower.

This combination of operational challenges requires an HVAC system to deliver low-velocity air to the studio and distribute it using convection and diffusion principles. And, the designers must locate the mechanical and electrical rooms as far as practical from sound-sensitive areas to avoid transferring noise and vibration.

Minimizing noise and vibration

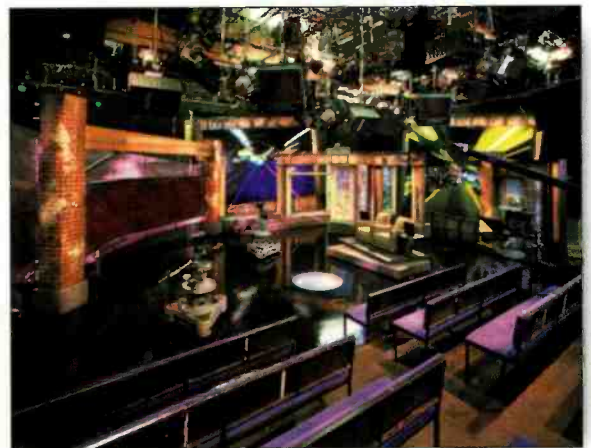
Choosing the right HVAC system is usually the first crucial step. A fan-coil system, which cools spaces by blowing air over coils that circulate chilled water, is not a good choice for an on-air live-audience studio. Although some manufacturers claim otherwise, this type of system must be placed as close to the space as possible, and is likely to transfer an unacceptable amount of noise and vibration. If an architect or HVAC designer recommends such a design, immediately begin asking tough questions.

Typically, packaged air-handling or air conditioning units are a good choice.

These units should be self-contained and include fans, motors, chilled water coils or direct expansion (DX) coils with compressors and, in some cases, silencers. Such standard systems typically meet studio noise criteria. If not, they can be upgraded from a packaged unit to a custom or semi-custom manufactured unit.

Once a station has selected the design for the cooling unit, it's time to decide where to locate it. Usually, that requires a balance between having it close enough to the studio for effective design and having it far enough away for maximum noise isolation. Typically, the roof is the only place available to hold it. Most facilities mount cooling units either on the rooftop or in a dedicated mechanical

room indoors. For indoor installation, the HVAC units must be mounted on isolators in an acoustically lined mechanical room located as far away from the studio as practical — at least 100- to 300ft. To help minimize the transfer of sound and vibration, use a fan with a variable-frequency drive. This allows the fan speed, and therefore the air velocity, to be varied. It is also best to control the fan with direct digital control (DDC) instead of using mechanical or pneumatic sensors and controls. DDC systems use electronic sensors and microprocessors to provide precise, dynamic control of the



In this typical on-air studio, ceiling elements such as the lighting grid, studio lighting, ductwork, plaque diffusers and acoustic installation are suspended above the stage and elevated live-audience seating.

variable-frequency drive.

When sizing the studio HVAC load, consider factors such as lighting load, number of occupants and, in some cases, envelope load, which consists of roof, walls and glazing. Lighting load can be as much as 35- to 75W/sq ft, yet the mechanical system should be designed for an average operating condition of 25- to 50W/sq ft for practicality, diversity and economy. The size of an HVAC unit for a studio of approximately 4500sq ft and a live audience of about 125 people can range from 60 to 75 tons.

This occupancy level also increases the fresh-air requirement. Typically, such a room requires an air flow rate of 15- to 20cfm per person. Therefore, the size of the air-handling unit

must increase proportionally. This is another good reason to locate the air handler on the rooftop, if possible. If a facility installs the air handler within the building, shafts to the rooftop must be large enough to deliver the required volume of fresh air as well as relief/exhaust air. In an existing building, new shafts are required to accommodate these requirements.

Air distribution vs. structural limitations

Air distribution presents structural challenges requiring ingenuity on the part of the mechanical engineer and close coordination with the architect, structural engineer and acoustical consultant.

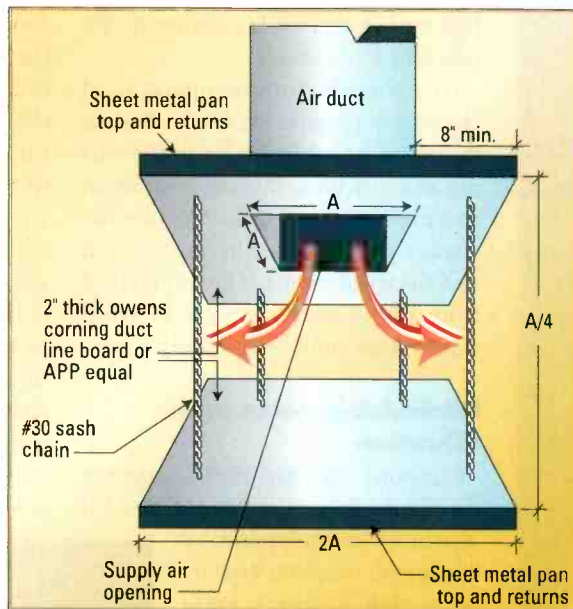


Figure 1. Diffusers reduce air velocity and noise. Shown here are the details of a plaque diffuser.

On-air, live-audience studios typically require a minimum floor-to-ceiling height of 18- to 22ft to accommodate

the lighting grid. The lighting grid needs to be kept on the same plane throughout to avoid shadows, and all utilities must be kept above this plane. This height requirement increases in proportion to the studio's area. As a result, there is often little space left above the lighting grid for ductwork because of the structural support and seismic restraint systems the lighting grid requires.

To meet noise criteria, slow-speed airflow (typically 600ft/min) is required. This can be achieved with large ductwork. To achieve the acoustical requirement of NC 25, reduce the exit velocity at the diffuser of the air conditioning system even further, to 300ft/min or less. This increases the size of the ductwork significantly. Noise can also be reduced

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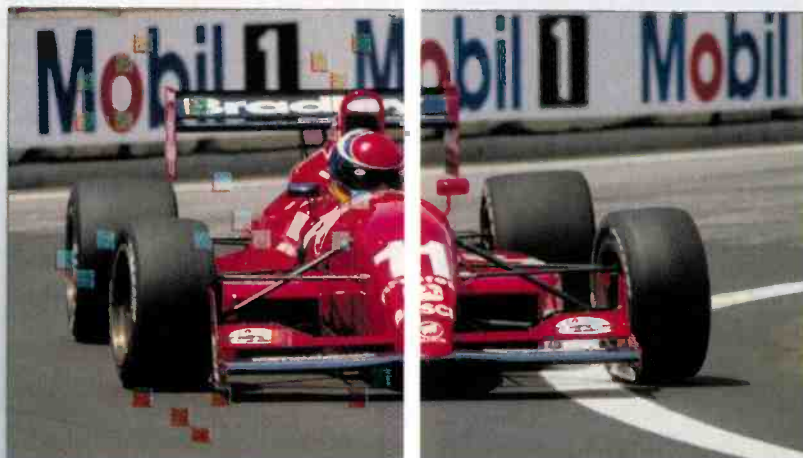
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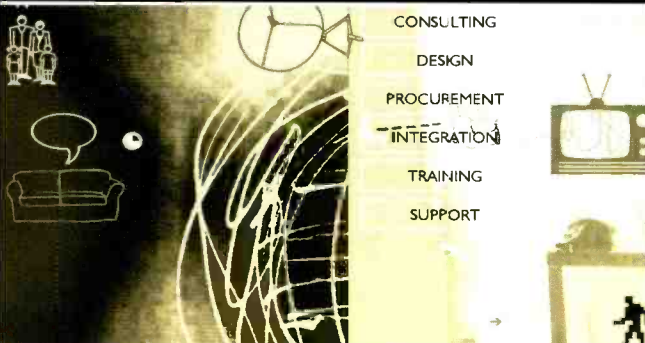
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by using silencers and acoustical lining in the ductwork. Be sure to locate the silencers outside the studio in order to reduce noise.

In some applications, engineers must further reduce air velocity at the diffuser, typically from 600ft/min to anywhere from 100- to 150ft/min. A custom-made plaque diffuser (see Figure 1 on page 42) is the most practical solution for live-audience applications because it achieves ther-

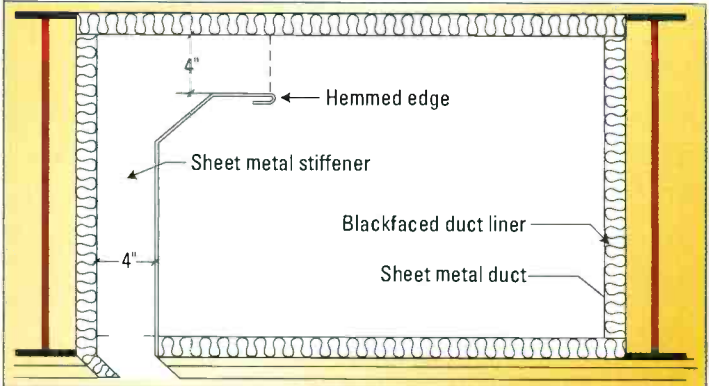


Figure 2. A tapered linear diffuser, shown here, is heavier and more costly than a plaque diffuser.

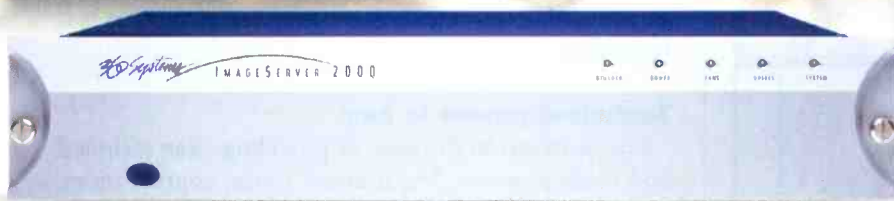
mal comfort and acoustical requirements. It is also cost-effective. Another custom-made diffuser, a tapered linear diffuser (see Figure 2) is heavier and costs more than a plaque diffuser. A third custom-made diffuser, a fully perforated duct/diffuser, is recommended only for studios with a ceiling height more than 24ft. Whenever possible, locate the diffusers so they direct airflow toward the faces of audience members. This provides the most comfort because the audience will feel coolness but no breeze or drafts.

