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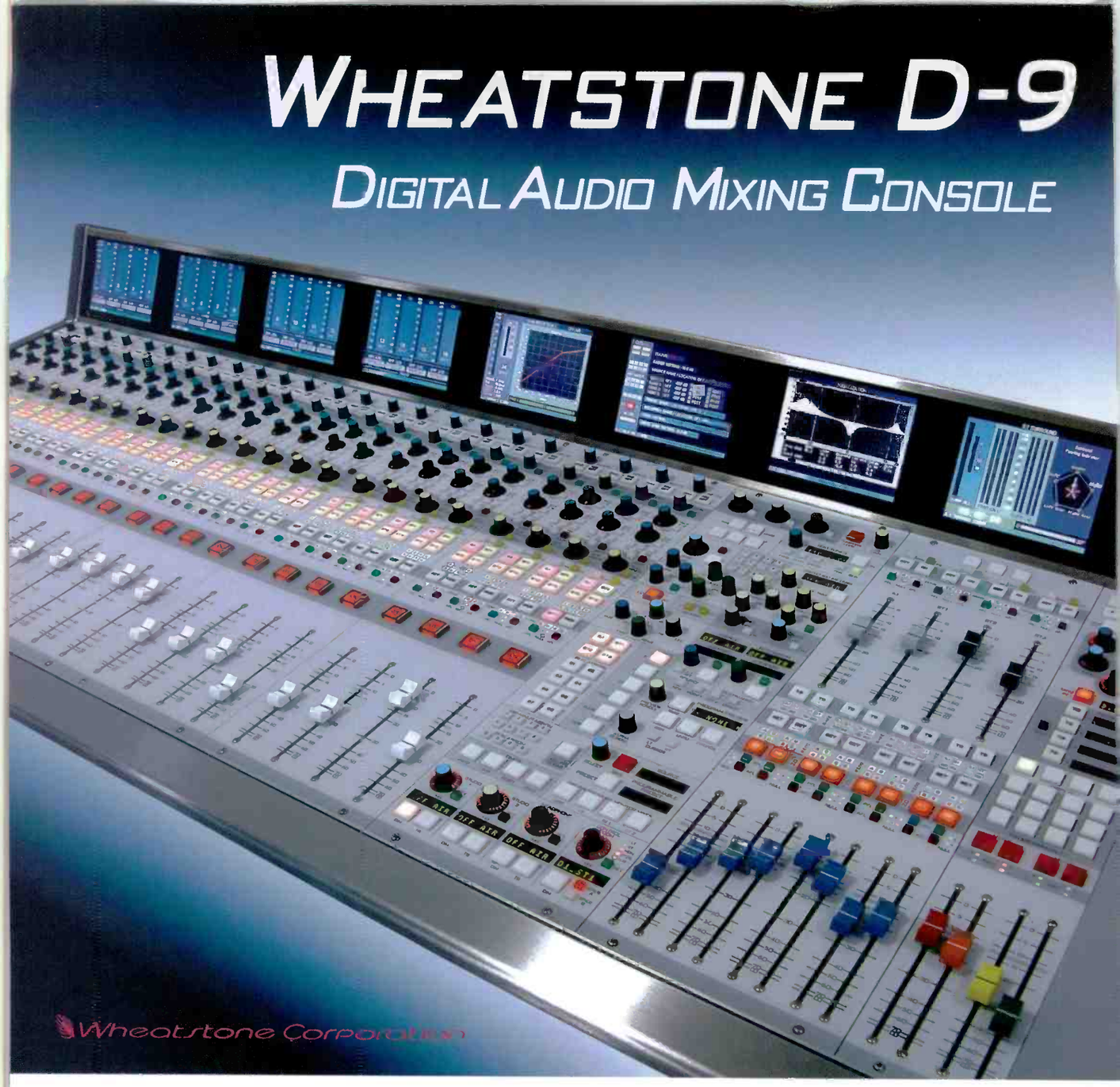

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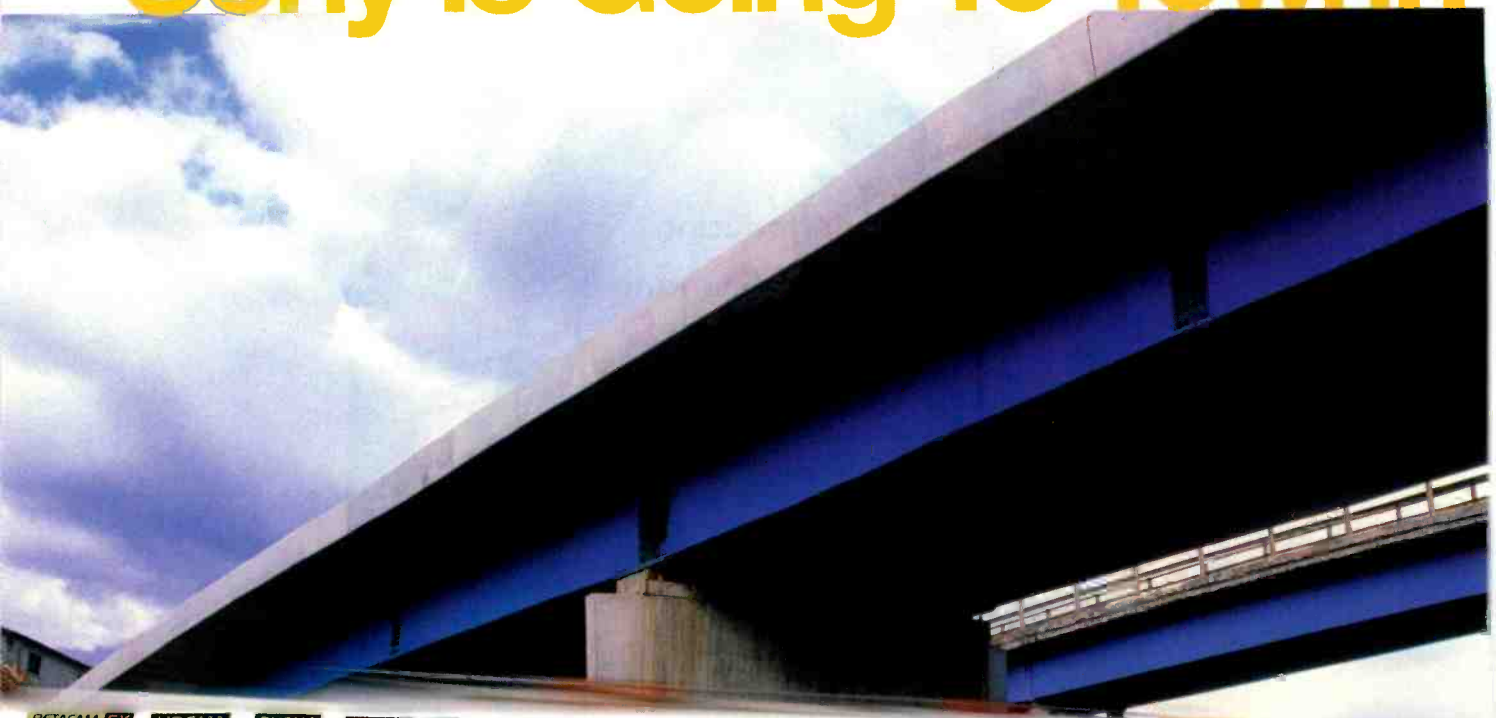

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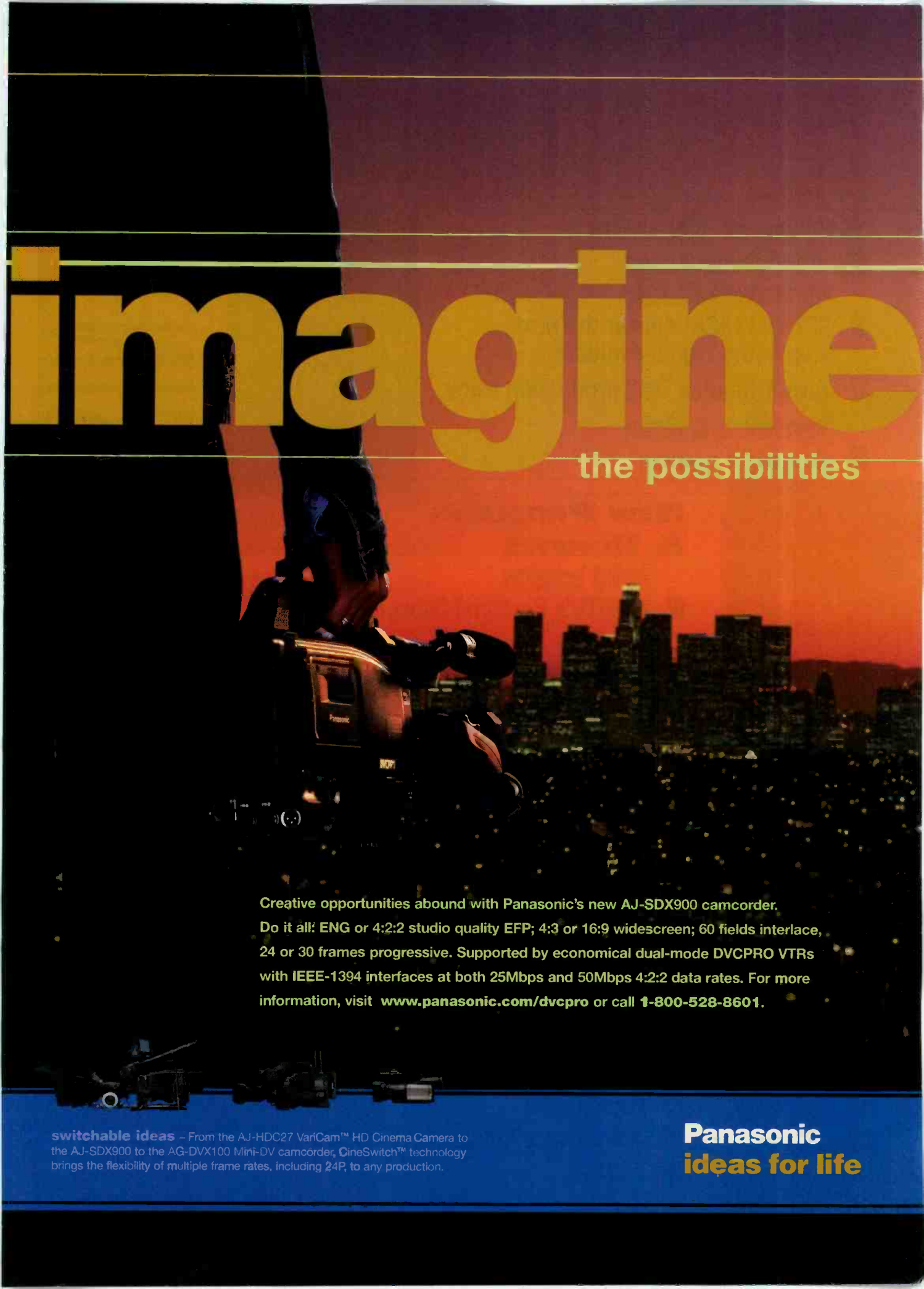
BEYOND THE HEADLINES

DIGITAL HANDBOOK

ON THE COVER: Solid State Logic's MTP digital audio production console, installed in Turner Studio's new 56-foot TS2 truck, allows for faster recall of settings between events, more flexible routing, and also helps to add more realistic audio elements to a broadcast.

(continued on page 8)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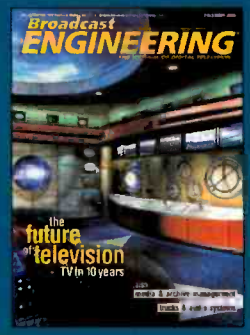

Broadcast Engineering magazine referred to one FCC Chairman as "...the most disliked Chairman ever..." for his actions on broadcasting. Name that FCC chairman. All correct entries will be eligible for a drawing of the new *Broadcast Engineering* T-shirts. Enter by e-mail. Title your entry "Freezeframe-September" in the subject field and send it to: bdick@primediabusiness.com. Correct answers received by Nov. 17, 2003, are eligible to win.

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IBC does not mean Itsy-Bitsy Convention

While you're reading this magazine, I'll be working at the International Broadcasting Convention, IBC. I'll be touring the exhibit halls at the RAI, visiting with exhibitors. Or perhaps, I'll be coasting lazily down one of the many Amsterdam waterways in a canal boat, drinking a good brew. Okay, the first will happen. I'm not so sure about the second.

The IBC is in some ways the show NAB ought to be. First, IBC is slower-paced. There's less frenzy. Everyone seems so busy at NAB. I tell readers that the noise level, figuratively speaking, is so high at NAB that you can't hear anything. At NAB, we don't see all we want to see, we don't visit all those we would like to visit. Worst of all, by the time the show is over, attendees and exhibitors alike are so overwhelmed with information they can't remember half of what took place.

On the other hand, the IBC looks like a traditional trade show. It focuses on the same technology as NAB, but with the added flair of being a truly international exposition. Three key differences I notice. First, the IBC show is longer. The exhibits run for five days instead of four. Second, the IBC is admittedly a smaller show in terms of headcount, but that's really a significant plus for both attendee and exhibitor. Third, IBC has become a far more congenial show than NAB, with more time to meet and visit in a less pressured setting. Friends often meet over a beer in an exhibitor's stand to discuss new products and technology.

I also find that IBC is a better place to develop friendships that span the distance between the United States and other countries. Exhibitors seem genuinely happy that you've stopped by to see them. At NAB, you're expected to stop by. Miss an appointment and the NAB exhibitors are angry. If the same thing happens at IBC, the exhibitor is disappointed you weren't able to see them. The difference is civility.

If you're not going, keep checking the *Broadcast Engineering* Web site. We have lots of new products for the show already posted there. By the way, if you are looking for information on new products, don't miss the new Product Shop section of the Web site. If a new product was released in the past nine months, it's probably listed in the Product Shop. You can search the site for specific technology, a product name or just browse.

If you're fortunate to be among the expected 40,000 attendees at IBC, look me up.

Brad Dick

editorial director

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December's "Modern Woman" editorial

I recently received your December issue of *Broadcast Engineering* and read the editorial entitled "The modern woman." It's great – and oh so true! I have to confess to spending an entire weekend buying a desktop PC (plus accessories) along with a new digital camera. This then lead to office furniture and communications issues – i.e. phones and lines. And so, I have to confess that I'm that woman who's going to make you want to "die right there on the showroom floor" with the way I was talking to the salesman in the store about my very specific requirements.

But I still want the jewelry...

JENNY EVANS, MANOR MARKETING

HDTV and 8-track tapes

Sound synchronization problems, unnatural digital motion, dropouts, lock-ups, 3:2 screen burn. Count me on board. Oh, and lack of programming.

DAVE FRICK, BELL ATLANTIC

April's Mobile 8-VSB editorial

Loved your April Fools story in *Broadcast Engineering*. Trouble is, it's too close to reality.

BOB JORDAN, WPXI

January editorial

Brad,

I found myself laughing out loud at your response to Scott Hamilton at News Corporation and your editorial "dig" at Fox Engineering. They are certainly within their rights to demand copy protection for their product, as is anyone in this digital age.

However, if any copy protection system becomes too onerous for consumers, I am sure there will be other content providers ready to step into the breach and satisfy the demand for digital programming. Mark Cuban of HDNet has already indicated he does not favor overreaching copy protection methods, and perhaps those eyeballs put off by draconian copy protection schemes will migrate to his channel.

That's the beauty of our free market system. As a "retailer" of mass-market entertainment, you make money by distributing your "products" as widely as possible. On the other hand, if you restrict the distribution of your products, other broadcasters will be quite happy to take your place and your market share. There are simply too many channels competing for our attention nowadays – no one wants to take a chance on losing viewers and negatively impacting their bottom line.

As for FOX's decision to adopt a non-HD, 480i/p standard for broadcasting digital TV, more power to them. I happen to think that many of the FOX 480p/24 filmed programs have superb transfers and high entertainment value. "24" is a good example. And a widescreen 480i/p component video format for live sports is certainly better than plain old 4:3 480i composite video. They're getting the most out of their digital pipeline.

But they may increasingly be going it alone. Once again, market forces are coming into play with regards to HDTV. In addition to CBS, NBC and ABC's extensive HD schedules, PBS is expanding its carriage of true HD programs with each month. WB has opted to carry several shows in the 1080i format. And Viacom will be converting many of their O&O UPN affiliates to HD in the near future.

With ESPN-HD, Discovery HD, HBO, Showtime, NBA-TV and other cable/DBS networks adding HD programming, it's clear that the majority of networks believe there is a strong future for HDTV. CBS' recent HD telecast of the Grammys in Dolby Digital 5.1 was superb technically and at a new level of TV programming. I expect ABC to answer the challenge with their HD coverage of the Oscars.

When all is said and done, TV audiences will decide if FOX's decision is a wise one. In the meantime, cool your jets and enjoy all of the HD programming that's there for the viewing.

PETER H. PUTMAN,
ROAM CONSULTING BE

April Freezeframe:

Q. In the ten-year period from 1971 through 1981, new tape formats were introduced, it seemed, almost yearly. Name the formats introduced during this period and the companies proposing each of them.

A. 1971	U-matic format introduced by Sony, TEAC and JVC
1973	A format 1-inch VTR shown by Ampex
1975	B format 1-inch VTR shown by Bosch
1976	C format 1-inch VTR shown by Sony
1981	Beta introduced by Sony
1981	M format introduced by Panasonic, RCA and Ikegami

Winner:

Olu Mide, Computer Warehouse

Test your knowledge!

See the Freeze Frame question of the month on page 8 and enter to win the redesigned *Broadcast Engineering* t-shirt.

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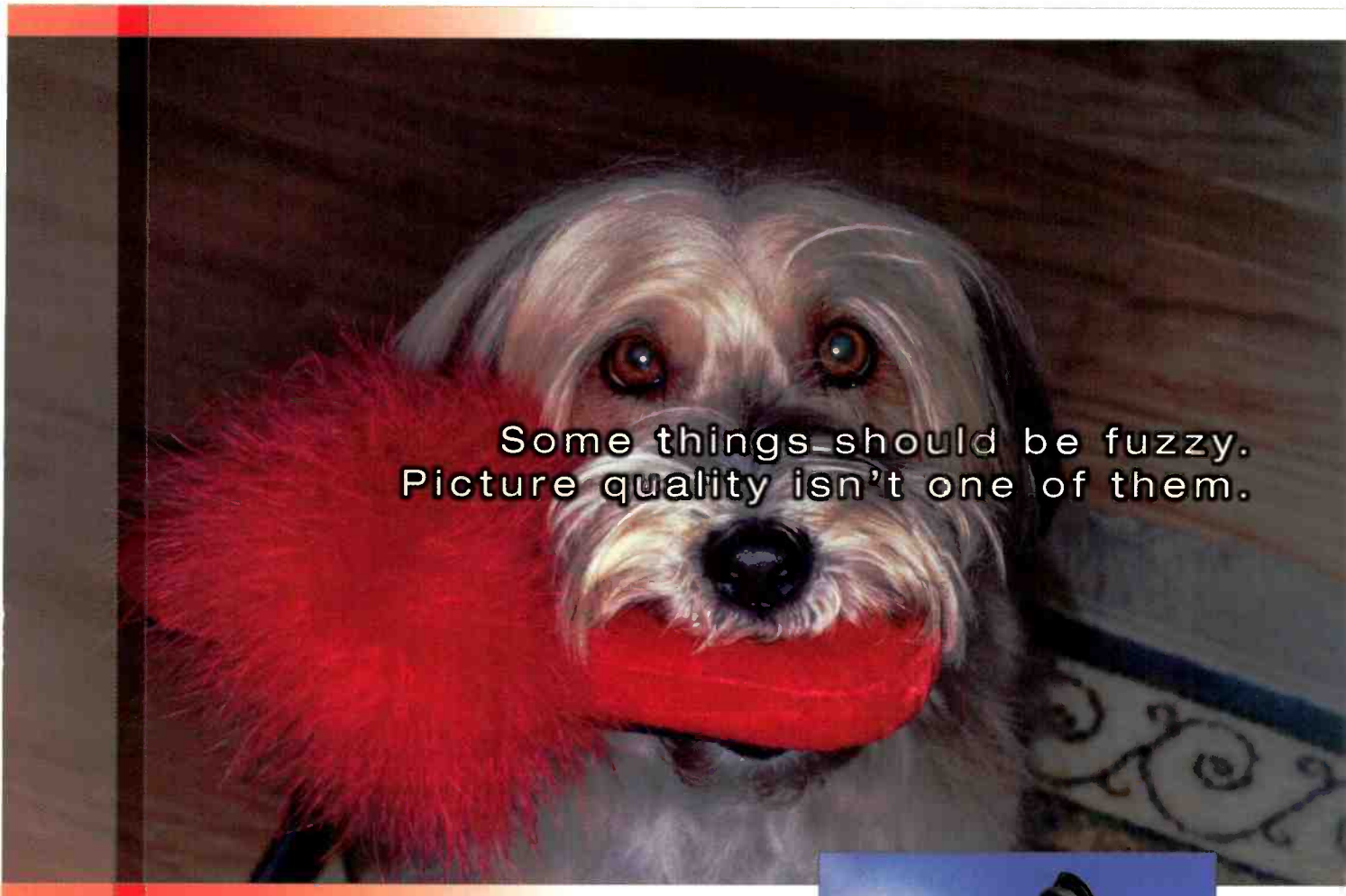

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Local production in HD

BY CRAIG BIRKMAIER

When I first saw the topic for this month, my immediate reaction was that this could be the shortest column I have ever written. Foot dragging and delays have been the hallmark of the transition to digital television for local broadcasters. Many stations have struggled with the financial burdens related to putting their digital transmitters on the air. And, just in case anyone has bought into the misguided hype that all broadcasters are being required to convert to HDTV, let me remind our viewers that the FCC did not mandate *any* HD programming. The chairman of the FCC and certain members of Congress have tried to hold the network's feet to the fire, regarding promises made about HDTV programming; however, when one reads the fine print of the FCC rules, broadcasters are only required to provide minimal DTV coverage over their city of license.

Local HDTV production is so far down the list that 2.4 percent of respondents to a 2002 survey conducted by SCRI for Broadcast Engineering indicated that they *never* plan to produce local programming in HD; another 28.6 percent were unsure if they would produce local programs in HD, and 23.8 percent indicated that they would not begin local HD production before 2006. (See Figure 1 on page 16.) We asked the question again in this year's survey. Don't expect the results to be significantly different.

The reluctance of local broadcasters to jump on the HD bandwagon certainly comes as no surprise. For the most part, the broadcast networks have also been dragging their feet with HD production. Much of the *high value* programming produced for prime time (and national/international syndication) is now being produced in HD, and the new season will see more coverage of sporting events in HD. But news and other programs with a short shelf life are rarely produced in HD. Not one local network-owned-and-operated TV station is doing local HD production. Then again, you can count the total number of local stations doing their news in HD on one hand.

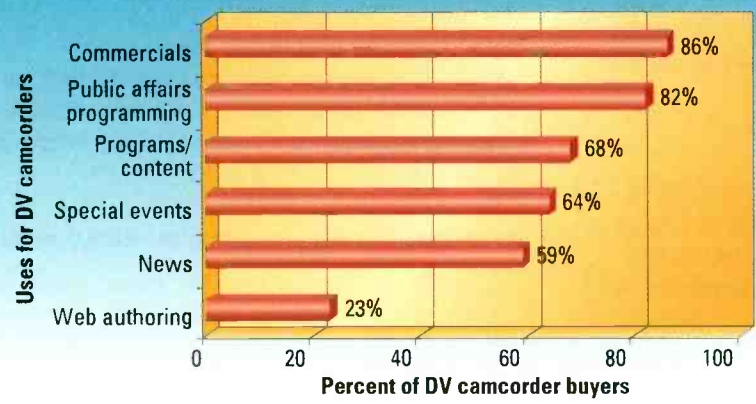
Options for affordable editing of HD are becoming more popular. Pinnacle's Cinewave offers the ability to do uncompressed nonlinear post-production of HD formats using Apple's Final Cut Pro software.

There is historic precedent at work here as well. It took more than a decade for color TV programming to fill the prime-time schedules of the networks. And it was more than a decade later when most local stations began to originate local programming in color. Decades after the introduction of stereo to TV, the majority of stations still do most local production with mono audio.

Bottom line, the "golden age of television"—for equipment manufacturers — is history. Gone are the days

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

Uses for DV camcorders
DV camcorders rise in popularity



SOURCE: Trendwatch, Inc. www.trendwatch.com

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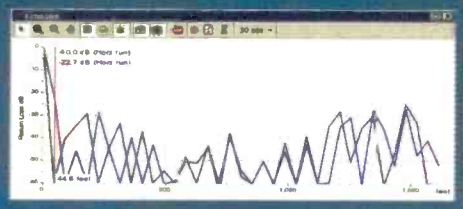

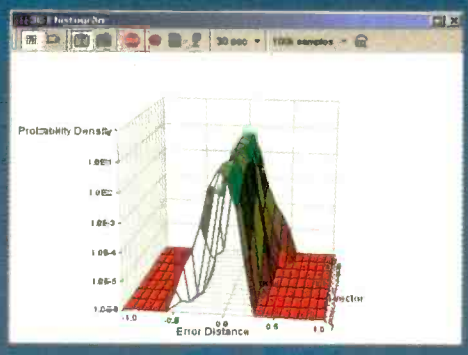

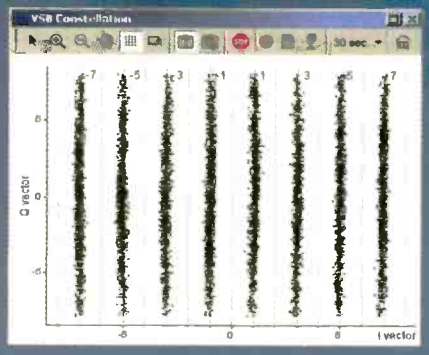

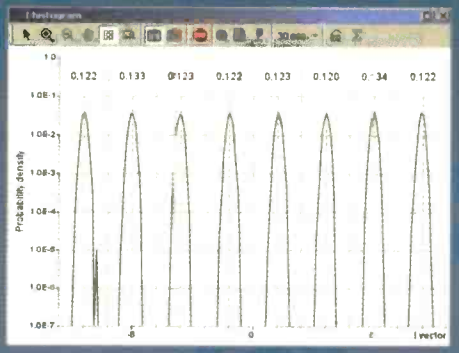

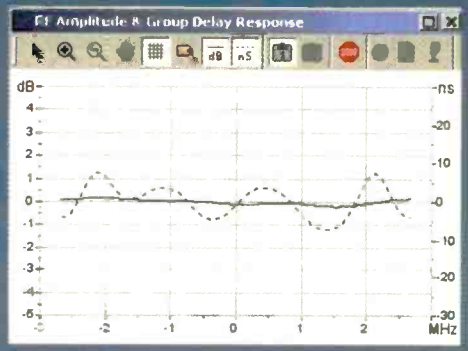

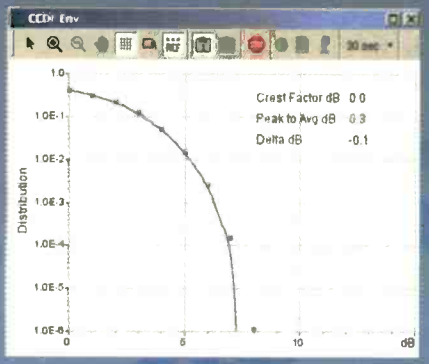

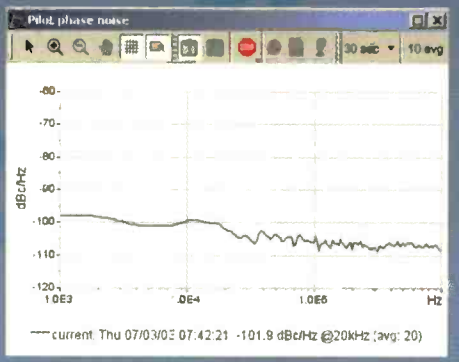

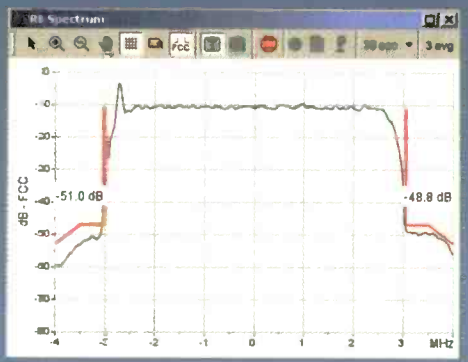

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when one station taking the plunge with a new technology would quickly force the others in a market to follow suit. Today's reality is ... *the bottom line.*

Reality TV

The thought occurred to me that this subject might be perfect for one of those David Letterman-style Top Ten lists: The Top Reasons for Local Broadcasters to Produce Programs in HD.