The overhead air distribution system described above is the most widely used system for studio applications. Another distribution method is to deliver air through a raised-floor plenum. With a low supply system, the return is located high for proper air circulation and effective cooling and comfort. In both overhead and under-floor methods, return air ducts have to be sized to deliver the air at a velocity not exceeding 300ft/min. Also, the placement of return air ducting is crucial. Don't locate return and supply airflow at the same height or location. With overhead distribution, locate the return at a low level. With under-floor distribution, locate the return at a high level.

Meeting variable loads

In a typical recording or broadcast studio, constant air volume control may be sufficient and effective. But, in an on-air, live-audience studio, the load generated by the audience can vary from day to day, show to show and even minute to minute during the course of the broadcast. For this type of studio, the ventilation system that can provide the best combination of comfort and energy conservation is a dedicated air-handling unit with variable air volume (VAV) control. The VAV control lets station staff adjust the

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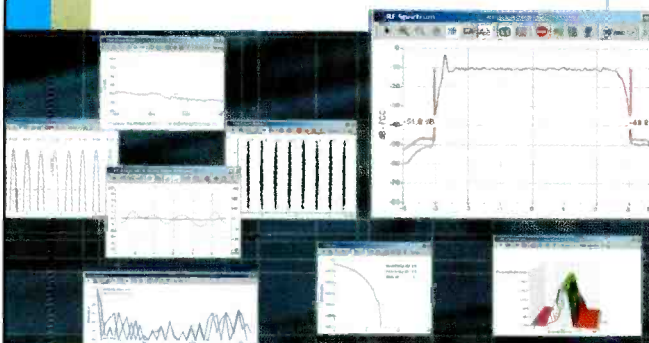
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air volume during a show to maintain adequate cooling (typically about 68°F or lower). The most cost-effective implementation would be a single, DDC-controlled air handler serving the studio.

Heightened electrical requirements

Electrical systems in live-audience studios require special attention. The electrical engineer must design a power system that provides maximum flexibility for the user. Typically, a studio lighting designer or set designers define the lighting load. The electrical system must be able to handle loads as high as 35- to 75W/sq ft and the power system must be designed with enough flexibility to meet both permanent and temporary equipment loads.

Life safety is a key issue in a live-audience studio. Emergency lighting can employ fluorescent house lights or battery packs.

Technical power is key

Finally, we get to the issue of providing clean technical and backup power. The dimmer room, control room, equipment room and certain AC outlets in the studios need clean power. The typical solution involves installing isolation transformers with an isolated ground or uninterruptible power supply (UPS). The technical ground usually consists of a ground bus bar in each technical room and copper conductors all daisy-chained together and tied into the building's main service electrical ground.

If the total technical load requirement is greater than 200A, it is often cost-effective to have a 480V, three-phase, four-wire service delivered to the facility, where it is stepped down to 277V or 120V. A filter or continuous UPS system can be added to further reduce interference/harmonics in the technical equipment. Also, the technical power and AV cabling/signal requirements should be kept on separate distribution systems to prevent distortion. Because transformers, UPS and dimmers are noisy, it's a good idea to house this equipment in separate rooms located at least 100- to 150ft away from the studio. Or else, to reduce the length and associated cost of cable runs, the transformer and/or dimmer room can be lined with acoustical insulation and the transformer placed on vibration isolators.

Plan for reliability

Broadcasting with a live audience is like performing a high-wire act without a net. The medium creates unique opportunities. But, with no room for error, it also presents challenges for television directors and facility designers alike. Nonetheless, carefully planned and skillfully designed mechanical and electrical systems will support successful live broadcasting today and in the future.

BE

Charbel Farah is associate partner, and Hisham Barakat is senior vice president, of Syska Hennessy Group, a consulting, engineering, technology and construction firm.



System Configuration Made Easy



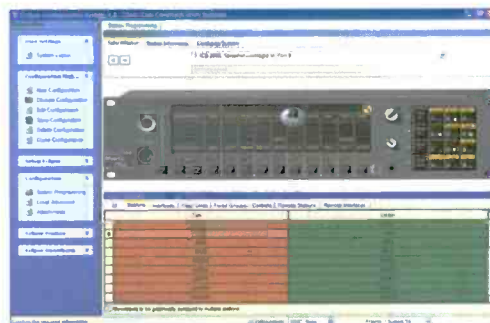
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Towers + lead paint = trouble

BY DON MARKLEY

The Environmental Protection Agency (EPA) has the task of protecting the public from the hazards of lead-based paints. Another arm of the federal government, the Occupational Safety and Health Administration (OSHA), is tasked with making the workplace safer. The two agencies work together to protect workers, the public and the environment. But a new set of regulations is presenting some obstacles for broadcasters.

Nearly all TV stations have towers with multiple layers of old lead-based paint. Coatings of acceptable lead-free paint cover these old layers, but they are still a problem.

The EPA's national regulations do not regulate towers and similar commercial structures with regard to the paint itself. The EPA routes inquiries into this problem to a regional EPA authority rather than a national office. The regional regulations normally apply to

residential lead problems such as wall paints, painted furniture, etc. For towers, the regional authority will refer you to your state environmental office.

But there are some basic EPA requirements that seem to exist nearly everywhere. First, you usually don't need to remove the existing paint if it is fully sealed within an acceptable paint. This

First, you usually don't need to remove the existing lead paint if it is fully sealed within an acceptable paint.

certainly should be an incentive to keep towers well painted and in good condition. If the paint on the tower is flaking off, the concern is contamination of the ground in the surrounding area. At that point, the paint has to come off the tower. In addition, if work is going to be done on the tower that will disturb the paint in any way, you may have

to strip the whole structure. That's when the fun begins.

Lead-paint removal

Stripping must be done in such a way that the chips and or paint dust don't escape. Usually, the surrounding area must be covered with a material that will keep the dust from getting through

to the soil. Workers must wear protective clothing and breathing apparatus, and this equipment must be destroyed after the work is completed. OSHA clearly specifies the method of destruction. If the tower is to be sandblasted, a protective sheath must surround it to contain all the dust. You have probably seen this taking place on water towers. It looks like a giant bag that completely covers the structure.

There are some chipping tools that use a vacuum attachment to keep flakes from getting away. Those are usable in some states. That brings back the gist of the whole problem: Individual states have different requirements. Federal regulations govern the disposal of the removed paint chips and dust, including the protective clothing and equipment to be used. But rules on how to do tower work vary.

The one thing that doesn't vary is the extraordinary depth of trouble you will be in if you don't do this whole thing right. If you think that OSHA can get the front office upset, just watch what happens if you cause windblown lead paint flakes to fall over a wide area. Don't argue — just get your resume up to date and think about moving far, far away.

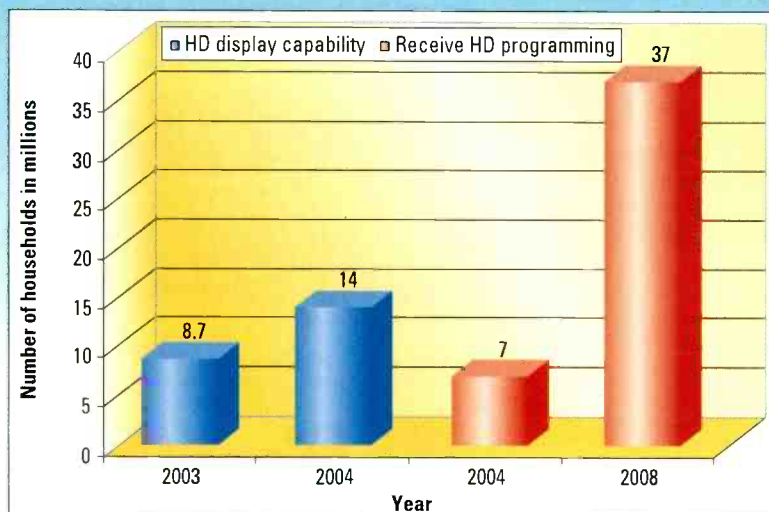


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To this same end, don't even think of using good old Charley from down the road to do this work without extensive supervision. It is imperative to use personnel trained in the proper use of protective devices and the disposal of unwanted material. Before you start any work on the tower that could possibly involve the

paint, contact your state environmental protection office and review their regulations carefully. There are structural firms and tower painting firms that are familiar with the local requirements and have thorough training. Then, get your ducks properly in order. This should include a contract with the painters, including

full hold-harmless agreements and naming the station as a co-insured. Before signing anything or allowing any work to begin, contact the station's insurance carrier and legal counsel. Remember, the corrective actions for soil contamination could involve the removal and destruction of soil over a large area. That involves costs too horrible to mention. We are talking about possible millions of dollars here while the front office yells at you — a lot.

Enough, you say. We need to replace that old tower anyway, so we'll just take it down and put up a nice new one that will be totally lead-free. Nope, it doesn't work that easily. You now have a few tons of contaminated steel. Assuming that you don't want to keep it on site sealed in a big baggie, you may have a great deal of difficulty getting a scrap yard to accept it. It will probably be necessary to go through the whole process of removing and destroying the paint before the tower even becomes acceptable junk.

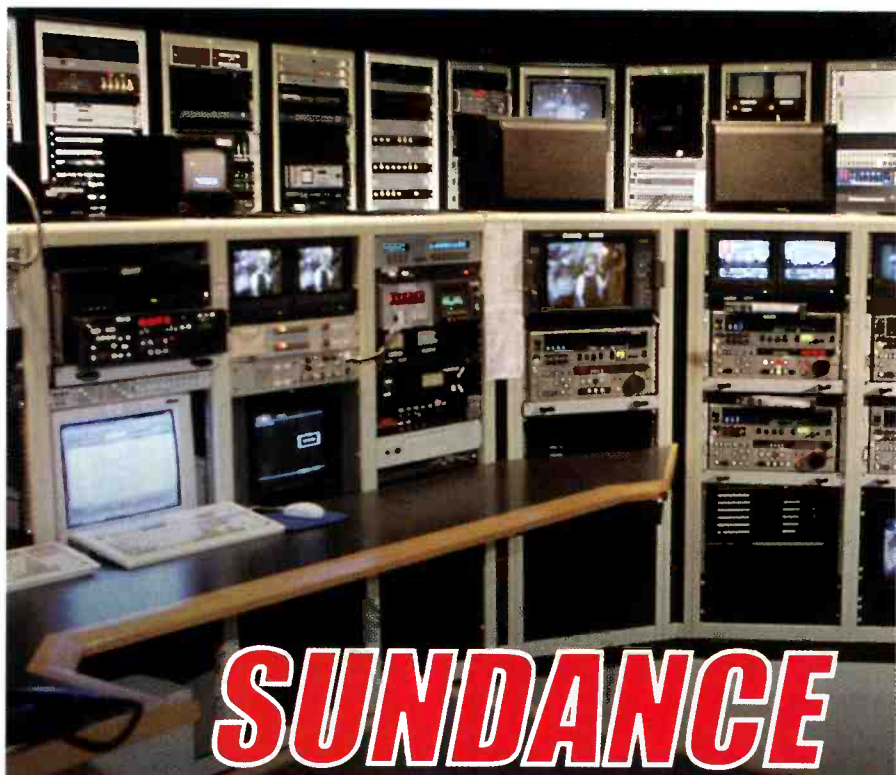
This isn't a simple situation. Done improperly, the costs of cleanup may well be greater than the value of the station. That thought alone should be enough to remind you to go through every hoop necessary before doing any work on the tower. It doesn't cost anything to go to the appropriate agencies and the station's insurance carrier to make sure that you are doing everything legally, and all bodily openings are suitably protected. The alternatives are truly awesome to consider.

And the whole lead-removal problem isn't going to go away. (If you have any doubts about that, just try to buy lead-based paint.) But it is a problem that station staff can easily deal with by using the appropriate contractors and working with the appropriate state agencies. Failure to do this will be a sure career ender. **BE**

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



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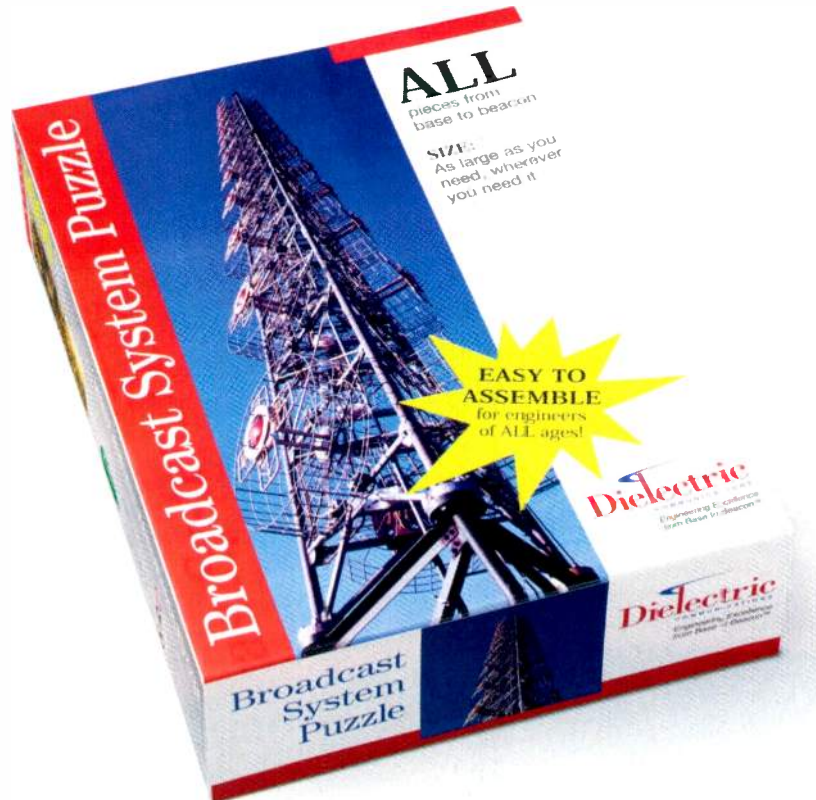
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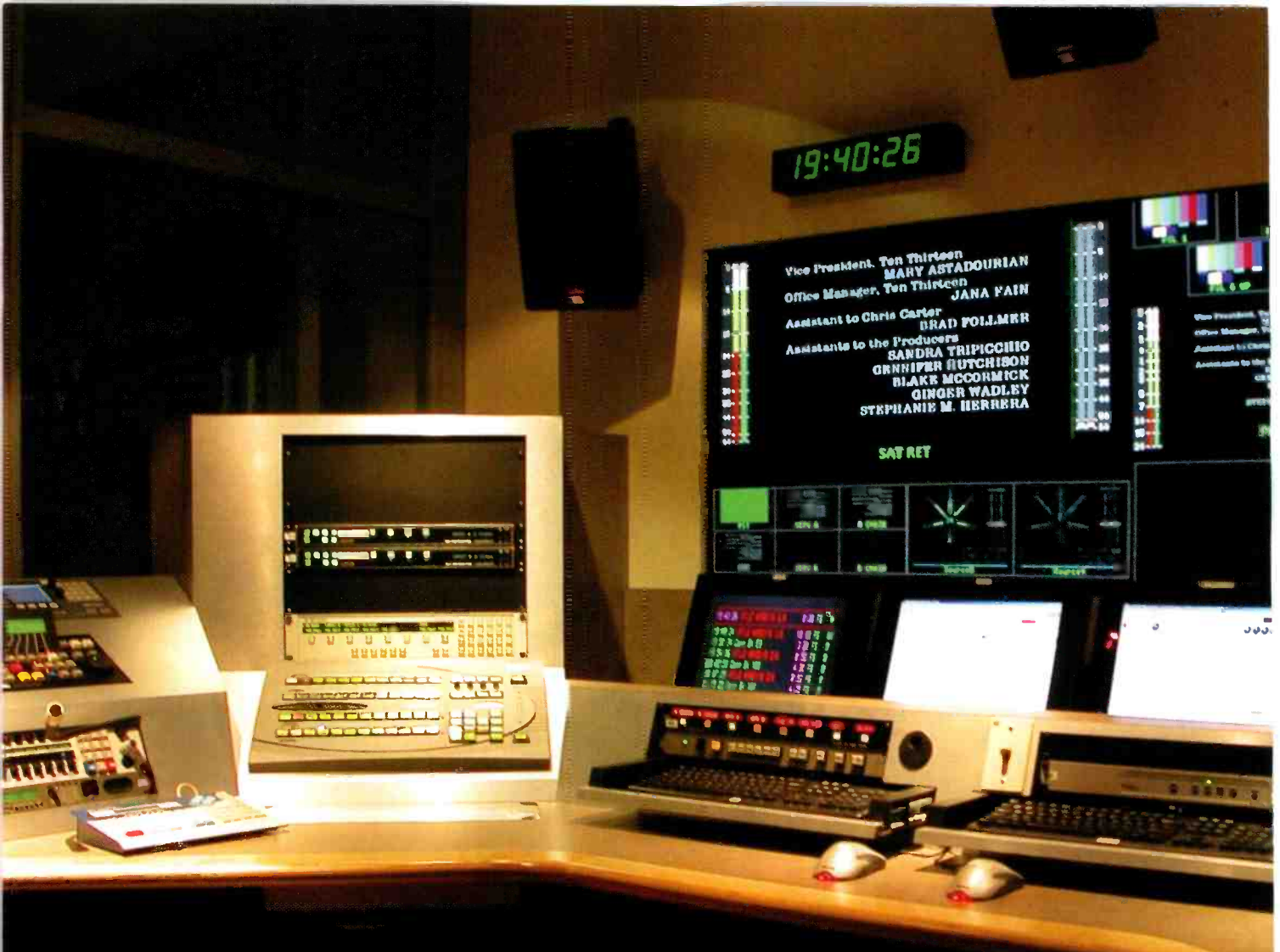
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Master control systems

By John Luff

Over time, master control has changed, but its basic function remains the same. Broadcasters around the world use master control systems to build program streams and insert interstitials such as advertising and promotions for future programs. This is not to say that the changes in master control have been minor or superficial. On the contrary, the changes have been dramatic, driven by factors such as FCC-mandated ancillary

services, the requirements of the marketplace, the details of the content and interstitials and a broadcaster's desire to differentiate his output from that of the competition.

Modern needs, modern problems

The FCC has mandated closed captioning, descriptive-video-service (DVS) audio, emergency alerts, ratings flags (V-chip) and, of course, DTV. Beginning early in 2005, broadcasters

must add PSIP to their signals. Taken individually, these requirements are quite simple to accomplish. But they add cost onto the broadcaster's ledger that is unlikely to be offset easily by new revenue.

The broadcaster's quest for a unique look has led to a much more complex menu of switcher options. Among these enhancements are pushbacks, more and shorter interstitials, weather and other announcements over programming, complex voice-overs, rich



Modern master control rooms, like the one shown here in Turner Broadcasting's new HD facility in Atlanta, have different paradigms of monitoring and control.

graphics — sometimes over content (for hire), burned-in and moving logos, and network logo insertion at the station. To this, add HDTV content and several program streams multiplexed together, each of which might have all of the above elements.

To maintain the old functions and accomplish new ones, the tools of master control have had to evolve. In the early days of color TV, a master control switcher might have had 12 to 16 inputs, perhaps one or two key

inputs, and a voice-over channel. It would likely have offered automatic transitions and a set of triggers for pre-rolling VTRs (or film chains). A preview output would have fed a separate monitor to allow the master control operator to look at network feeds on a larger monitor for quality control prior to air.

But such a limited master control could not adapt and expand to accommodate the changing demands of the FCC, station management and sales. Some of the new functions — such as V-chip, pushbacks, EAS, and even DVS and closed captioning — could be (and often are still) performed downstream. However, the explosion in the number of ancillary signals added to the output begs the issue of control, certainly of human control. Some functions, like

and sales departments to squeeze more content and dollars out of a station's sole consumer product. Today's hardware offers rich graphics, layered signals and effective control of complex events.

Operator interface

To make all these functions work, the operator needs an easy to use interface. (The links between traffic and automation facilitate much of the manual selection in the background.) The key component of this interface is software that can configure complex displays understandable to the human operator. The GUI must include three elements that enable the operator to understand complex events and manage them when they go wrong.