But Letterman is still not doing his show in HD, although he may soon join Jay Leno in the late night battle for HD supremacy. And there was the minor problem that I couldn't stretch my brain wide enough to come up with 10 crazy reasons for stations to take the HD production plunge.

But it did occur to me that local stations might be missing the boat with the current *reality TV* craze. After all, the biggest purported advantage of HDTV is how lifelike and realistic it can be. If I were a news director in Los Angeles, the first thing I would do is put HD cameras in my news helicopters. Just imagine how much more detailed and lifelike those freeway chases would be in HD!

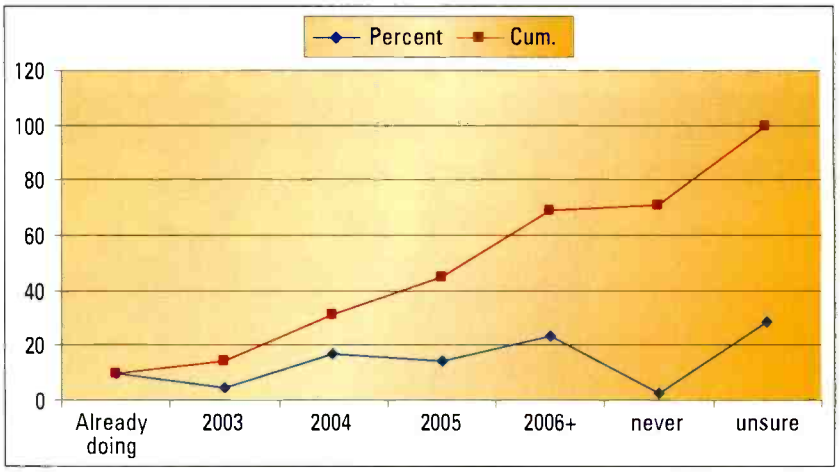

Figure 1. In a 2002 survey by SCRI, local stations were asked: When do you plan to begin local HDTV production?

Related Links

King Launches 1st Local HD Show
http://www.sonyusacinealta.com/content/article_67.shtml

History of WRAL Digital
http://www.wral.com/News/623644/index.html

WRAL Redefines Local News With All-HD Newsroom
http://www.wral.com/wralinfo/460731/detail.html

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http://www.media100.com/PressRelease.asp?pageid=845

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http://www.pinnaclesys.com/ProductPage.asp?Product_ID=108&Langue_ID=7

Perhaps it is the *reality* of HDTV that's the big problem. Hollywood has stubbornly held onto *the film look*, noting that it is an important aspect of the motion picture experience. Apparently the video equipment manufacturers got the message — this whole 24P thing has nearly hijacked the HDTV transition. So much for the glory of 1080i ... even if virtually all of the HDTV displays being sold use the 1080i-scanning format.

Broadcasters have become accustomed to the look of SDTV. Sure it has improved over the years with advances in acquisition and display technology, but fundamentally it is limited. It is limited by the number of lines (525/625); it is limited in color fidelity; and it is limited by the filtering needed to keep interlace from flickering obnoxiously. Just call it the TV look.

The ability of DTV broadcasts to bypass composite video encoding (NTSC/PAL) is a big help; just look at the delivered picture quality and the success of DVDs. But MPEG-2 encoding has its own unique set of artifacts, and a modern digital component plant is needed to gain the full advantage of what MPEG compression can offer. Heck, more than half of the stations in the United States have not even upgraded to digital, much less HD.

Let's face it: Broadcasters like the look of local production that they have spent decades perfecting. It's not too demanding, of the sets or the talent. Do we want to see what those news sets and anchors really look like? There are some things that make-up and paint just can't hide with HDTV.

Broadcast pioneers

It would be unfair, and misleading, to suggest that local HD production is non-existent. WRAL in Raleigh/Durham has been broadcasting all of its news programming in HD since 2001. KING-TV in Seattle does HD newscasts and claims to be the first station in the United States to offer a regularly scheduled daily program in HD. The Belo-owned NBC affiliate began carrying its homegrown daily magazine show, *Evening Magazine*, in HD this past April. The show is shot, edited and broadcast completely in the HD format. KING also offers its Saturday evening *Northwest Backroads* in HD. Boston's Hearst-Argyle-owned ABC station WCVB-TV carries a nightly news magazine show, *Chronicle*, and has broadcast it in HD on occasion, but does not have any plans at the moment to broadcast the show in HD regularly.

Local HD newscasts typically use HD studio cameras. However, most ENG footage is still shot with standard defi-

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nition cameras. With the cost of HD studio cameras coming down, it is expected that more stations will originate the studio portions of their newscasts in HD as they go through normal equipment replacement cycles. Several camera manufactures including Panasonic and Thomson Grass Valley are offering cameras that provide an upgrade path to local broadcasters. These cameras use HD imaging sensors and can be equipped with SDTV back-ends that can be upgraded to HDTV when the station is ready.

Options for shooting outside the studio are also beginning to proliferate. At NAB, JVC introduced a low-cost HD camcorder that shoots both 480@60P and 720@30P. Several consumer electronics companies have recently announced their intentions to develop a new HD camcorder format that records using the popular DV tape format, extending on the capabilities of the announced JVC product. The new format will record MPEG-2 transport streams to DV tape and will support both 720@60P and 1080i@30i acquisition.

Options for affordable editing of HD are beginning to appear as well. Pinnacle's Cinéwave offers the ability to do uncompressed nonlinear post-production of HD formats using Apple's Final Cut Pro software. And Media 100 has demonstrated an HD option for its 844X product line. At NAB, Media 100 also previewed a version of its popular Media 100 nonlinear editing system running on the same HD hardware developed for the 844X.

So don't rule out the possibility that your station may be doing HD production in the near future. And ... the number one reason to do local production in HD: used car ads! BE

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

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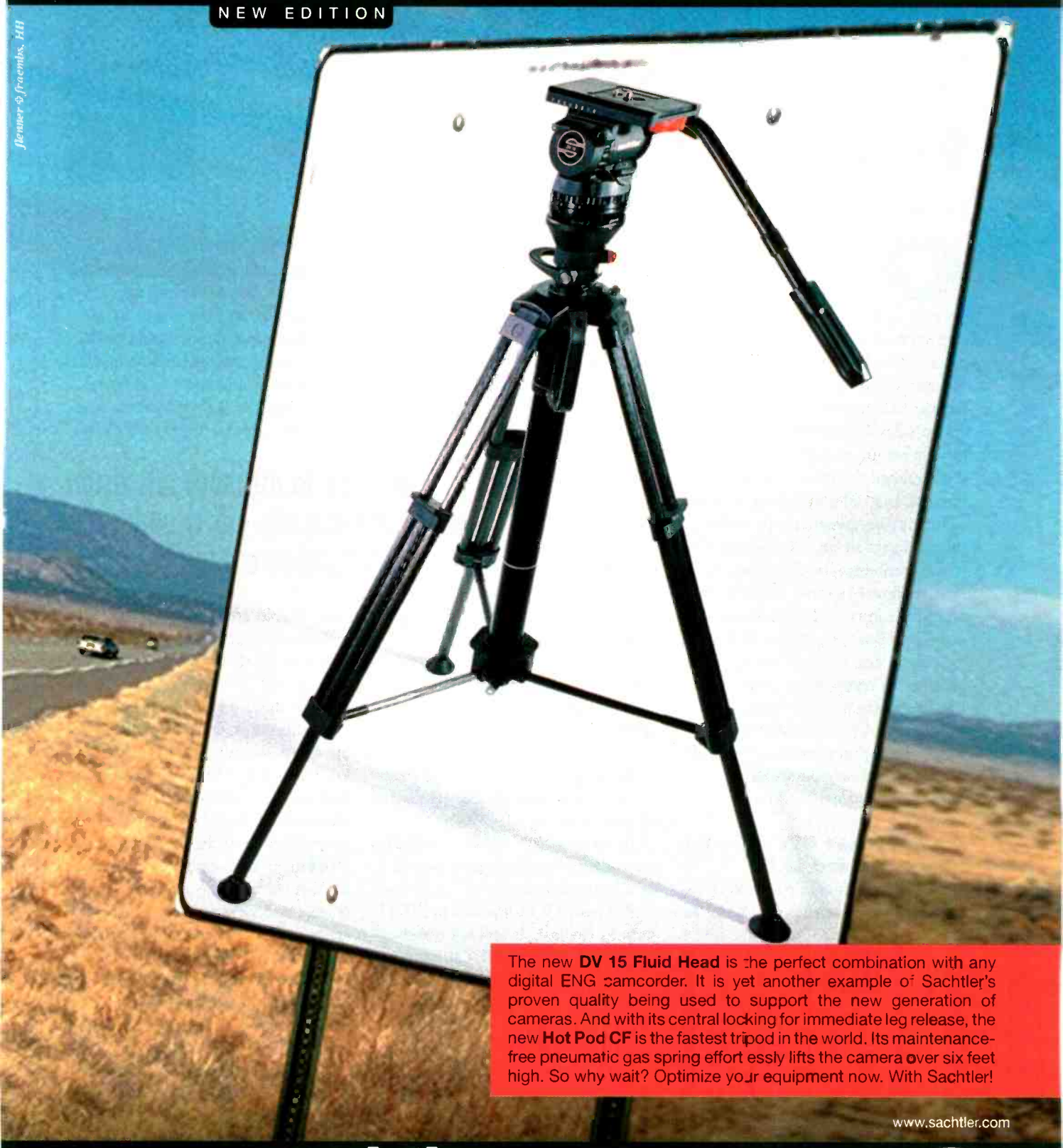

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BEYOND THE HEADLINES

TV duopoly twists

BY HARRY C. MARTIN

One of the most interesting twists in the TV ownership regulations adopted June 2 was that the commission's decision *not* to attribute television joint sales agreements (JSA) under the *television* ownership rules, even though it will attribute JSAs under the new radio ownership rules. The commission did not distinguish the two services, but rather distinguished the two divergent procedural paths to adopting the new rules.

During the ownership proceeding, the commission provided notice that it was contemplating making radio JSAs attributable; thus, the public had an opportunity to comment on that possibility. But the commission did not articulate, and the public could not consider or comment on, any equivalent proposal on the TV side. The resulting inconsistency is likely to be fixed soon. The commission has pledged to initiate a new rulemaking to address the attribution of television JSAs.

FCC proposes DTV rules for translators and LPTV

The FCC has issued a rulemaking notice proposing new rules to govern the DTV transition of TV translator, LPTV and Class A TV stations. The agency wants to make over-the-air DTV service available in rural America, where most TV translators and many LPTV stations now operate.

For DTV translators the FCC is proposing that:

- Stations be technically capable of retransmitting the complete signals of DTV broadcast stations.
- Local message insertions be permitted, with the possibility that operators will be able to alter the content or video format of their signals.

For LPTV and Class A TV stations operating in the DTV mode, the FCC is proposing that:

- DTV signals must have video resolution at least comparable to that of an analog TV signal.
- Remaining DTV capacity would be available for ancillary services such as data transmissions.

For both TV translators and LPTV stations the FCC is seeking comment on the following additional issues:

- Whether the spectrum made available for DTV operations should be limited to channels in the core (channels 2-59), or whether channels 60-69 should be made available – at least during the transition, and perhaps permanently where core channels are not available.
- How the commission should assess the interference potential of TV translator and LPTV stations, *i.e.*, whether current contour overlap standards are sufficient or, alternatively, if the agency should use the DTV interference values applicable in evaluating interference from Class A TV stations.
- Whether the first round of DTV transition applications should be limited to incumbents, with follow-up windows to accommodate new entrants.
- Whether the DTV transition deadlines applicable to full-power TV stations should apply to TV translators, LPTVs and Class A stations.

The FCC decided not to attribute television joint sales agreements (JSA) under the television ownership rules.

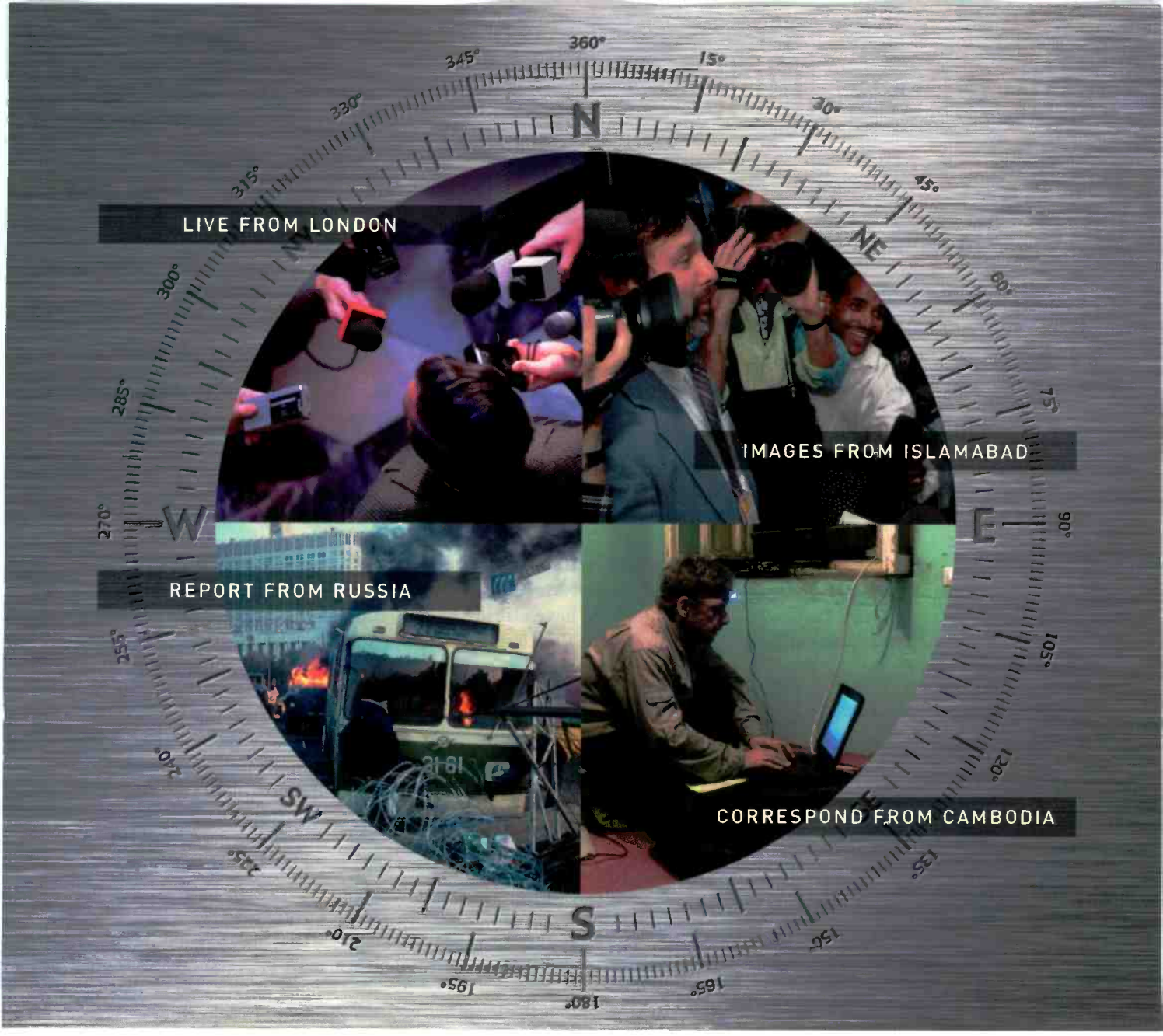
This proceeding raises the issue of whether the FCC will impose "flash/cut" deadline on TV translator and LPTV licensees. Translator and LPTV operators do not have a companion DTV channel, which they can use to build a DTV audience during the transition. If a trigger mechanism is adopted, such as the 85 percent penetration test that applies to full-service DTV, there could be problems for operators and viewers in rural areas because audiences depending on translators and LPTVs for over-the-air service likely would be the people who would constitute most of the 15 percent without DTV sets. These people would lose service when DTV penetration in the larger communities in a market cause the market to reach the 85 percent threshold and trigger a flash/cut to DTV. BE

Dateline

Television stations in the following locations must file biennial ownership reports in their public files on or before Oct. 1: Alaska, Florida, Hawaii, Iowa, Missouri, Oregon, the Pacific Islands, Puerto Rico, Virgin Islands and Washington. On the same date stations in these locations must place their Annual EEO Reports in their public files and post them on their Web sites.

Harry C. Martin is an attorney with Fletcher, Heald & Hildreth PLC, Arlington, VA.

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



TRACKING DOWN THE STORY MIGHT BE HARD. SENDING IT WON'T.

Unfortunately, the places in the world that make news don't always build the best local communications networks. Which can be a bit of a problem for reporters and broadcasters, especially when live transmissions or urgent news updates are demanded. But, fortunately, Inmarsat has the answer. Or rather, a range of them. Our unique network covers almost the entire globe, with an unrivalled record for reliability. And offers a full suite of Inmarsat Global Area Network solutions, including high-speed voice, data and video transmission; web access; e-mail and fax. To find out how we can help make sure your stories get across, just visit our website at **www.inmarsat.com/media**

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On-demand television

BY YVETTE KANOUFF

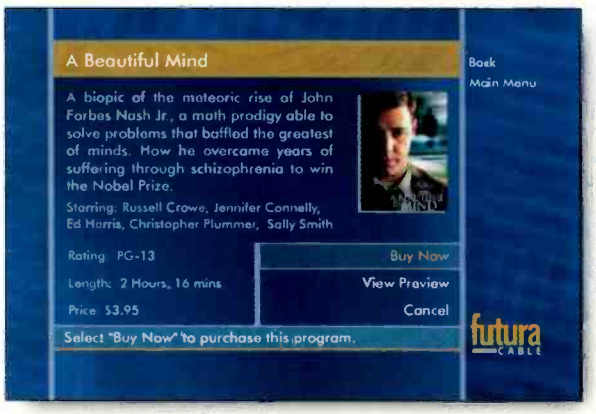
Following the successful launch of high-speed data service in numerous markets worldwide, broadband network operators are moving forward with further revenue-boosting services. Chief among these is video-on-demand (VOD).

VOD provides an interactive gateway to vast video content libraries, allowing viewers to control and personalize what they watch. It also enables content providers — namely broadcasters, television networks and studios — to extend their assets and brand. Delivered at the click of a remote, and at a reasonable cost, VOD promises to transform television from purely scheduled broadcast programming with an array of on-demand options.

To secure this value proposition, all the top U.S. cable operators have launched successful VOD services or trials. Most are in the process of full-scale rollouts in metropolitan markets — many planned for thousands of hours in on-demand content libraries. Much of the content comes from television networks eager to capture viewers in this growing medium. About 15 million cable subscribers in the United States can select VOD today – that's a fifth of all cable subscribers. To date, all signs from these launches indicate these providers will more than meet the revenue goals forecasted by business models. In short, VOD is working. Consumers want it, and the services are generating revenues — and loyalty — beyond costs. Further, regional and national broadcasters are testing the waters for their previously aired programming.

Supporting standards and content opportunities

Hard numbers have already been demonstrated in the United States, and the cost per stream is continuing to drop below $400 because of advances in transport, software, edge device and server technologies. Hurdles that face worldwide markets seeking to implement this technology have been mitigated by conditions in the United States. U.S. providers, for example, have traditionally only dealt with two set-top box (STB) manufacturers, two programming guides, three major VOD vendors and a limited number of middleware vendors. Also significant: Standards dealing with almost every aspect of VOD are in place in the United States, as opposed to a conflicting array of choices (or the non-existence of agreed-upon standards) in Europe and Asia.



VOD services offer consumers premium content and control over their viewing experience.

VOD launch requirements

The challenge in launching a full VOD service begins with preparing the network by integrating the appropriate technology, from servers to transport to edge devices to set-top boxes in the customer's home, as well as the software to automate, monitor and provision. Unfortunately, as many VOD providers have discovered, network operators do not have the manpower or expertise to be good systems integrators.

That makes vendor selection more important than any previous voice, video or data offering. In addition, a large-scale VOD launch places a huge strain on networks to maintain the rigid QoS standards necessary to ensure a viewing experience subscribers will value.

Service plays a critical role. While some vendors in the VOD delivery chain offer round-the-clock support, others have limited capabilities or charge extra. Vendors experienced with integration can support an end-to-end VOD solution, rather than one isolated component that then has to be integrated by a system operator.

Scalability goes hand-in-hand with service and network integrity, and breaks down into two problem areas: content propagation (the collection, storage and dissemination of video from numerous sources to various

VOD provides an interactive gateway to vast video content libraries, allowing viewers to control and personalize what they watch.

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points along the network) and software that can manage schedules, collect metadata (such as program synopses and movie posters), and automate billing. Ramping up for a full-scale VOD launch, and planning for future technologies or service enhancements, requires solutions that address these issues.

The financial turbulence of prior years has led to many costly VOD mistakes. Vendors can go out of business or get acquired, which in turn can change their priorities in product offerings and support. Operators must frequently *re*-integrate technology as a result, which with a large-scale deployment bears steep costs. Therefore, careful selection of experienced and integration-savvy vendors is critical.

A new era in television

Difficult economic times force tough choices on broadband network operators. Skittish financial markets over the past three years have placed a stranglehold on capital. It's easy to see why new services, network upgrades and other investments have been put on hold. In part, the United States is ahead in the VOD game because American cable operators upgraded their plant before the big chill.

But the harsh climate has also weeded out weaker technologies and vendors, reinforced the need for strong partnerships, and put the focus where it should be — on demonstrating proven revenues.

Ultimately, VOD plays the key role in giving customers control over their viewing.

While VOD already has success on the revenue front in the United States, its true promise lies in its ability to change behavior. Through VOD, viewers grow accustomed to receiving on-demand content, navigating interactive programming guides and customizing their viewing, particularly with the use of accompanying digital video recorders (DVRs).

Ultimately, VOD plays the key role in giving customers control over their viewing and bringing them into the new era of television interactivity. Viewers want to be free of schedules and limited choice. They like selection and convenience, and experience shows that operators, broadcasters and other content producers, and advertisers have a tremendous opportunity to usher in a new era in television. BE

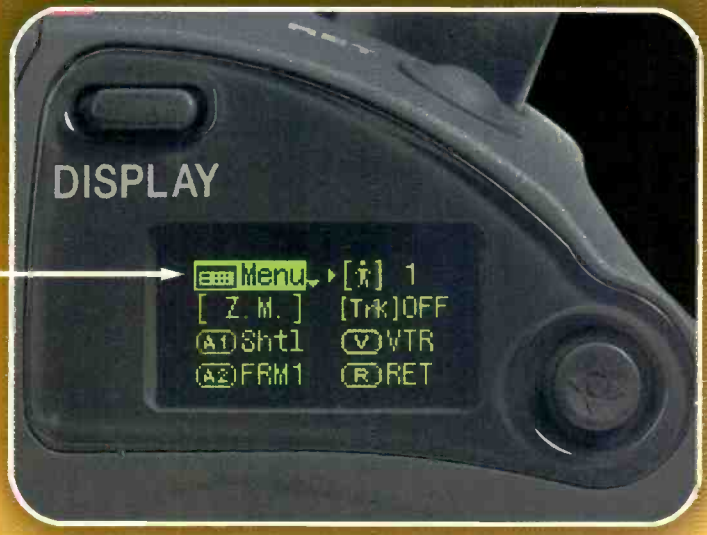
Yvette Kanouff is corporate vice president of strategic planning for SeaChange International.

Canon's new 'e' lens brings 'e'nhancement to a new level.

From its enhanced features to its environmental design, Canon's new J22ex7.6B IRSD/IASD lens is engineered to impress. The widest angle portable telephoto lens ever produced, the J22ex7.6B is the first in a series of Canon e-IFxs and e-HDxs broadcast lenses. These lenses feature enhanced digital technology, which improves on the performance of the highly useful Digital Drive tools and are manufactured with non-polluting components including lead-free glass, minimizing environmental impact.

Enhanced Features
Environmental Design

J22ex7.6B
First in a series of e-IFxs and e-HDxs lenses



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The 1.485Gb/s HDTV SDI interface

BY MICHAEL ROBIN

The SMPTE Standard 292M, *Bit-Serial Digital Interface for High Definition Television Systems*, describes the manner in which various HDTV formats, including the exclusively North American 1280x720, are organized to achieve a common serial bit-rate. Table 1 details the essential source-format parameters. They are identified as A through M and are referenced to four SMPTE standards as follows:

- *SMPTE 260M:* The legacy HDTV format with 1125 lines per total frame, 1035 active lines per frame 2:1 interlaced with a 30Hz or 30/1.001Hz (NTSC-friendly) frame rate.
- *SMPTE 259M:* A European HDTV format with 1250 lines per total frame, 1080 active lines per frame 2:1 interlaced with a 25Hz frame rate.
- *SMPTE 274M:* A family (ever expanding) of 1125 lines per total frame, 1080 active lines formats.
- *SMPTE 296M:* A uniquely North American HDTV format with 750 lines per total frame, 720 active lines per frame progressively scanned with a 60Hz or 60/1.001Hz (NTSC-friendly) frame rate.

All formats are transmitted using the same nominal 1.485Gb/s serial bit rate. This is obtained by adjusting the number of total lines per frame and words per total line while maintaining the appropriate number of total active lines per frame and words per active line. All nominal frame rate formats (A, C, D, F, G, I, J, L) are operating at a bit-serial data rate of 1.485Gb/s. Formats with an NTSC-friendly frame rate (B, E, H, K, M) operate at 1.4835Gb/s (1.485/N). The divisor N has a value of 1.001. The difference between the two data rates is negligible. This article focuses on the D format that is typical of other formats.

Reference SMPTE Standard	260M		295M	274M								296M	
Format	A	B	C	D	E	F	G	H	I	J	K	L	M
Total lines per frame	1125	1125	1250	1125	1125	1125	1125	1125	1125	1125	1125	750	750
Y words per total line	2200	2200	2376	2200	2200	2640	2200	2200	2640	2750	2750	1650	1650
C_B/C_R words per total line	2200	2200	2376	2200	2200	2640	2200	2200	2640	2750	2750	1650	1650
Total active lines	1035	1035	1080	1080	1080	1080	1080	1080	1080	1080	1080	720	720
Y words per active line	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1280	1280
C_B/C_R words per active line	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1920	1280	1280
Frame rate (Hz)	30	30/N	25	30	30/N	25	30	30/N	25	24	24/N	60	60/N
Interlace ratio	2:1	2:1	2:1	2:1	2:1	2:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1
Divisor	1	N	1	1	N	1	1	N	1	1	N	1	N
Serial bitrate (Gb/s)	1.485	1.4835	1.485	1.485	1.4835	1.485	1.485	1.4835	1.485	1.485	1.4835	1.485	1.4835

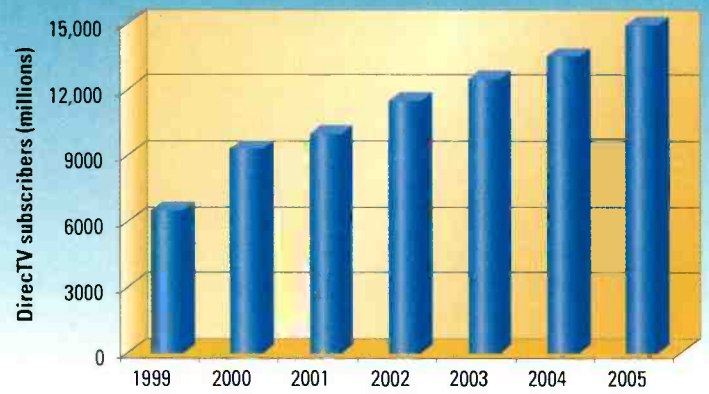
Table 1. The source-format parameters are identified as A through M and are referenced to four SMPTE standards.

FRAME GRAB

A look at tomorrow's technology

SAT SUBS Head North

DirecTV subscriber totals are on the rise



SOURCE: Kagan World Media

www.kagan.com

The source data

The D format source data consists of two bit-parallel data streams operating in tandem:

- A bit-parallel Y data stream with a resolution of 10 bits per sample and a data rate of 74.25Mwords/sec.
- A bit-parallel time-division-multiplexed C_B/C_R data stream with a resolution of 10 bits per sample and a data rate of 74.25Mwords/sec.