First, the GUI must have a setup task,

To maintain the old functions and accomplish new ones, the tools of master control have had to evolve.

closed captioning and V-chip, need only monitoring under normal circumstances. Other functions related to transitions in aural or visual program content (such as added lower-third graphics, pushbacks, voice-overs) add greatly to the number of things the operator needs to control and monitor. As a result, automation — first in the form of cart playback of interstitials, and later in servers — became a way to extend the amount of content an operator could handle reliably. The cart machine received a log from traffic and played entire interstitial pods as a unit, greatly easing the load on the operator and allowing more complex content.

We can credit (or blame) the rise of computers for enabling the next level of complexity in master control. If the growing demands on the master control operator had pushed him to his limit, might it not be possible for a smart machine to assume some of the burden? Manufacturers met this challenge by producing new master control hardware with rich feature sets that permit creative traffic, program

which a facility might use only when it installs the master control or when it adds or removes peripherals. Many manufacturers now include in their peripherals embedded features that stations can activate later through software authorization keys. In addition, the setup functions offer a set of graphics and operation templates that allow the station to create and manage a unique look.

Second, the GUI must provide understandable data about the current operational state of the hardware and embedded software. This allows the operator to see that the next event has been sent to the hardware for execution (hopefully), and displays it on the preview system. Taken together with automation, this GUI element must clearly indicate critical information and facilitate manual operations that are part of normal practice. It also must permit multichannel monitoring for situations like multiplexed SD/HD in DTV. A hardware control panel is often part of this element. Increasingly, touch screens or mouse-driven

computer displays are supplementing or supplanting the hardware panel we usually associate with master control. At the very least, it is becoming desirable to have a touch screen as a backup to the hardware interface. The best ones look exactly like the hardware panel so the operator understands them instantly.

Lastly, the modern GUI must provide fault reporting and resolution. For a multichannel operation, this may be the most important piece of software. It is not enough to have the monitor go dark and leave the operator wondering if it was the video/audio processor that failed. The system must alert the user to the highest degree possible. Consider the case of an operator working in a duopoly. He would have two NTSC channels (at least for the next few years), and two DTV channels, each of which might have up to four or five streams present.

At any one moment, the operator is looking at four to 12 streams and their associated hardware chains. Concise and useful data will make the difference between lost events or lost hours.



Signal monitoring can now be done on plug-in modules in DA trays, as with Thomson Grass Valley's Maestro.

Modern hardware

Master control systems have evolved from stand-alone devices to hardware that can integrate and centralize functions like graphics creation, CG, still stores, logo inserters and DVEs. Yet the industry seems to be moving to view

crosspoints and processors independently. (The opposite viewpoint is covered later in this article.) We might consider the switching requirement as an unnecessary overlap with routing, which is almost certain to exist in the facility. Thus, the processor (audio and video) might have Ethernet connections for moving graphics, receiving live data streams for processing as lower-third character generation, and other control ports, including automation. It might also have ports to feed requests to servers and other external devices. But the number of inputs may be reduced to half a dozen, some of which are key and fill inputs. By doing this, several manufacturers have been able to reduce the size of the processor to a card in a DA tray (though not a small one). Other manufacturers have made boards that mount in a routing switcher frame, using the same control system to facilitate

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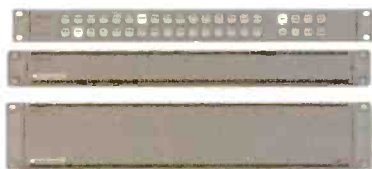
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Master control systems

broader control issues and crosspoint selection in a seamless fashion.

This tight integration, combined with separation of function, provides for interesting possibilities in fault management. It is not hard to envision a system that takes note of a failed master control processor and substitutes a backup in a 1-for-N (or N-for-M) redundancy strategy. The operator might be asked if he wants to move

acknowledgement of this predominant design strategy and a way for manufacturers to guarantee the sale of a router.

Integrating graphics into the master control processor is also a powerful and fundamental change in architecture. Take promotions, for instance. The ability to generate the graphics for backgrounds or fill in text fields in a template derived from live or other

What if, instead of moving the crosspoints out, you moved master control functionality into the station's central routing switcher?

to a bypass path or simply replace a failed board with one from a pool of spares. By reducing the redundant switching functions and using an existing routing switcher or slot, the manufacturer saves on costly design, documentation and duplicative manufacturing of power supplies, frames and connectors. Cost comes down and reliability goes up, which is just the trade-off you need in a complex master control environment.



Control surfaces like Eyeheight's playout module have evolved to simpler metaphors.

Even when the processor is not card-based in an existing or multi-use frame, the economies achieved by not duplicating crosspoints are clear. This approach enhances and simplifies the master control switcher. Modern system designs seldom have sources uniquely fed to master control switchers. Most have at least a few routing switcher outputs dedicated to master control inputs. The strategy of building the processors without internal crosspoints seems to be an

sources can simplify the creation of a playlist for a complex channel. For instance, traffic might only call a template when inserting a weather crawl; an outside service provides data to fill in the text. The same method can apply to EAS. A keyboard is often available for simple text generation in the processor. You might even load a set of templates that would allow a reduced feature set for a backup to a production control room. But, clearly, these devices are not intended to replace complex character generators.

Whither goest master control?

There's a second way to look at the dynamic of moving crosspoints out of the master control switcher. What if, instead of moving the crosspoints out, you moved master control functionality into the station's central routing switcher? The connector count goes down further, the integration with facilities management software might be enhanced, and the manufacturing cost should drop even further. It would also simplify system design, though at the expense of the ability to monitor paths inside the routing switcher that are no longer accessible.

In part, this is a generalized change in the way we look at routing switchers. Because all of the signals are present in the facility's hub router, you might ask: Why move them outside? At least two manufacturers have taken



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slightly different but parallel strategies. One is developing specialized cards to put in a frame that also holds routing. The other is adding daughter cards to a router that offers features like keyers and voice-over capability.

This last approach plays well in the multichannel DTV environment. Many stations, particularly those in

public broadcasting, see a need for simplified master control streams with fewer options at lower cost. Putting this functionality into the router allows it to route key and fill signals from any source seamlessly to any processing card for output as a simplified master control stream. This might also work well where a broadcaster uses his

DTV bandwidth to provide functionality as a cable headend might, while also providing local branding at low cost. There is always a downside and, in this case, you might have to add a character generator and manage the content to allow a single generator to function on a time-shared basis with many outputs.

Lastly, you might consider having no master control switcher, but rather a processor that operates entirely in the compressed domain. Systems like this

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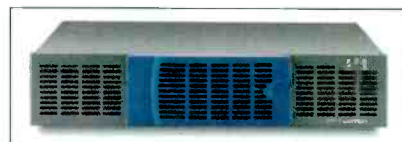
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Some master controls, like Leitch's DTP, operate entirely in the compressed domain.

have been available for several years. They allow you to link together and brand the MPEG server output (and, perhaps, a network signal delivered as MPEG). In addition, this type of processor allows you to add many normal master control functions without going back to baseband for processing and switching. The first wide-scale deployment of such a system in the United States is the FOX Network HDTV distribution. That system uses a number of devices that can combine local and network signals into a single output (which, after all, is the fundamental function of master control).

Looking forward

Several things are clear. The pressure of cost and flexibility requires new tools and operational techniques. Everyone who plans or manages a facility needs to understand the dynamics at play and the range of options available. Life will never be the same again. And there is much to learn. **BE**

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

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THE EVOLVING MASTER CONTROL

By Steve Sulte and Eric Goodmurphy



TVOntario in Toronto uses Leitch's Opus master control switcher to operate two broadcast networks. The single user interface controls multiple station outputs, which is key to signal consistency.

Blame it on branding, the use of those ubiquitous logos that appear in the corner of the TV screen. At first, these logos just winked on and off after each break. A year later, they stayed throughout the entire program. Now, they've become a mainstay, including everything from station IDs to promos for future programming and election results. This branding improves our

viewing experience by helping us navigate through today's sea of entertainment alternatives.

Branding is the logical outgrowth of a broadcast channel's quest for a unique identity and increased viewership. As broadcasters continue to look for creative ways to generate more revenue by repurposing content, it's ironic that something so small has become such an important (and effec-

tive) tool. Cable networks can produce new channels almost overnight, all tightly packaged and branded for our enjoyment. The model works well.

But branding places new demands on master control. Simulcasting analog and DTV channels (with commercial inserts) is complex enough, even without considering brand content or data services.

This article explores the emerging,

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THE EVOLVING MASTER CONTROL

scalable master control environment and its ability to accommodate current and future workflows in multiple formats economically. In addition to offering a rich set of features, these new switchers must also be poised for the next round of technical challenges.

Traditional and contemporary models

Things were simple when we transmitted single analog channels. As the cornerstone of a station's infrastructure, the master control switcher was (and in many cases, still is) a dedicated box with dedicated inputs and a minimum number of capabilities. If a broadcaster required another output channel, he had to buy another switcher — simple, but expensive.

Yet, as multichannel transmissions have blossomed, the stress on master control has increased. New capabilities such as automation, character generation and squeeze effects were added around the switcher, but were not typically integrated. The trend toward more informative on-air images has added additional pressure, as master control systems must now handle increasingly diverse, localized branding and data services.

Many broadcast facilities have cutting-edge support for DTV, but their

master controls are still years behind. If your switcher is a 15-year-old beast, today's multichannel commercial insertion and branding requirements have likely overstressed it. And facilities that haven't upgraded within the last three years are probably adding functionality as peripheral equipment.

Once a station decides to update its master control, the engineering staff is often surprised to learn that a new generation of master control devices not only provides the necessary staples, but also enables new channels and capabilities to be added economically. In basic terms, master control has gone modular.

The new mini masters

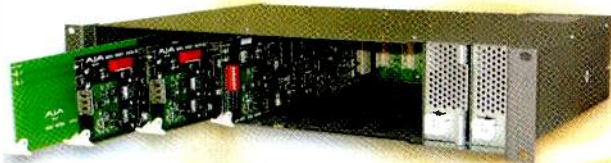
Because of broadcasters' continuing need to realize more value through upgraded channels and services (all within budget), facilities are starting to deploy a new generation of low-cost, modular master control solutions. These "mini" masters are more flexible than their monolithic predecessors. New channels and capabilities such as branding and surround sound can be added with ease. A facility can start with a single SD channel with a minimum feature set and upgrade to HD and more advanced features without purchasing new frames or panels.