Each of the two data streams carries the following data in the horizontal

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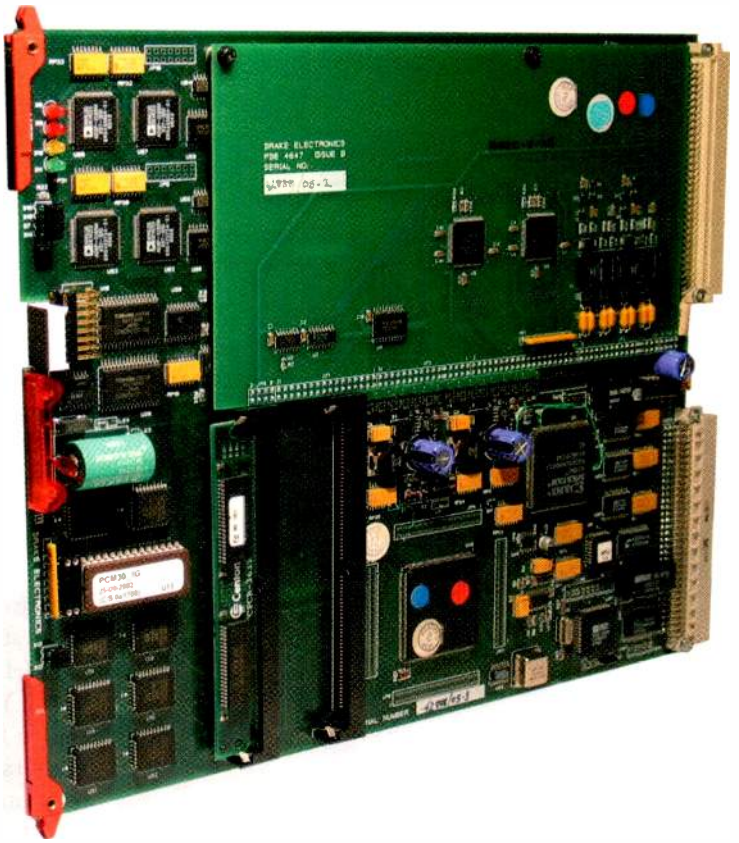

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blanking interval:

• Its own set of 4-word end of active video (EAV) and start of active video (SAV) timing reference signals (TRS) for a total of eight words. In a manner similar to that used with the SDTV format, described in SMPTE 259M, each TRS comprises three synchronizing words (3FF, 000, 000) and a fourth XYZ word. The XYZ word of each of the two data streams carries the F, V, H information as well as the P0, P1, P2 and P3 protection bits.

• Two words of line data (LN0 and LN1) with line number information in a binary code.

• Two words of cyclic redundancy codes (CRC). Two separate CRCs are calculated for the luminance data (YCR0 and YCR1) and color difference (CCR0 and CCR1).

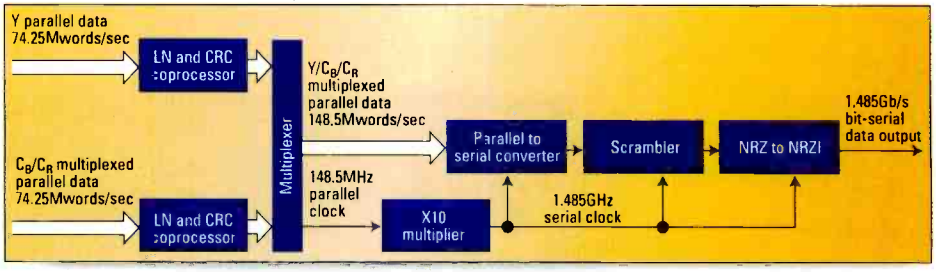

Figure 1. Conceptual block diagram of an HDTV serializer. The HDTV serializer performs coprocessing, data multiplexing, parallel-to-serial conversion, scrambling and NRZ-to-NRZI conversion.

The serializer

Figure 1 shows a conceptual block diagram of an HDTV serializer. The serializer performs several functions:

• *Coprocessing:* Each of the two bit-parallel data streams is fed to a coprocessor, which inserts line number and CRC data. An additional coprocessor may be used to insert ancillary data.

• *Data multiplexing:* The formatted bit-parallel data streams feed a multiplexer. The two 74.25Mwords/sec bit-parallel data streams Y and C_B/C_R are multiplexed word-by-word into a single 148.5Mwords/sec 10-bit parallel data stream in the order C_B, Y, C_R, Y, C_B, Y, C_R, Y and so on as shown in Figure 2. In this drawing, the first row shows details of the horizontal blanking interval of the Y data stream. The second row shows details of the multiplexed C_B/C_R data stream. The structure of the multiplexed Y, C_B, C_R data stream is shown in the bottom row.

• *Parallel-to-serial conversion:* The output of the multiplexer feeds a parallel-to-serial converter whose output is an non-return-to-zero (NRZ) coded bit-serial data stream with a 1.485Gb/s bit rate.

• *Scrambling:* The NRZ bit-serial signal feeds a scrambler, which randomizes long sequences of "zeros"

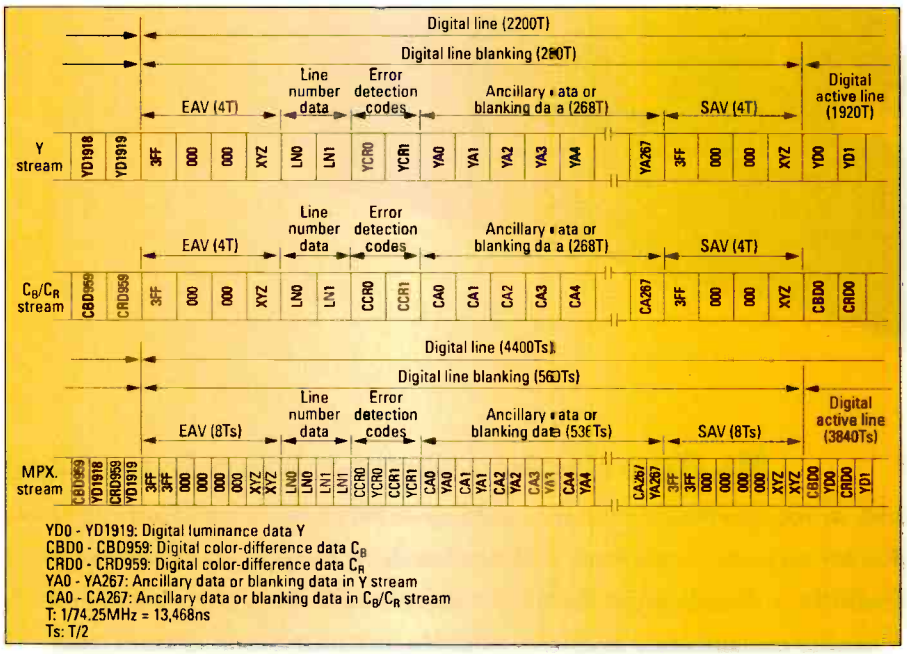

Figure 2. Formation of Y, C_B, C_R multiplexed data stream from separate Y and C_B/C_R data streams

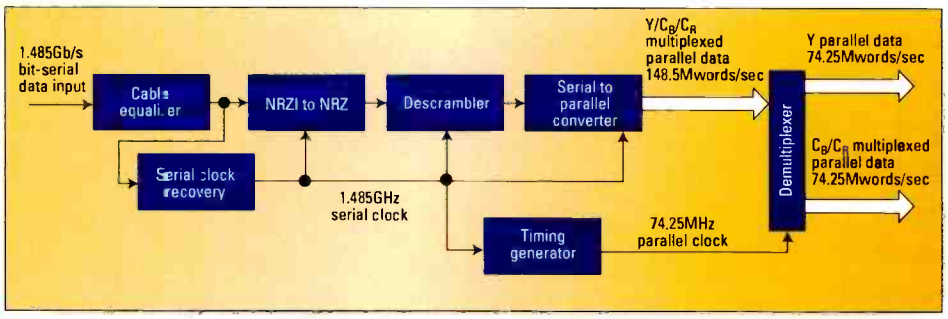

Figure 3. Conceptual block diagram of HDTV deserializer. The deserializer performs cable-loss equalization, serial clock recovery, NRZI-to-NRZ conversion, descrambling, serial-to-parallel conversion and demultiplexing.

SONY

it's a digital world:

MPEG Times

Over 900 TV stations broadcasting in digital

The DTV transition reached another milestone as the NAB count of digital stations exceeded 900 this week. Some 98% of U.S. TV households are in markets served by at least one DTV broadcaster. 78% are served by fu

OVER 1,000 MPEG IMX DECKS DELIVERED TO U.S. TV STATIONS AND PRODUCTION HOUSES

Sony's MPEG IMX production system achieved another plateau this month as cumulative sales in the United States surpassed 1,000 units. Over 8,000 units have been shipped worldwide. Users praise the format's phenomenal picture quality. operating costs and backward compatibility with decades of assets reco and Betacam SP®. format

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worldwide sales exceed 380,000 VTRs and corders, the DVCAM format has scored achievements as Sony's fastest-growing the world's number one pro digital video format. DVCAM products have proven popular for television news, corporate and event videos, documentaries and digital cinematography.

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and "ones."

• *NRZ-to-NRZI conversion:* The scrambled NRZ data stream feeds an NRZ-to-NRZI converter, which converts long runs of ones to transitions, thus further helping the clock recovery process in the receiver.

The deserializer

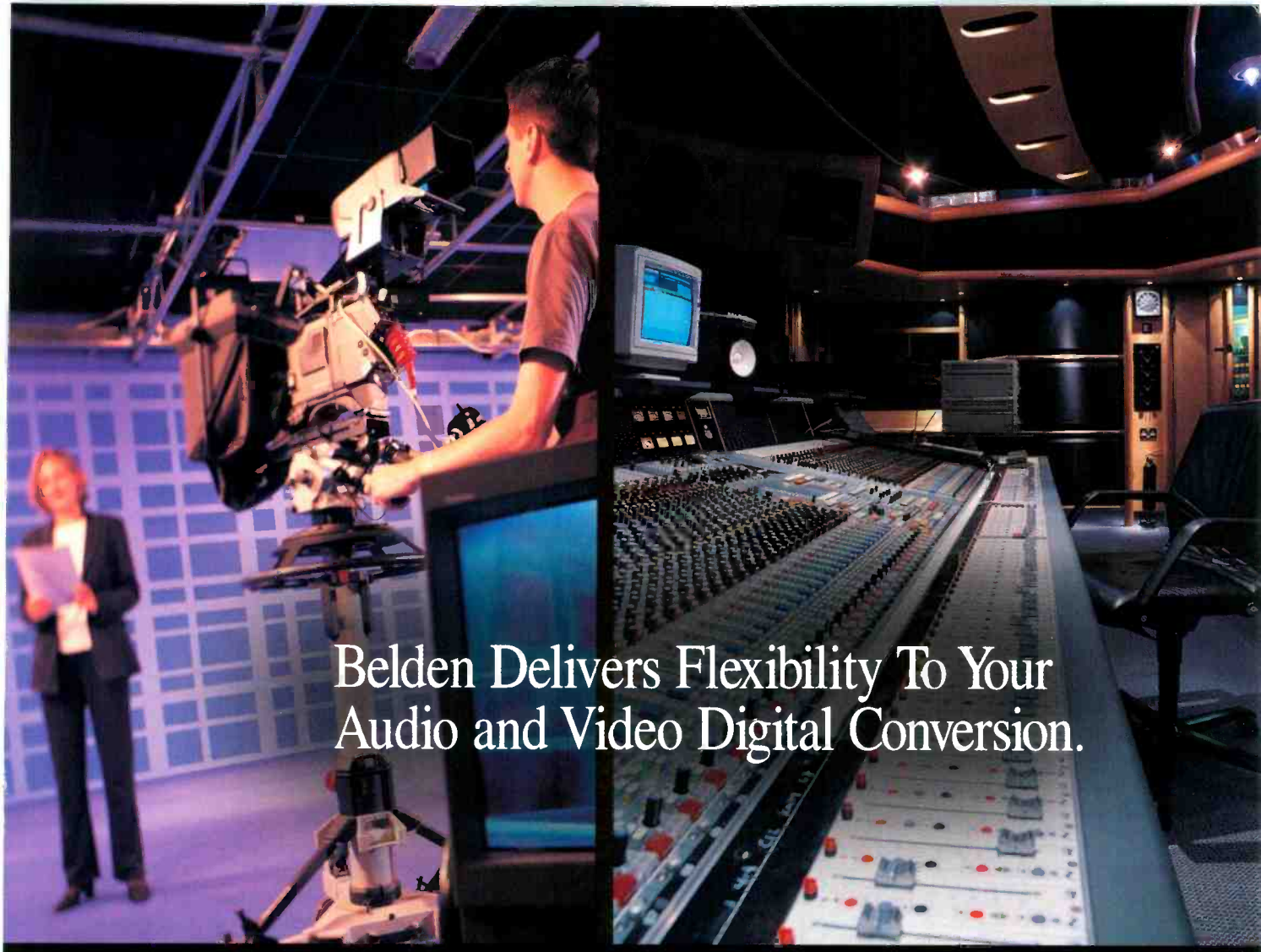
Figure 3 on page 28 shows a conceptual block diagram of a deserializer. The deserializer performs several functions:

• *Cable-loss equalization:* An automatic cable-loss equalizer corrects for high-frequency (≥8MHz) and low-frequency (<8MHz) losses introduced by the coaxial cable. The equalization capability is a manufacturer's choice. Some circuits are capable of automatically equalizing losses introduced by up to 100 meters of Belden 1694A coaxial cable. If a safety margin of 15 meters is taken into consideration, the capability of the equalizer is on the order of 85 meters of cable length. For longer distances, coaxial cables have to be replaced with fiber-optic distribution systems.

Transmitter characteristics	Receiver characteristics
- Unbalanced output - Source impedance: 75Ω nominal - Return loss: ≥15dB (5MHz to 1.485GHz) - Output signal amplitude: 800mV$_{p-p}$±10% - DC offset: 0.0V ±0.5V - Rise time and fall time: ≤270ps between 20% and 80% of signal amplitude. Differences not to exceed 100ps. - Overshoot of rising and falling edges: ≤10% of signal amplitude - Jitter: Above 10Hz: <673ps p-p Above 100Hz: ≤134.6ps p-p	- Unbalanced input - Input impedance: 75Ω nominal - Return loss: ≥15dB (5MHz to clock frequency) - Optional cable loss equalization: 20dB at half clock frequency - Interference tolerance: DC: ± 2.5V <5MHz: <2.Vp-p 5MHz to 27MHz: <100mV p-p >27MHz: <40mV p-p

Table 2. Transmitter and receiver characteristics of bit-serial interfaces.