Scalability, which is becoming commonplace for server and router manufacturers, is being applied to master control. An entry-level mini master might include a spartan yet highly capable feature set comprised of basic transitions and a single SD output. This unit can then upgrade to features such as clean commercial insertion (with effects), Dolby 5.1 mixing, and DVR capabilities for localization and time delay — for both SD and HD.

These upgrade modules for logo insertion, character generation, emergency alert, upconversion, voice-over mixing and squeeze effects are not specific to master control, but are, in fact, the same modules used throughout the facility — allowing the facility to leverage them across many applications. Processes that were typically performed upstream have now become native capabilities with one controlling interface.

From the customer's point of view, upconverting an SD signal is the first logical step in unveiling a new HD channel. Using the mini-master concept, the facility can budget for a fully branded SD channel today and reuse the base switching and branding functionality when the time comes to broadcast natively in HD with surround sound. This would not be pos-

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THE EVOLVING MASTER CONTROL Challenges on the horizon

sible if new frames, power supplies and interconnects were required. Within this model, incremental growth is easy and cost-effective.

Next-generation automation systems are already multichannel-aware. In addition to controlling legacy devices, the automation system's timeline

The master control operator's task is also easier with today's advancements and, in most cases, the job entails more monitoring than control. Where control is required, new advancements in panel architecture are reducing complexity and providing operators with more flexibility to tai-

Because of this increased scalability and modularity, broadcast facilities are now solving problems within master control that have historically been difficult to solve anywhere else in the transmission chain. But new challenges are looming, based in part on the rapid evolution of audio, video and metadata.

Today's master control is almost entirely AES-capable, but the concern will be the proper handling of HD and Dolby 5.1 within this environment. Multichannel 5.1 audio for transmission is becoming a *de facto* requirement with broadcasters who are now designing infrastructures based almost entirely on DTV with surround sound capability.

With high-definition, surround-capable home theater systems being offered at incredible price/performance points, consumers are forcing broadcasters to get much better at what they do — particularly with regard to audio and video quality.

For example, a voice-over in Dolby E is not just a simple cross-fade — additional considerations must be addressed such as metadata and synchronization. It is becoming apparent that the logical place to solve many of these issues will be at the egress of a channel,

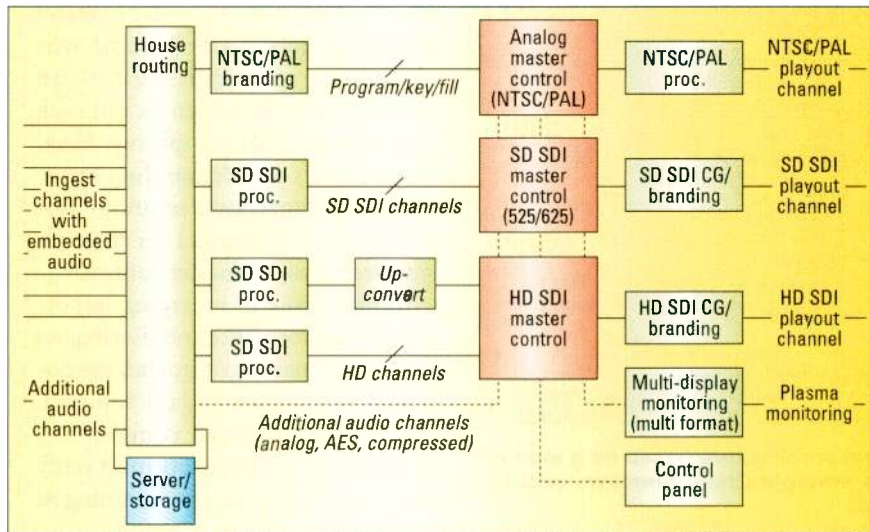


Figure 1. In traditional master control architecture, equipment is more dedicated and overall functionality is less scalable and modular than contemporary designs.

controls multiple server channels and master control switcher crosspoints, as well as transitions and branding. If some or all of these capabilities are integral to the master control switcher, complexity is greatly reduced.

lor interfaces to specific applications. Some manufacturers offer a range of panels, from traditional hardware panels to software-based GUI panels that can be customized for specific workflows.

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the master control environment.

Another ongoing challenge is maintaining synchronization between video and audio signals throughout the facility. Transcoding Dolby E at various points creates frame delays. Enabling and bypassing video processes upstream (e.g., aspect ratio converters, downconverters, etc.) creates additional delays. Using frame synchronizers at specific points can resynchronize these signals, but each path change adds complexity. Here, broadcasters are demanding automated, content-aware solutions that use metadata to correct for these issues seamlessly at master control.

Another issue of emerging importance is conformance monitoring, an area where master control has the potential to offer an elegant solution. Within an increasingly complex mix of daily content, the facility must verify that it is playing all programming as

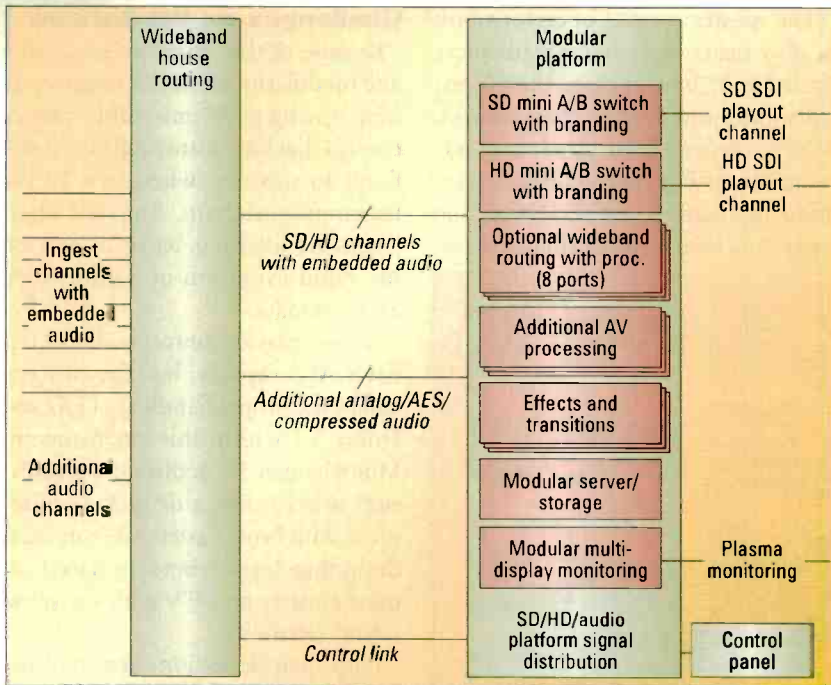


Figure 2. A contemporary master control architecture based on a modular platform is flexible and scales well to emerging requirements, enabling users to repurpose modules as required.





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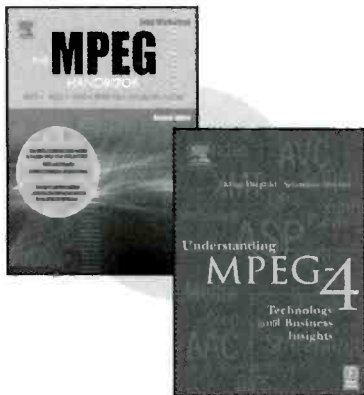
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planned and on schedule.

Watermarking and metadata technologies can offer potential solutions, and with the modular integration capabilities of today's master control, manufacturers can offer these features as future scalable enhancements.

Master checklist

There are several important factors to consider when selecting a new master control switcher:

THE EVOLVING MASTER CONTROL

leverage its core technology across applications. An excellent example is time delay, which is an important requirement when planning for multiple-time-zone broadcasts. Exploiting the modular concept shouldn't require an entire server, but rather a single plug-in storage or time-delay module.

Master control a la carte

Master control switchers are now available in a variety of economical,

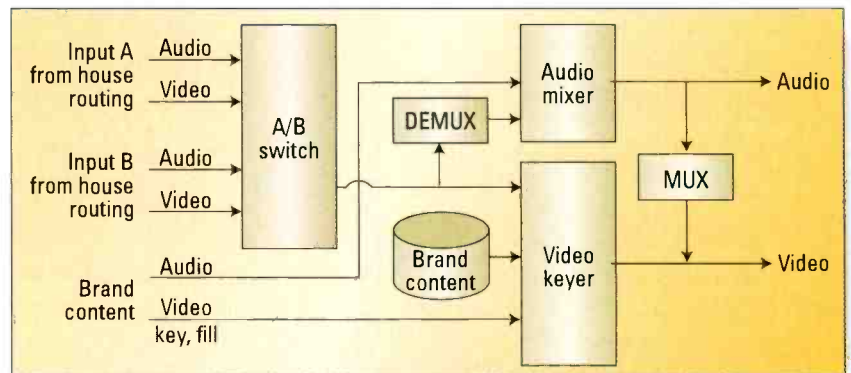


Figure 3. This is a detailed functional view of a channel branding and switching module. This module provides the cornerstone of mini master capability, including A/V branding, CG and switching.

- In addition to the basic requirements for modularity and upgradeability, consider a solution with an internal, self-contained routing matrix for seamless A/B mixing. The matrix lowers the reliance on the house router, and the modular framework allows for additional input blades. Conversely, if cost is an issue, marrying a simple A/B master control to the house router is effective.

- Select a solution that offers a choice of panels. The ability to configure a panel for a particular event or application has many advantages.

- Consider a company whose switching fabric is deterministic, with the ability to guarantee a transition in a precise amount of time — regardless of network traffic. When automation instructs the system to perform a task, ensure that the latency is within acceptable limits or fixed within a deterministic number of frames. Your LAN's IP traffic should not be a gating item.

- Look closely at the company's modular direction, and its ability to

scalable configurations, all targeted at making it easier for broadcasters to repurpose content, create new channels, brand their output and generate more revenue with existing assets. This *a la carte* solution eases the visual and financial requirements for getting a new channel to air. The continuing modular trend also makes sense given today's economies of scale. On a budget slated for improvements only, a large master control switcher would be out of the question. However, additional channels or plug-in capabilities for an existing mini master would likely be right in line.

The big-city station has different needs than the country station. The new wave of mini masters provides the flexibility to create a unique on-air look on a limited budget, with the potential to upgrade as required. **BE**

Steve Sulte leads Leitch's chief technology officers' group. Eric Goodmurphy is a product manager for master control switchers and development at Leitch Technology.



Adopting an IT-based broadcast infrastructure

BY BRUCE DEVLIN

The move to digital operations has freed broadcasters from many of the limitations of working in an analog environment. But, as broadcasters put their new digital infrastructures in place, it is becoming increasingly obvious that they need to integrate an IT-based workflow.

IT-based broadcast infrastructure reduces redundancy and allows greater sharing of media across a facility. This, in turn, streamlines production workflow. A common network also offers greater creative latitude in the use and reuse of graphics, program content and other material.

As broadcasters shed the constraints of the traditional broadcast business, they must consider a series of issues and opportunities inherent in the adoption of an IT-based broadcast infrastructure.

These include selecting an appropriate platform and operating system and deciding on the file types they will support. These decisions affect interoperability within the

Above: As part of its IT infrastructure, Hollywood's PacificTitle & Art Studio uses an SGI InfiniteStorage CXFS shared filesystem SAN.

facility. Regardless of the type of infrastructure being instituted, concerns such as storage and security present themselves. And, of course, the broadcaster must consider the facility's network and how it will enable this new digital, file-based workflow.

Video-centric and IT-centric workflows

Figure 1 on page 68 shows a representation of a traditional workflow. The key points of this model are the multiple copies of the material that exist in the system and the number of people required simply to move the content around. With a traditional asset management system, multiple copies exist on tape and local video servers, and are distributed by SDI routers and/or "sneakernet." The final output originates from a copy of the program on a localized playout server, which delivers live SDI content to an encoder for air.

Figure 2 on page 69 shows the equivalent facility in a tapeless environment. Here, the emphasis is on shared content and multiple accesses to a central, managed resource. Multiple users can access content without making copies, preserving video and audio quality. This type of system

Adopting an IT-based broadcast infrastructure

interoperability over the network, regardless of the devices connected to it and the file systems used. (Such file systems include FAT, NTFS, HPFS, SMB, UPFS and ISO9660.)

One platform might support one set of rules for file naming, ownership, access and modification, while a second platform may rely on an entirely different set of rules for the same functionality. The time the facility spends managing communications, privileges and rights between these different platforms could instead be used to improve the quality and quantity of material the facility produces and distributes. This difference in functionality may arise from the vendor's choice of OS or file system, but the customer bears the administration cost.

A networked facility achieves the greatest benefit if the design engineer or systems integrator can build the broadcast infrastructure on the file format or standard that offers the greatest flexibility. Often, this will determine the choice of a server or primary storage device.

New file standards

New file standards such as MXF and AAF are changing the way facilities can use file types internally or across a network. These new standards include

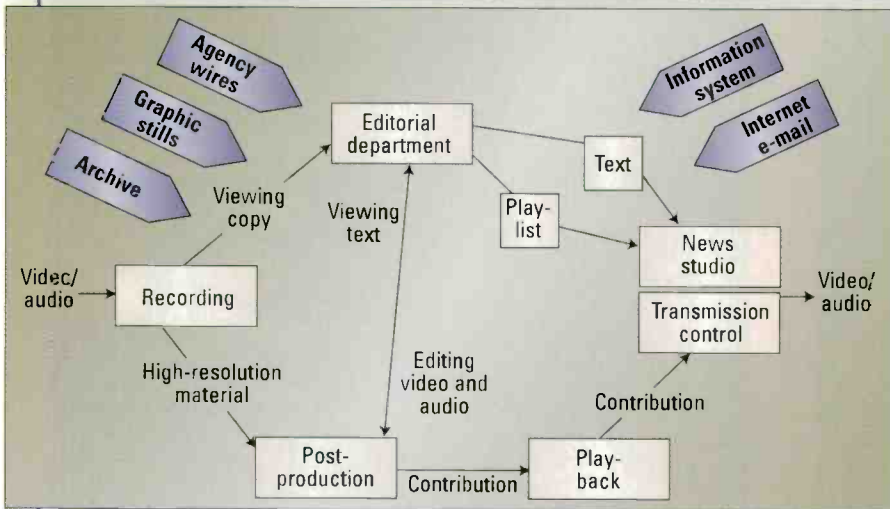


Figure 1. With a traditional workflow, the system contains multiple copies of the material and a number of people are required to transport the content within the facility.

also allows for increased automation because file transfers for airing can come from the central server according to the playout schedule. Actual broadcasts may involve live compression or pre-prepared offline compression, depending on whether the ultimate target is broadcast, VOD, phones, the Internet, etc.

Platforms, OSs and file formats

Interoperability is key to building an efficient IT-based infrastructure. So, it's important to select the right

server platforms and operating systems for editing and graphics.

Some facilities will choose a single OS such as Windows, Unix, Macintosh, Linux, Irix or BSD. This consistency provides a seamless flow of data and media, though it can limit the choice and use of equipment. Other facilities may rely on several different operating systems working on a common network. Here, the vendors dictate the OS in exchange for the functionality, pricing or feature sets the broadcaster wants. In this case, interfaces are necessary to bridge the gap and facilitate

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both the essence of the original file as well as metadata about the file format, such as sampling rate, image dimensions and similar parameters. With this information, a smart device can determine if and how it can use each file.

The MXF wrapping mechanism interweaves individual video frames and associated audio. The file's header and footer contain a description of what is in the file (the types of essence, the size of the pictures, the sample rate of the audio, etc.) for quick reference.

Vendors are still improving the MXF and AAF standards through testing, reporting and collaboration. Testing

tools, available for Internet download, allow broadcasters to implement a common and consistent level of interoperability among their broadcast systems. One example is the tool provided by the MXF Test Centre of the IRT, the Germany-based Broadcast Technology Institute, which has made its MXF test tool available for download at www.irt.de/.

Vendors including Snell & Wilcox are also providing free, online access to their code base to speed improvements to the MXF standard (www.snellwilcox.com/mxf/). As broadcasters increase interoperability

through these standards, they streamline their operations and achieve more cost-effective production and playout.

Data networks and storage systems

Storage costs have dropped, but the overall cost of implementing and administering these solutions has increased. The total cost of ownership, however, depends on leveraging operational benefits.

The local area network (LAN) is the simplest storage solution for IT-based asset management. You can connect a direct, attached storage system to a LAN to provide fast transfer speeds, immediate access and in-house control over the entire network. For a facility where media transfer and sharing is a strictly internal affair, a LAN provides sufficient access.

Broadcasters who need to share media across facilities would fare better by using metropolitan area networks (MANs) or wide area networks (WANs). Such networks have greater reach than a LAN but have less reliable data transfer speeds and are more dependent on outside sources for maintenance. In applications such as live broadcasting, these drawbacks can jeopardize the quality not only of video transfer, but also of the on-air product.

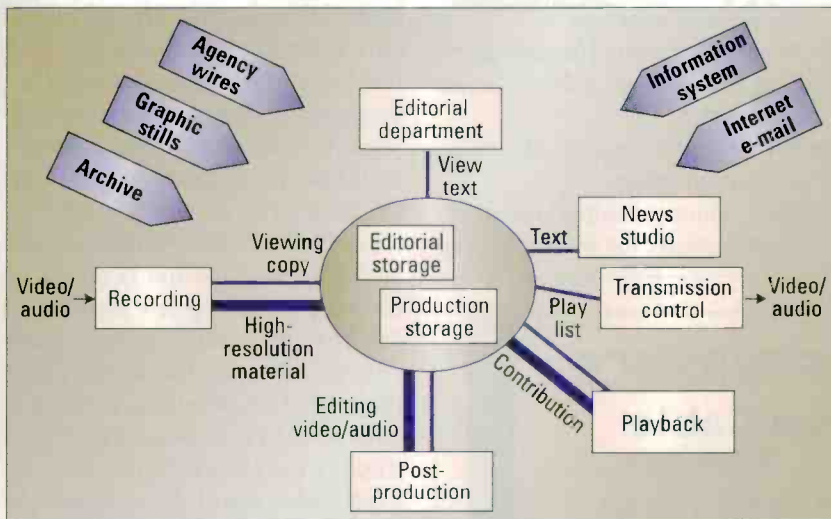


Figure 2. In a tapeless environment, the emphasis is on sharing content and multiple points of access to central, managed resources.

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Adopting an IT-based broadcast infrastructure

and purging

It is possible to build a system that uses the best of both technologies to hit certain price and performance criteria. For example, one broadcaster from the Athens Olympics used a SAN system with a few hundred hours of content for live ingest with online editing of the live content. Behind this was a large (1000-hour) NAS system that had less strenuous real-time requirements, but was optimized for large volumes of near-line storage at reasonable cost.

Security measure

Security is a loaded term today. A security threat may be as simple as human error resulting in the loss of data, or it may be as great and overwhelming as a flood, earthquake or other natural disaster. It could also take the form of a malicious threat from an employee, computer virus or external attack.

A careful evaluation of the broadcast facility's vulnerabilities is critical in choosing an appropriate security solution. Centralized IT storage, while efficient, also requires a number of protection technologies and education of its users to achieve successful, continuous operation. In the end, the main goal of ensuring system security is to establish a reliable and cost-effective solution for upholding an acceptable broadcast standard.

IT now and to come

IT-based digital broadcast infrastructures open many doors for broadcasters. And with these opportunities comes the challenge of choosing among an ever-increasing selection of products and solutions. Deploying new transmission, storage and management tools in a file-based environment enables the broadcaster to lower the costs of using an inter-vendor solution. Open-source, IT-based standards such as MXF and AAF are helping broadcasters to optimize operations to suit their changing needs.

BE

Bruce Devlin is vice president of technology at Snell & Wilcox.