• *Serial clock recovery:* The bit-serial signal is self-clocking. The receiver contains a clock regenerator that recreates the clock through a phase-locked loop (PLL) and a voltage-controlled oscillator (VCO). The PLL bandpass is a compromise between noise rejection (narrow bandpass) and pull-in range (wide bandwidth). It is typically 2MHz. The clock regenerator uses the received scrambled NRZI signal ahead the recovery of



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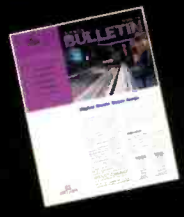

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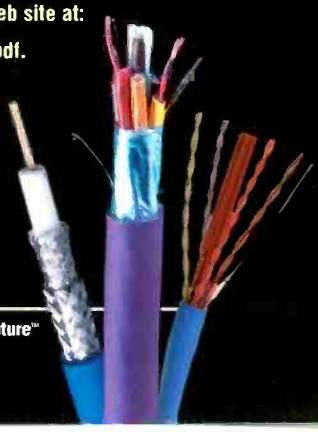

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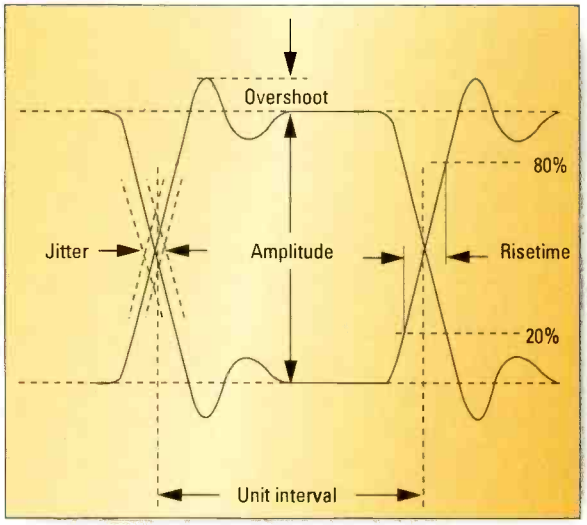


Figure 4. Eye diagram parameters

the original NRZ signal.

• *NRZI-to-NRZ conversion:* A reverse process recovers the NRZ signals by restoring the original long sequences of ones.

• *Descrambling:* A reverse process removes the random transitions introduced by the scrambler in the serializer to recover the original NRZ signal.

• *Serial-to-parallel conversion:* Recovers the original 148.5Mwords/s time-division-multiplexed Y, C_B, C_R data stream.

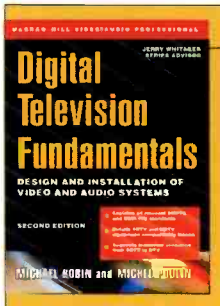
• *Demultiplexing:* Recovers the original Y and C_B/C_R data streams.

Performance specifications

Table 2 on page 30 summarizes the characteristics of the HDTV bit-serial interface and the tolerances on the performance-indicative parameters. They refer to a typical "eye diagram" waveform. (See Figure 4.) 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 recently translated into Chinese and Japanese.*

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



The Second Edition of Michael Robin's book may be ordered directly from the publisher by calling 800-262-4729. The book is available from several booksellers.

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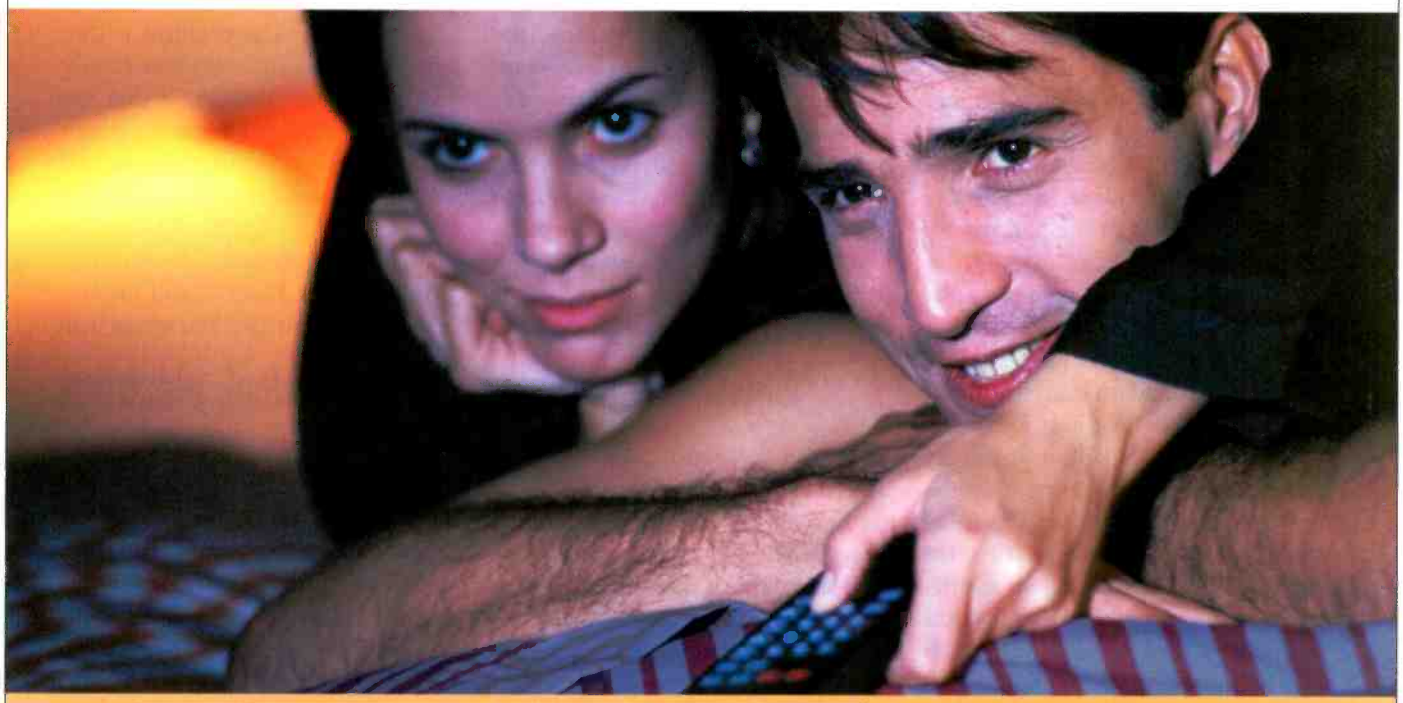

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Troubleshooting networks

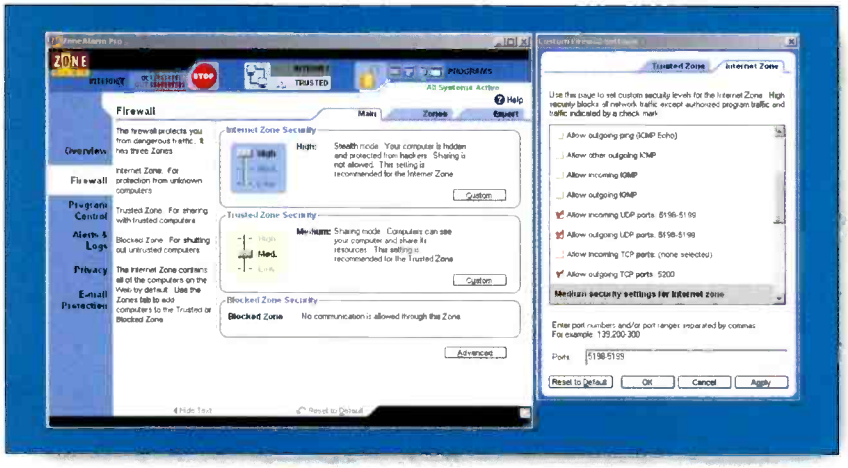
BY BRAD GILMER

Network problems may be physical, electrical or software-related. For that reason, troubleshooting networks can be challenging. Fortunately, computers come with hardware and software that can help you isolate and resolve most problems.

If your computer is unable to communicate on the network, the first thing to check is the link light. The link light can be found on the network interface card (NIC) or next to the RJ-45 connector on a laptop. It usually indicates two things – first, that the network card drivers have been installed and the computer has detected the card and, second, that an electrical connection exists between the card and another network component such as a hub or switch. If the light is out things definitely will NOT work. If the light is on, then you may or may not be able to access the network, but you do have a physical and electrical connection between the computer and a network device.

If the light is out, check the physical connection to be sure the RJ-45 connector is seated properly. Move the connector at the far end to a different port on the switch. Run a new cable between the computer and the switch. But before you do that, try a different computer – or, better yet, a laptop – to see if the computer itself has a problem. If the link light comes on with a different computer using the same wire, then it is time to check the drivers to see if they are communicating with the NIC. Many NIC cards come with test utilities that will verify that the drivers are working and that the card is installed correctly. You may want to uninstall the drivers and then re-install them. Follow your NIC card manufacturer's instructions to do this. (Remember that updated drivers for your NIC may be available for download over the Web.)

Network problems may be physical, electrical or software-related.



ZoneAlarm Pro lets users enable specific ports to pass through the firewall using the "Custom" settings of the firewall.

I would like to explore another problem that has been the cause of a lot of frustration for many engineers running Windows. The problem is this: Sometimes a client computer cannot locate a server. You know that the server is up and running, and perhaps you have other computers on the network that have already connected to the server.

Normally, you would double click "My Network Places" and choose "Computers Near Me." You would then see the server you wish to attach to, double click its icon and enter a username and password. But frequently, the computer you want to attach to does not appear in "My Network Places," and clicking "Computers Near Me" and "Entire Network" fails to reveal it. Many times it is possible for you to ping the server successfully, but you still cannot access it in Windows. If you are having this problem, here are some things you can try.

First, try pinging the server. Go to "Start" and then "Run." Type "Command" in the box and select "OK." Once the DOS window opens, at the command prompt type "ping" and the IP address of the server you want to ping. You should see a series of messages with a "Time To Live" (TTL) indicating that the ping was successful. (It used to be that, if the server was up, you could ping it. And in most cases with internal servers, this is still the case. But be aware that many servers connected to the Internet now have been configured to not respond to ping requests because this has been used in Denial of Service attacks in the past.) In any case, if you can ping the server, this is one more indication that

continued on page 40

continued from page 34

a good network connection exists between you and the server, and that it is up and running. If you are unable to ping the server, first check to see if the server is set to respond to ping requests. If you can ping the server from other computers but not the one with the difficulty, you must correct this problem before you can connect.

Your computer must belong to the same workgroup as the server. If not, you will not be able to connect to it. Usually the workgroup name will be WORKGROUP. To check your computers' workgroup, right-click on "My Computer," and select "Properties" and then "Network Identification." Still unable to see the server? Check with your network administrator to be sure there is a Windows Name Server (WINS) running on the network. Oops – you are the network administrator? Well, you can either configure the server you are trying to attach to as a WINS, or you can try attaching to the server without using WINS.

Sometimes you can find a server by searching for it even if it does not show up under "Computers Near Me." Go to "My Network Places" and select Search. Enter the server name preceded by two backslashes – Example: *\\dill_pickle*. If you still cannot find the server, and the target computer has a shared drive (for example, D:\), there is one last trick that may allow you to attach to the shared drive directly. Select "Start" and then "Run." Enter the computer name followed by the shared drive's name – Example: *\\dill_pickle\c:*. Choose "Ok."

This "invisible server" problem can be particularly vexing. If you have other suggestions that have worked in the past, please email them to me at *brad_gilmer@primediabusiness.com* so I can share them with others.

Another problem that can be particularly troublesome for broadcasters is getting specialized software to operate correctly with firewalls. Broadcasters may need to run tight security on their connections to the Internet, but they may also need to enable special services to support their users. You should not start making changes to your firewall setup without having a backup plan in mind in case it takes you a while to get the firewall back up and running.

Most firewalls perform Network Address Translation (NAT) so that addresses of computers inside the network are hidden from the Internet. Firewalls may also perform Port Address Translation (PAT) so that a computer on the local network (a Web server for example) can be seen from the Internet. With the exception of a few well-known ports (for example, Web browsers, FTP and Telnet), most firewalls block attempts to communicate with a computer using unknown ports. However, a broadcaster may be using a special audio application, high-end video conferencing software or some other specialized software that requires other ports to be enabled through the firewall.

As computers and networks become more important to broadcast operations, troubleshooting these technologies becomes more critical.

If the firewall is not properly configured for these specialized applications, the user may see some sort of communications error message, or a timeout error because the application is unable to establish communications with the desired port on the computer at the other end. Fortunately, the fix for this is fairly straightforward. First, you will need to read the documentation for your application to find out what ports and protocols it uses. Usually the documentation will specify the port and whether the application is using UDP or TCP. Sometimes you will find this information on a support section of the manufacturer's Web site under "Firewalls."