NAS	SAN
Connected through fast IP networks (Ethernet)	Connected through SCSI interfaces over Fibre Channel
The NAS head manages the file system (which knows about filenames).	A separate computer, often called the metadata controller (MDC), manages the file system.
Identify files by filename	Identifies only disk blocks. The MDC manages the file system (which knows about filenames).
Uses byte offsets to move within a file	Transfers raw SCSI disk blocks
Any computer with a network connection and permissions can open a file on an NAS.	Special software is required to manage the file system.
File metadata (permissions, dates, etc.) handled through the same Ethernet connection as the file data	File metadata often handled through Ethernet connections. Actual file data handled through the Fibre Channel connection.

Table 1. NAS and SAN networked storage solutions each have their own unique advantages and disadvantages.

Newer and smarter storage options include network attached storage (NAS) and storage area networks (SANs). Table 1 compares these two storage architectures.

It's impossible to say which system is better, faster or cheaper because the ultimate choice will depend on a number of factors, including:

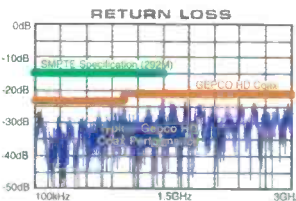
- Number of simultaneous accesses needed to the storage
- Bandwidth required for each access
- Type of file (large video vs. small audio files)
- Nature of the access — streaming or random access
- Total volume of storage required
- Requirements for online backup

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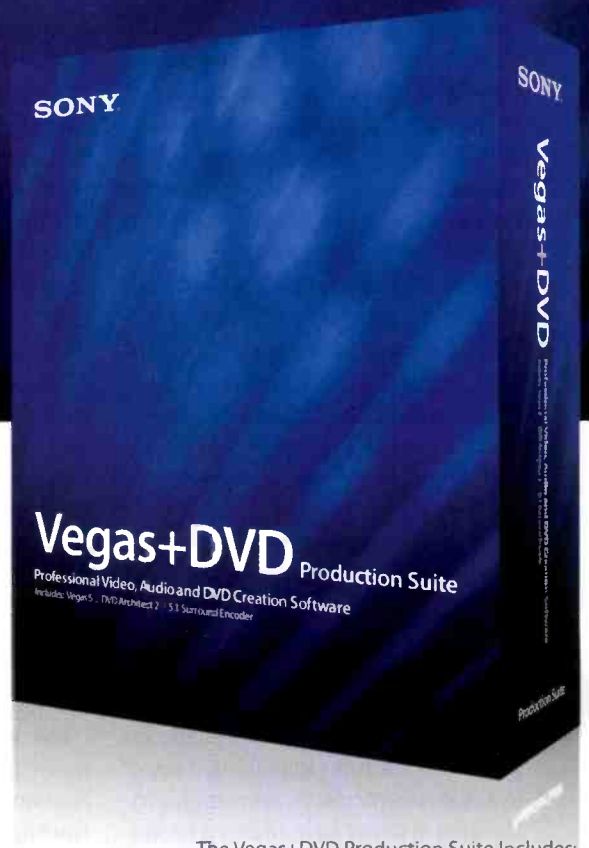
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- Media subclip creation
- Customizable keyboard mapping
- Networked rendering
- And much more

New in DVD Architect 2:

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Automating master control

BY RICHARD BRICE

Many factors are coming together to reshape the modern master control room. Today, master control must enable broadcasters to respond to the demands of consumers looking for a broader selection of channels that provide more information and greater interactivity. Viewers also are demanding a higher quality viewing experience with HD and multichannel audio.

To offer more channels, each targeted to a smaller viewing audience, broadcasters must reduce their per-channel playout cost. This requires more affordable and more efficient equipment.

Integrated master control

Facilities used to use a separate switcher, character generator, logo generator and clip server for each channel. Modern master control systems can integrate all of these functions under the control of a single interface. In addition to making it easier to automate interfaces, more highly integrated systems have reduced broadcasters' overall equipment costs significantly. Today, master control functions can be readily combined, as long as master control discipline, workflows and values are respected.

To be successful, modern master control products need to be designed from the ground up for multichannel playout managed by a single operator.

In a multichannel environment, the goal is to make the difficult job of being visually aware of each channel as easy as it can be. Miranda's Master Control Glass Cockpit is one example of this development. The system features soft control surfaces for monitoring, setup and adjustments, along with dedicated transmission panels.

With a high level of multi-vendor system integration, a single operator can control more channels more effectively, and stations can add extra channels with minimal impact to their infrastructure. More recently, manufacturers have taken integration further by integrating local master control operations with remote sites. This allows a single operator to control multiple channels spread across multiple locations. The PBS ACE project uses this type of distributed control. A consortium including Accenture, AF Associates, BroadView Software, Intel, Masstech, Microsoft, Miranda Technologies, Omneon Video Networks, OmniBus Systems, and SES AMERICOM developed a master control infrastructure for PBS. The solution uses IT strategies to automate repetitive processes and reduce the need for costly manual operations at member stations.

The solution uses Miranda equipment for local branding, local and systemwide signal monitoring, signal routing, and interfacing. It provides multilevel, automated system monitoring and remote problem identification. It allows PBS to remotely monitor, over a standard Internet connection, exceptions occurring on stations in diverse geographical locations.

A more engaging viewing experience

To meet the demand for a more engaging viewing experience, broadcasters are continually enhancing their channel branding and graphics capabilities in the master control room.

Typically, stations can use a dedicated graphics automation system, separate from the main playout automation system, to simplify the control and



Integrated master control systems like Miranda's Master Control Glass Cockpit provide support for multichannel operations.

management of the more complex on-air graphics today's viewer expects.

Control is critical in a multichannel master control environment because operators have neither the skills nor the time to complete tasks manually. One person might manage 10 channels in a facility, so control must be both simple and contextual.

Advances in this area include Miranda's new Imagestore Intuition branding graphics generator, which allows complex multilayer graphics and animations to be controlled effectively by station automation, or via intuitive hard or soft manual control panels. This control is at the heart of effective channel branding.

Changing trends in viewer tastes, economics, automation, and presentation have led to the development of master control systems that offer today's stations more flexibility. **BE**

Richard Brice is managing director, Europe, at Miranda Technologies.

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PrimeVision rethinks remote audio

BY PAUL LYDON

The audio area in a television remote broadcast truck has generally taken second place to the video control and graphics areas. It is usually the smallest section in a vehicle and houses an average-sized mixing console that, until recently, was most likely analog. Now, digital audio consoles are more common. These usually offer automation and recall functions that allow engineers to reset for different scenes more quickly.

The onboard mixing console has become acceptable for use with speech on broadcasts of sport and ceremonial events. However, it is still the convention to work with a special mobile recording studio for live or as-live music and entertainment programs. Improvements in the functionality, reliability and quality of digital audio consoles have led some remote truck op-

erators to consider using a single console installed in a dedicated area for all applications. Building a complete package not only helps cut costs but also raises the quality of the facility. Unusually, a truck's audio section has expandable sides, which is the norm for the video areas in modern remote broadcast trucks. This makes it big enough for a mixing engineer and a score reader, plus a tape operator and any additional multitrack equipment.

Selecting an audio console

The broadcaster selected the Studer Vista 8 in part because of its flexibility for use with both music and sports events. It works well for recording to multitrack or for live events. Also, high-quality sound makes it suitable for all kinds of music. For multitrack recording, the desk can be used merely as a means of monitoring the incoming signals. For live broadcasts, it has



PrimeVision uses the Studer Vista 8 console to record live audio in its HD30 remote truck.

work alongside the director and control the main console remotely.

Console in action

HD30 recorded performances of the ballet *La Sylphide*, held in July at the Paris National Opera, for NHK television and later DVD release. The music was recorded through 26 microphones in the auditorium onto a TASCAM DA-98. A live stereo mix was recorded on the audio tracks of a Sony M-2000HD VTR, with a backup on tracks three and four of the DA-98. The necessary components for a 5.1 mix were recorded on the remaining six tracks.

Among the permanent gear in the audio area is a TC Electronic System 6000 for reverb and processing. Classical music is the truck's primary focus, so there is no need for racks of equalizers and processors. Audio monitoring is accomplished on Genelec 1031 loudspeakers, supported by two Studer self-powered loudspeakers.

The use of the Vista 8 audio console in its audio section has enabled PrimeVision's HD30 to use one console for audio production of both sports and live music events. **BE**

Paul Lydon is a consultant based in the UK.

Building a complete package not only helps cut costs but also raises the quality of the facility.

erators to consider using a single console installed in a dedicated area for all applications.

This reappraisal of audio is partly explained by remote truck companies' migration to HD. Multichannel 5.1 sound is regarded as the best accompaniment to HD, and operators are installing suitably equipped audio consoles. Danish company PrimeVision entered the HD market in June with the HD30 truck. This 689sq ft vehicle accommodates up to 30 cameras, 154 HD monitors, an 80-input video mixer and a Studer Vista 8 digital audio mixer.

PrimeVision engineers built a control room in the truck that would handle all audio, eliminating the need for a mobile studio for music projects.

the headroom to deal with sometimes overpowering orchestral instruments.

The console ranges in width from 56.14- to 118.35in, depending on the total number of faders. The broadcaster configured the truck's system with more than 250 inputs and 150 outputs. It features three bays containing a total of 30 channel strips, with the Vistonics user interface. Twelve faders control up to 52 outputs/inputs or any combination.

The control panel also features a Vistonics interface, but with 10 faders and surround sound monitoring. Additional faders are available on a 10-fader sidecar section that can be detached from the main desk and located in the video section, so the audio engineer can

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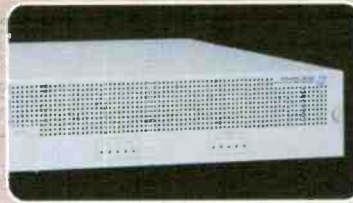
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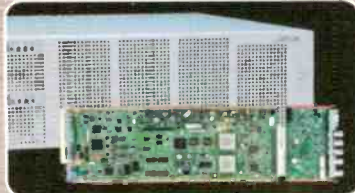
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Test and measurement



BY JOHN LUFF

Testing analog audio and video signals was predictable and understandable — once you learned what a waveform monitor and VU meter looked like. The test equipment showed representations of amplitude over time. Variants of analog signals and test equipment evolved over decades, but there was no radically new technology from the early 1950s to the 1980s.