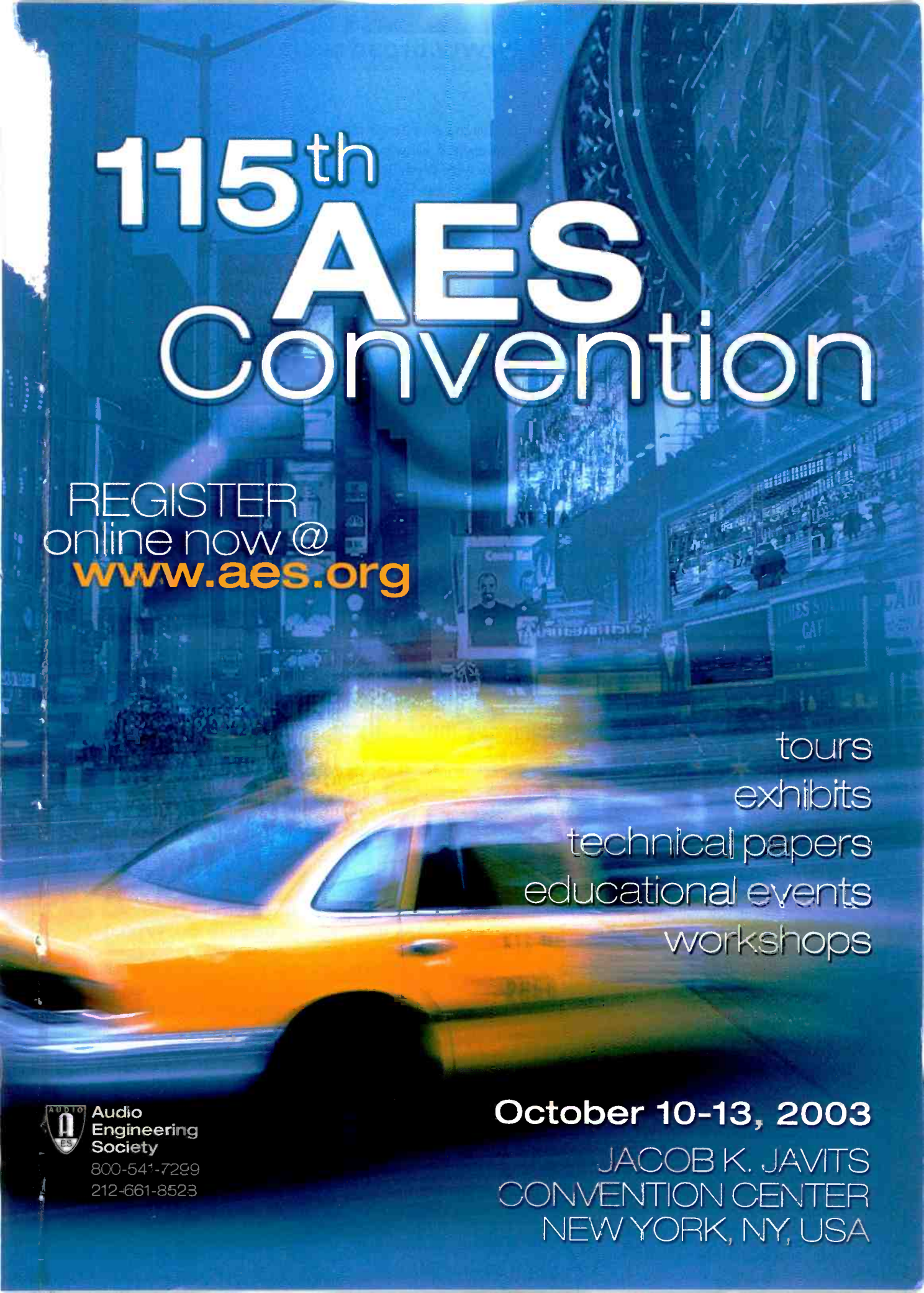
As an example, an application I use requires that ports 5118 and 5119 be open for UDP and that port 5200 be open for TCP. Next, you will need to do some more research on your firewall. Almost all firewalls have a port configuration area that allows you to define which ports may pass through the firewall. Some firewall applications try to make things easier by specifying applications (such as WWW or FTP) along with the port numbers. But in my example above, because this was a voice-over-IP application that was not very common, I needed to enter the information directly.

Once you have learned how to set up this area of your firewall, just enter the information into your firewall and test the application to see if it works. One final note – on some firewalls, ports can only be opened for a specific address on the local network. You have to tell the firewall software the IP address of the computer inside the firewall that needs to have access to the specific port. The firewall does not allow that port to pass through the firewall for every computer on the network. If your firewall works in this way, you cannot use DHCP on the inside of your firewall, because the IP address of the target computer will change each time the lease with the DHCP server expires. (Apologies if this gets a little complex, but I spent some time figuring it out and wanted to pass the information along.)

As computers and networks become more important to broadcast operations, troubleshooting these technologies becomes more critical. It is important for broadcasters to obtain training and experience in maintaining networks as part of their overall professional expertise. **BE**

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

SEND Send questions and comments to: brad_gilmer@primediabusiness.com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This specially commissioned truck is outfitted with a 96 channel Max Air mixing system and is set-up to simulate a local TV station digital audio control room with playback of 48 channels of digital audio and 8 video streams, which includes program, preview and 6 camera/OB sources.

About Euphonix

Euphonix is a leading manufacturer of large format digital audio mixing consoles, converters and routers for live broadcast applications. This year Euphonix celebrates 15 years of success and innovation in the professional audio industry. Founded in 1988 in Silicon Valley, Euphonix has satisfied more large format digital console users worldwide than any other manufacturer.

The Euphonix broadcast product line includes the all-digital System 5-B mixing console, which has been shipping for over three years, and the powerful new Max Air mixing system designed to make the transition to digital affordable for all stations.

Euphonix maintains direct sales and service facilities around the world together with an extensive network of distributors.

With over 100 audio mixing systems installed in on-air TV broadcast facilities, Euphonix has a strong and loyal client base including ABC & Seven Network Australia, Canal + France, CCTV China, CBC Canada, Television New Zealand, and in the US, KCBS, CNN, Harpo (Oprah), In Touch Ministries, National Mobile Television, NBC Network News, NBC (Tonight Show), Paramount Pictures, Telemundo, Tribune Broadcasting, WEDU (PBS), Westwood One, and WFLD (Fox).

Extended US Tour Dates

2003

Tue Sep 02	Fri Sep 5	Ashville & Greenville, NC
Mon Sep 08	Fri Sep 12	Columbia, NC & Miami, FL
Mon Sep 15	Fri Sep 19	Orlando & Jacksonville, FL
Mon Sep 22	Fri Sep 26	Baltimore, MD
Mon Sep 29	Fri Oct 3	Harrisburg, PA
Mon Oct 6	Fri Oct 10	Philadelphia, PA

Oct 10th-13th Visit Euphonix at AES in NY, Booth 826. The Max Tour will be in New York the week after the show.

Mon Oct 13	Fri Oct 17	New York, NY
Mon Oct 20	Fri Oct 24	Washington D.C.
Mon Oct 27	Fri Oct 31	Montgomery & Mobile, AL & New Orleans, LA
Mon Nov 3	Fri Nov 7	Houston, TX
Mon Nov 10	Fri Nov 14	Dallas, TX
Mon Nov 17	Fri Nov 21	Little Rock, AR & Memphis, TN

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South & Central USA - Nashville, TN, USA (615) 327-2933
North East USA - New York, NY, USA (212) 889-6869
Europe - London, UK +44 (0)20 7267-1226
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www.euphonix.com

Western Mobile Television Chooses Two System 5's for their HD Trucks

Western Mobile Television, LLC ("WMTV"), a new mobile production company, has installed two all-digital System 5-B audio mixing systems in their two new HD equipped OB vehicles. Based out of Phoenix, WMTV is using the trucks to cover professional sports events, such as NBA basketball, NHL hockey, and MLB baseball. They are among the first mobile units in the US that are HD/SD and 5.1 surround sound capable.

Both 82-channel System 5-B's were specified to handle multi-format surround outs, as well as the complex mix minus and clean feed requirements demanded by today's sportscasts. This is also the first installation of Euphonix's new Jupiter compatible 768x768 TDM audio routing system that handles all audio routing for the truck and can be controlled from the System 5-B as well as the Thompson Router Control panels throughout the truck.

General Manager, Philip R. Garvin, of WMTV explains why the network chose System 5-B, "We needed a solid, reliable audio console that could handle large numbers of inputs and outputs, and was simple to operate, especially in terms of its 5.1 surround capabilities. The System 5-B was also the lightest of all the systems considered."

Mr. Garvin was also impressed by the integral Euphonix TDM router, "The other major advantage of going with Euphonix was their router system—it saved us money, time, and weight in that we did not need to install an audio level and audio I/O in our main GVG router, we simply used the large Euphonix StudioHub router and I/O which can be controlled from our Jupiter panels as well as from the System 5-B—a very elegant solution."

System 5 Scores High on Versatility for Religious Broadcaster, GETV

All it took was a test drive behind the System 5 to convince Director of Audio Production, Mark Harrier he had found the console that had everything Global Evangelism Television (GETV) would need. Soon after his demo, GETV purchased a 32 fader System 5 console with 48 channels.

Harrier stated, "It was evident the System-5 was the right console for us due to its versatility. It's the most flexible console that we could find for our situation; where the main audio control room goes from live television production to a multi-track recording session and then on to audio post production."

First Max Air in China for Henan TV

Henan TV Station, one of the leading 24-hour broadcast stations in China and the largest TV producer in Henan Province has ordered the first Euphonix Max Air ever in China. The console, a 24-fader digital Max Air, with 96-channels of processing will be used in one of the Station's OB Vans.

CBC Radio Going Live with System 5-B

The Canadian Broadcasting Corporation (CBC), Radio, has installed a System 5-B digital audio console into their world class Toronto Radio Drama studio. CBC is Canada's largest cultural institution. The 24 Fader System 5-B Console, with 82 channels of processing will be used for recording and mixing radio dramas

TDM Broadcast Router Frame

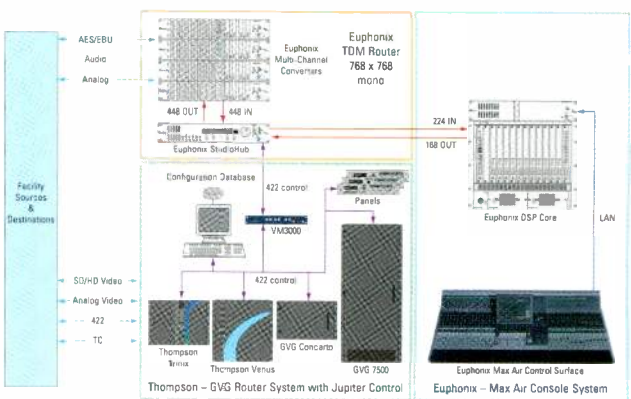
Learn More At: www.euphonix.com

Phillips Jupiter Router Connectivity

The Euphonix StudioHub 768 x 768 high-performance MADI router solution brings a new level of quality, and affordability to digital audio by substantially reducing the amount of audio I/O that has traditionally been required for remote trucks, production control rooms and post production rooms. Savings of over $30,000 per installation can be achieved.

StudioHub has been designed to communicate with industry standard routing control systems, such as the Thompson VM3000 Jupiter control system. **This ELIMINATES the need for two independent routing and I/O systems** while satisfying the demands of redundancy for on-air operation. All console sources and outputs are available on the facility router and the console patch system simultaneously! StudioHub connects directly to the Euphonix full line of MADI converter products which include analog, 75ohm AES, 110ohm AES, SDIF, ADAT, legacy ProTools and TDIF formats.

StudioHub



Euphonix: Live On Air...

Director of Engineering and Technology at Tribune Studios, Jim Toten

Twin Max Airs for Tribune Broadcasting

Tribune Studios, a division of Tribune Broadcasting, has installed twin Max Air digital audio consoles in its Hollywood production facility. Both 96-channel, 5.1 surround-capable consoles will be mainly used for live-to-tape production sound on shows such as *'The Sharon Osbourne Show,' 'Family Feud'* and *'Style Court.'*

Tribune is one of the country's premier media companies, operating businesses in publishing, broadcasting and on the Internet. It reaches more than 80 percent of U.S. households. Tribune properties include 26 television stations and Superstation WGN on national cable.

CNN Orders Five Max Air Digital Audio Consoles

Cable News Network (CNN) has purchased Euphonix Max Air consoles as part of its on-air digital audio mixer upgrades. The Euphonix Max Air Tour vehicle made special stops at the Atlanta and New York studios so engineers could get hands-on experience on the system as part of the buying process.

Three 96-channel Max Airs will be heading for CNN in New York and two will be installed in their Atlanta headquarters for on-air digital audio mixing, replacing analog consoles. The first system will be installed in October 2003.

The order also includes the new Euphonix TDM audio facility router system. In New York all sources from the seven studios feed each of the Max Air consoles via MADI. A show in any studio can be mixed from any of the audio control rooms providing unrivalled flexibility of operation. Over 400 sources feed each console's computerized audio patching system called PatchNet controlled from the Max Air's touch screen. A similar system will be installed in Atlanta.

PBS Station WEDU, Takes it to the Max

When WEDU's VP of Engineering & Operations, Frank V. Wolynski, set out to find an audio console, he had no idea how far Euphonix could take him; to the Max. Wolynski explained why WEDU chose Max Air, "Our focus was to find a console that performed extremely well and that was easy to adapt to. Max fit that bill. Tedious setup of patching and groups are basically eliminated with Max Air. The Console can flip from a complex configuration to another in moments, restoring all inputs and outputs for any particular show."

WEDU plans to use Max Air for broadcasting shows such as "live" election debates, Tampa Bay Week, news uplinks for Fox News, CNN, CNBC, Court-TV, and many more. WEDU is the premiere public television station licensed to Tampa and St. Petersburg, in West Central Florida.

Digital Audio Mixing Products for Broadcast

SYSTEM 5-B

System 5-B is Euphonix's top of the line digital audio broadcast mixing system designed for larger installations. System 5-B has 8 knobs per channel, hi-res stereo meters next to each fader and a color TFT screen at the top of each channel showing routing, metering and panning graphs. The system can be expanded with over 300 channels and is available with full dynamic automation for live/post applications.

Max Air

Max Air
Max Air is a compact and cost effective on-air digital audio mixing solution. Max Air has 96 channels, 32 mix busses, 12 aux sends and 24 mix minus/clean feeds plus a dedicated mix minus bus with N-1 feeds from each channel. Each channel strip includes 4 knobs, with a central assignable Superchannel. Max Air has been designed to be fast, easy to learn and use, with a highly intuitive touch screen display for master functions.

Both systems make use of the same rugged routing, DSP and I/O hardware, and both have comprehensive redundancy packages designed for reliable on-air operation. Each console is fully 5.1 surround capable.

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Tools for DVD production

BY BARB ROEDER

NAB2003 saw an influx of DVD authoring tools and production equipment that are making this delivery format more affordable and approachable to any video production team. Content creators are using DVDs to distribute educational materials, entertainment and corporate communications. The level of sophistication needed to produce professional DVDs depends largely on your application, but you'd be surprised at how much you can do on a small budget. Here we'll explore the features and limitations of today's spectrum of tools in terms of preparing the audio and video signals and generating the required user interface elements to meet the DVD format specification.

Applications abound, starting at under $100 and ranging upwards of several thousand dollars. Entry-level authoring applications are often wizard-driven and have limited access to the interactivity features of the DVD specification. Generally, they target the prosumer market. This article will focus more on the mid-range applications, priced from $200 to $700, and these days offering more flexibility and built-in features than ever before. Most have software MPEG encoding engines, which can suffice for content that can fit the bit budget of two hours of video and audio encoded at an average bit rate of 8Mb/s.

A good compression engine with features such as variable bit-rate encoding, full search algorithms for motion estimation and field-based encoding options is required to tweak the encoding process when bit budgets are tight. Also, sophisticated preprocessing of the signals can reduce the encoding requirements by removing unnecessary detail. For instance, if your source originated as film at 24fps but has been converted to video at 30fps, you'll need an inverse telecine operation to remove redundant fields prior to encoding. If the target delivery platform is a desktop DVD-ROM, you'll also want a good de-interlacing filter to accommodate the progressive scanning of the computer's display.