Then along came digits, computers, compressed video, surround sound, complex RF signals like COFDM, and phase-shift keying (8-VSB, QPSK, 8PSK, 64QAM, etc.). The comfortable and familiar technology no longer sufficed at even the minimum level. A rich set of new tools for the new technologies has developed in the last 10 years. Vector modulation monitors, rasterizers, remote monitoring probes, surround sound scopes, MPEG syntax monitors and a host of other tools now allow us to look at complex, sometimes esoteric, signals. Some test instruments display only textual information, a far cry from the intensely graphic interface of the waveform monitor.

Video was easy when the scope represented the same thing that was on the wire. There was no need to decode for display. A simple special-purpose oscilloscope was created that locked to the repetition of the line or

vertical frequency of the picture.

Once created, the sensible display allowed operators to see any defect in the signal and the displayed picture. With digital video, SMPTE 259 resembles wideband noise on an oscilloscope, and that is no mistake. It is actually one of the pieces that makes it work. Find the clock, decode the digits, deserialize the signal, convert the signal from digital to analog, and then display. Verify the correct format, find the embedded data and audio signals, and display them. That is a lot more stuff to do than we did only a decade ago. And audio (PCM AES, or AC-3/Dolby E compressed) or compressed video (ASI) could be on the same coax. ASI looks similar to SMPTE 259. Just because it looks like noise doesn't mean it is SMPTE 259M. Audio is similar, though AES digital audio is not turned into a noiselike signal for transmission.

For the most part, scopes today have moved away from the cathode-ray display. Even if the form factor is similar, most waveform monitors use digital sampling and a raster display. With some rasterizers, it is possible to put the output on computer displays ranging in size from a few inches to several feet across. This is one example of the merging of conventional technology and computer technology. If the display can be a VGA screen (XGA, etc.), the test instrument can also use computer analysis techniques.

Today, engineers use many different measurement displays. An eye pattern is a specially triggered and displayed version of the time vs. amplitude display. The impression is that the eye is a repeating pattern, like sync in analog video. But, in reality, it is visible only by overlaying all of the transitions from which digits are decoded.

Another radically different class of displays uses text to view the syntax of digital signals. SDI, AES and compressed video lend themselves to this technique. It is possible to have an MPEG signal that is perfectly decodeable in all respects except that the syntax breaks a rule or two and leaves the signal useless in some or all decoders. MPEG signals use a complex series of symbols that are legal only if assembled in a specific syntax. But that type of test instrument can

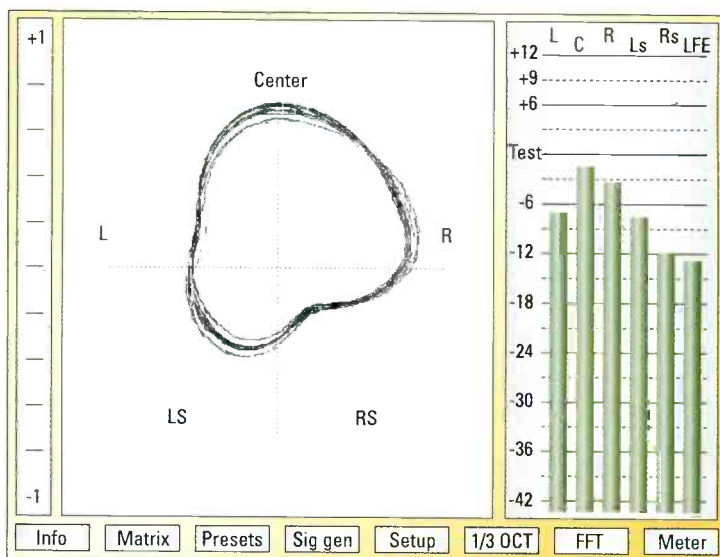


Figure 1. New scopes display the spatial distribution of the surround sound signal, along with the levels in each channel. These scopes can be programmed for different metering ballistics to match in-house and international standards. Surround sound MSD600C from DK-Technologies shown above.



An operator uses Tektronix's WFM700 multistandard waveform monitor. The monitor features an HD/SD eye pattern display, one of the many different measurement displays engineers use to monitor digital signals.

display complex and rich information in away that is easy to understand. It displays statistics about the signal and its content with format information that allows the user to troubleshoot difficult and obtuse problems in a complex domain. The ability to set

alarms for out-of-limit or missing items allows the complexity to be invisible when all is well.

What about audio? How hard can it be with just two wires? Well, what about compressed 5.1 audio? How about Dolby E? How do you test AES? Specialized instruments analyze the content, the bit stream and the acoustic content (surround sound image). (See Figure 1.) A VU meter is interesting, but what about apparent loudness, content of the metadata or formatting of the data?

In addition to instruments that test the signal itself, we must also address the complex RF transmission technologies that deliver the signal to the end user. The ATSC's 8-VSB signal, as well as similar transmission technologies used for cable (QAM) and DVB-T (COFDM), require a new variety of test instruments that display RF in a way that allows the user to

determine if the modulation meets the standard. Without these tools, it would be impossible to tell if the transmitter and its modulator are functioning properly.

These sophisticated tools are but a subset of the full suite of tools available. Waveform monitors can combine measurement capability for SD and HD signals, embedded audio, and even embedded compressed AC-3 or Dolby E. Modern facilities must have IT test instruments such as Ethernet testers and digital circuit test sets for T1 and DS3 lines. One key to successful measurement in an environment this complex is training on the right tools, and on analyzing the signals. **BE**

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



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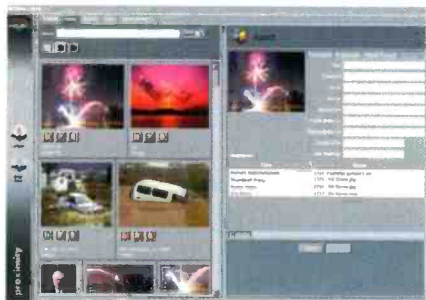
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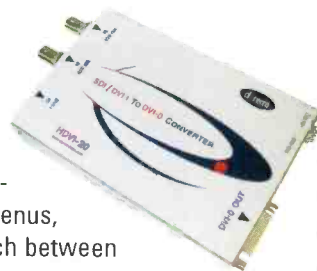
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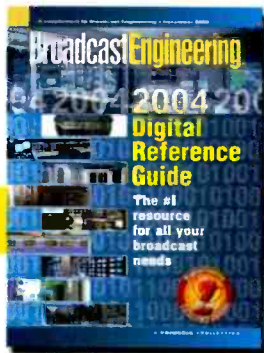
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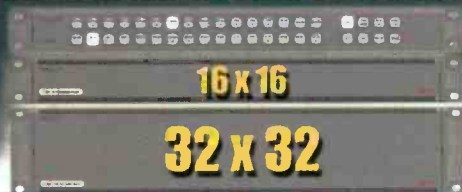
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WDSI FOX61TV - seeks Assistant Chief Engineer: experience with UHF Transmitter preferred, ability to maintain studio equipment, analog and digital tape recorders and DVC Pro equipment required. Good communication skills a must. Send resume and cover letter to: WDSI FOX61 Attention Christene Ramsey, 1101 East Main Street, Chattanooga, TN 37408, email to wdsijobs@pgtv.com or fax to 423-265-3636. NO PHONE CALLS PLEASE. Deadline for resumes is October 31, 2004. WDSI FOX61 is an equal opportunity employer and a drug free workplace.

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All the news that's fit to stream

BY PAUL MCGOLDRICK

Television news is a conundrum. The process to select the stories that are broadcast is a picky one. Not picky in the sense that the stories have to be just right, but picky because of the sheer quantity of what is available.

In a network operation, a local station's selection of news items stems from previous assignments that reporters were sent out to cover, along with those stories that came up unexpectedly. They cover local interests, concerns and amusements and don't hesitate to break away for an occa-

tion between channels with highly similar formats. Many, however, are missing major opportunities to further inform us, creating untapped revenue streams. Organizations will do whatever they can to protect their main "property" which, in the case of the television news operation, has been the broadcasting of their product. But according to a study by Ball State University for the RTNDA, 91.7 percent of all TV stations in the United States have a Web site that also carries news. That's about 25 percent more than radio stations. Of the top 100 stations,



No one would attempt to succeed in the print news business without people to check stories and determine priority and location according to house rules of importance and significance. The same should be true of an online version. Go look at Google's news service and you will see what happens when there is no human making decisions about what are top stories and how to classify the publications they mine.

The Web can be a source of revenue for a news operation, but stations need to recognize the link between using resources and success. No publication will survive without quality content, streaming or not. That's true of the medium we work in, and it's true of the online medium, too. **BE**

No publication will survive without quality content, streaming or not.

sional freeway chase. The network covers a tiny selection of the stories, with a focus on the content that the network itself has originated. International stories tend to be only those that involve Americans' lives, giving us a pretty narrow-minded view of the world around us.

At the alternate networks, CNN has developed a fabled reputation for coverage of, particularly, international events. Today, in a crisis, many people will turn to one of the cable networks for the earliest — if not the most in-depth — coverage.

The most interesting news phenomenon this year is the broadcasting of "fake" news. Comedy Central's *The Daily Show with Jon Stewart* is on the right channel — comedy. But, despite its comedic tone, it has become a major political force, attracting guests of all political backgrounds.

Apart from CNN, FOX and Comedy Central, the broadcasting of news has, in general, become a staid repeat be-

only five did *not* have a Web site at the time of the survey.

Those Web sites generate more e-mail complaints than the stations get for any other area of their operations. Readers complain of typos, illiteracy and plain dumb errors. The news sections on the Web sites often also contain unremoved coding; strange mixtures of upper- and lower-case lettering; fragmented sentences; and quotes, often without quotation marks, from sound bites that are badly transcribed — or plain misquoted. Sources are identified incorrectly or not identified at all.

You'll find that many Web site operations are a one-person show. Whereas management will approve on-air scripts at warp speed, it doesn't want anything to do with the written scripts for the web. And, although the reporters who originated the broadcast story would be the best source to modify it for HTML reading, they're already off onto the next assignment.

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



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