A good compression engine with features such as variable bit-rate encoding is required to tweak the encoding process when bit budgets are tight.

Professional studios that need to create DVDs on a daily basis will look toward hardware encoding tools and high-end authoring systems from companies such as Sonic Solutions. A look at the requirements for authoring will reveal how the mid-range products can fit into the video production facility to author professional quality DVDs.

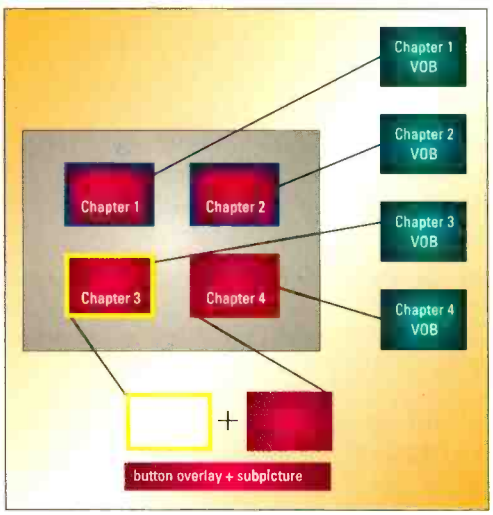

Figure 1. A typical menu page, button construction and links to chapters on a DVD are shown here. Video objects (VOBs) are linked to a chapter menu screen in a DVD authoring application. The buttons themselves consist of an overlay that can change states and a subpicture, which can be a graphic, framegrab or motion sequence.

Encoding audio and video

MPEG is the standard format used on DVDs for video and audio, although the specification also allows for PCM and AC-3 audio formats. Encoding engines are generally built into these professional applications, but they may be limited in their flexibility. That won't be a problem if you have about an hour of content for your project or if you can afford to produce a DVD-9, which will handle more than

Professional audio processing is another area that won't necessarily be included in a standard DVD authoring or encoding package. Any special effects, signal sweetening or noise reduction is best left to a separate professional audio application.

You can use the DVD authoring applications to accomplish other basic encoding operations. Some even allow you to do variable-bit-rate encoding and adjust the GOP structure of the MPEG video stream. If you want to do more sophisticated encoding outside of the authoring environment, these applications will always allow you to import the MPEG A/V streams already compressed. Otherwise, some applications will be bundled

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with capture applications, or you can import AVI, QT or DV source material already stored on your system.

Interactive authoring features

Interactivity on a DVD can range from basic chaptering in a tree-like structure to sophisticated user controls for viewing different camera angles in a scene. Most basic authoring packages will easily accomplish the former but will not handle the latter. Those that do are priced higher, such as Apple's DVD Studio Pro and Sonic Solution's ReelDVD.

A menu page to reach the various sections of the DVD will also be created in your DVD authoring application. Ease of use and integration with other content creation tools you have in the facility will depend on the DVD authoring application itself. For instance, an interactive menu is defined on the DVD with layers representing the background, the area or overlay that composes the button and the visual information that is placed in that button. A typical menu page, button construction and links to chapters on a DVD are shown in Figure 1 on page 42. Most applications will allow you to import still images from Photoshop, where you have more control over the artistic look of the menu. Only Adobe's new Encore DVD will permit you to make revisions to those layers right in the authoring application. Otherwise, you'll need to go back to the original source and edit there.

On a DVD, the overlay image can actually be a motion sequence, for instance showing a scene from each chapter point on the DVD. Again, motion menus are supported in the higher end authoring applications, but not necessarily those in the $200 to $300 range.

One other feature that you may find relevant to your content is the e-DVD support on the disc you create. This uses the "DVD others zone" defined in the specification to store Web links and data that the user can access while viewing the DVD. Courseware distributed on a DVD could link the user to a Web site that logs test results and gives them feedback on their instruction. E-commerce capabilities can also be programmed onto a large catalog database stored on a DVD.

Conclusion

DVD sales and rentals are beginning to surpass VHS tapes and low-cost players, and drives are finding their way into the corporate environment as well. Video producers need to look toward new tools to keep them competitive in this arena, and developers are answering that call with affordable and feature-rich applications to create professional content on a DVD. BE

Barb Roeder is president of Barb Wired LLC, a technology consultancy specializing in the formatting and delivery of digital media. She can be reached through her Web site at www.barb-wired.net.

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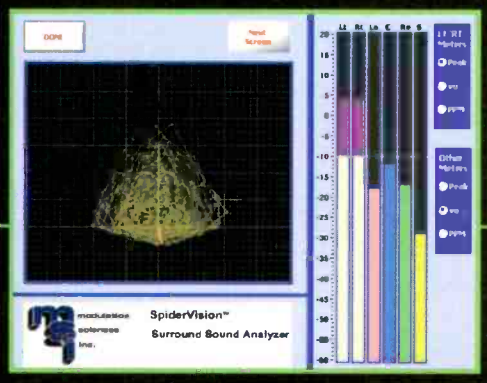

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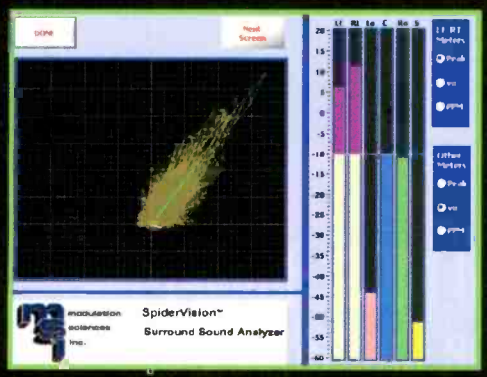

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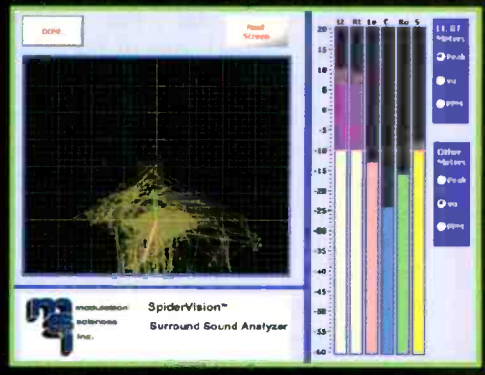

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Georgia Public Broadcasting:

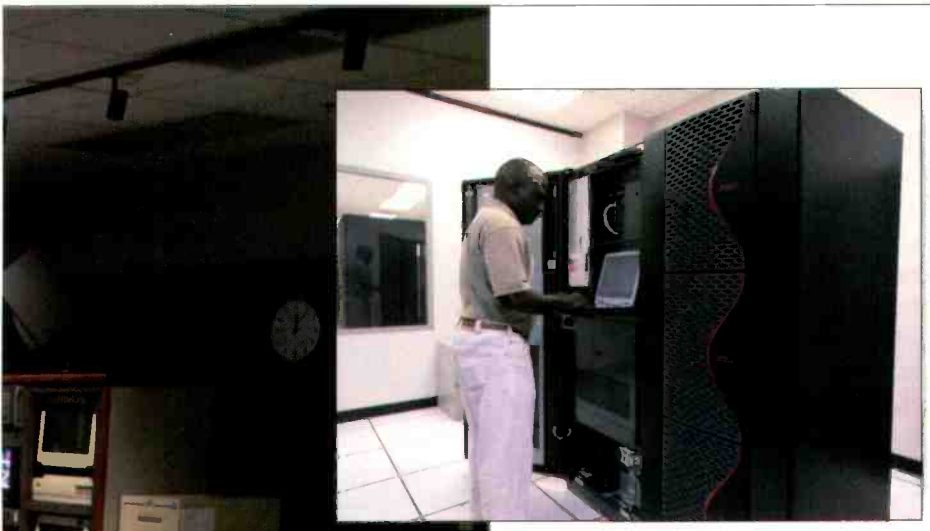
SGI and MCSi deliver the next step in the digital evolution

BY BILL BUHRO

The public broadcasting system in the United States is one of the leaders in transitioning its member stations and infrastructure to a digital format. Atlanta-based Georgia Public Broadcasting (GPB) wanted to go further. GPB provides multiple channels of television and radio public broadcasting and a rapidly growing Internet streaming media service to educators throughout Georgia. The service is to be provided to public and private schools as well as parents homeschooling their children.

In early 2002, GPB issued a request for proposal and the Broadcast Solutions Group of systems contractor MCSi with SGI Professional Services responded. The architecture from SGI needed to meet not only broadcast playout requirements, but also the common data management, shared storage and archiving infrastructure that the station envisioned for both its broadcast and nonbroadcast data. The station also desired to build a highly reliable centralized storage environment that would support both the Internet service and the broadcast operation. The result of the SGI and MCSi collaboration was an IT-based open digital infrastructure that met the station's enterprise-level storage requirements and transformed its videotape-based broadcast workflow into a simple yet effective, full-digital dataflow incorporating media management. The total cost of ownership advantages of this open, digital infrastructure are just now beginning to be realized.

At the core of any good architecture is a good foundation. In this case, the



Horace Ebehart is shown working on GPB's main disk storage environment, the Hitachi DataSystems 9980V.

GPB chose the SGI Media Server for broadcast to be the workhorse for their DTV on-air playback for its ability to ingest and play out any compressed video format.

foundation is the storage infrastructure. To determine what type of infrastructure best met the facility's needs and anticipated growth, MCSi and SGI first evaluated its broadcast workflow requirements, and then gathered requirements for the IT department and the educational media technology group. Foremost on each group's mind was reliability. This along with many other requirements drove the decision to recommend an enterprise-class RAID storage system coupled with a redundant Fibre Channel storage area network fabric.

Central storage and storage infrastructure

The team proposed Hitachi Data Systems 9980V central storage as the main disk storage environment. It was chosen for its many enterprise-class performance, redundancy and high-availability features. It has no single point of failure and is designed to grow seamlessly to dozens of terabytes.

Next was the requirement to connect all the participating departments – broadcast, IT and educational streaming media – to that central storage. Further considerations included the varied locations of the people who would be using the system, what type of files they needed to access, when they needed to access them, and what type of workgroup and desktop environments they were using. After the team evaluated user and workgroup criteria, it became apparent that the current mixture of platforms used by all of the sectors would need to be universally supported. These included SGI IRIX, Windows, Macintosh, Linux and other Unix environments. All clients needed shared access to the data stored in the central repository. Client I/O needs varied from 56kb/s to over 600Mb/s.

With the many types of operating systems needing access, the team suggested a battle-proven 64-bit heterogeneous shared file system, SGI CXFS, for storage area networks (SAN). Implementing a shared file system allows platforms of varying operating systems to attach to the central storage – either by network or Fibre Channel – and see that storage just as though it were local to that desktop or workstation. It facilitates a high-availability data infrastructure, meaning it is developed and constructed in such a way that there's no single point of failure in the SAN architecture. GPB is the first U.S. broadcaster to install an SGI CXFS shared file system as part of a digital infrastructure.

The next challenge was determining the balance between the data that was required by the various departments, and its storage. The team had to decide how much data or material should be kept online vs. how much could be conveniently accessed from nearline, as well as how much would be archived. The type of material ranged from legacy productions, to a large library of materials in the educational media organization, to backup data from the IT department. During the team's analysis, it became clear that a nearline tape robotic system would be required. Several tape robotic systems were evaluated, and the ADIC Scalar 10K was selected, with LTO-2 tape media.

The internal user organization includes several hundred people. This internal user group provides data access to thousands of teachers and educators around the state through its Internet services. This large number of users, all of whom have different levels of familiarity with the information residing in the infrastructure, dictated the need for media management. The project team enabled automated operations with regards to the movement of data within the storage infrastructure, to allow the material to be easily found and maintained.

At the core of any good architecture is a good foundation. In this case, the foundation is the storage infrastructure.

The facility's media management requirements went beyond what is commonly used in the IT world, which is a hierarchical storage management solution (HSM). HSMs typically have little user interface associated with them; they simply respond to a set of migration rules for moving data between online, nearline and offline storage. With input from SGI and MCSi, GPB selected the Masstech Group MassStore product, which manages and has access to the broadcast data infrastructure. In addition, it provides the interface for moving broadcast data between the various storage systems.

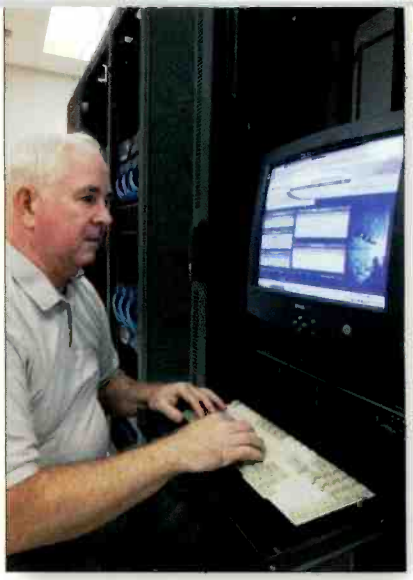
These systems include three types of servers: SGI Media Server for broadcast MPEG-2 video servers, Virage Solution Server, and Masstech MPEG-4 proxy server, interfacing with the Hitachi Data Systems disk storage system and the ADIC robotic tape system. (See Figure 1.)

Broadcast operations

The station chose the SGI Media Server for broadcast to be the workhorse for their digital on-air playback. The Media Server's ability to ingest and playout a variety of standards-based file formats – i.e. MPEG-2 I-frame, MPEG-2 Long GOP, DVCPRO 25 and 50, and IMX/D-10, as well as its support for the new MXF file exchange format – ensure that the facility will be able to handle any of today's popular compressed video formats. The station chose MPEG-2 I-frame as its air master format, which will easily facilitate its transition to direct ATSC digital transmission.

The SGI Media Servers are used for on-air playback at the facility. As mission-critical applications, they are connected directly to the central storage infrastructure through a high-speed, high-availability 2Gb Fibre Channel redundant SAN fabric. These on-air servers are used in a protected configuration for playing to air all four of the station's 24-hour broadcast feeds to more than two million viewers weekly.

To achieve the eventual goal of eliminating as much videotape in the workflow as possible, several channels of the Media Server for broadcast have been allocated for ingesting content into the centralized storage. Under control of Harris automation and a Masstech media management system, the four-channel national program feed is directly ingested as multiple program transport stream (MPTS). SDI contribution material is also ingested from other satellites, live sources and videotape, while manual controls allow for "rushes" or ad hoc recording.



Buster Hampton works on the MassStore, which manages and accesses the broadcast data infrastructure while providing the interface for moving broadcast data between the various storage systems.

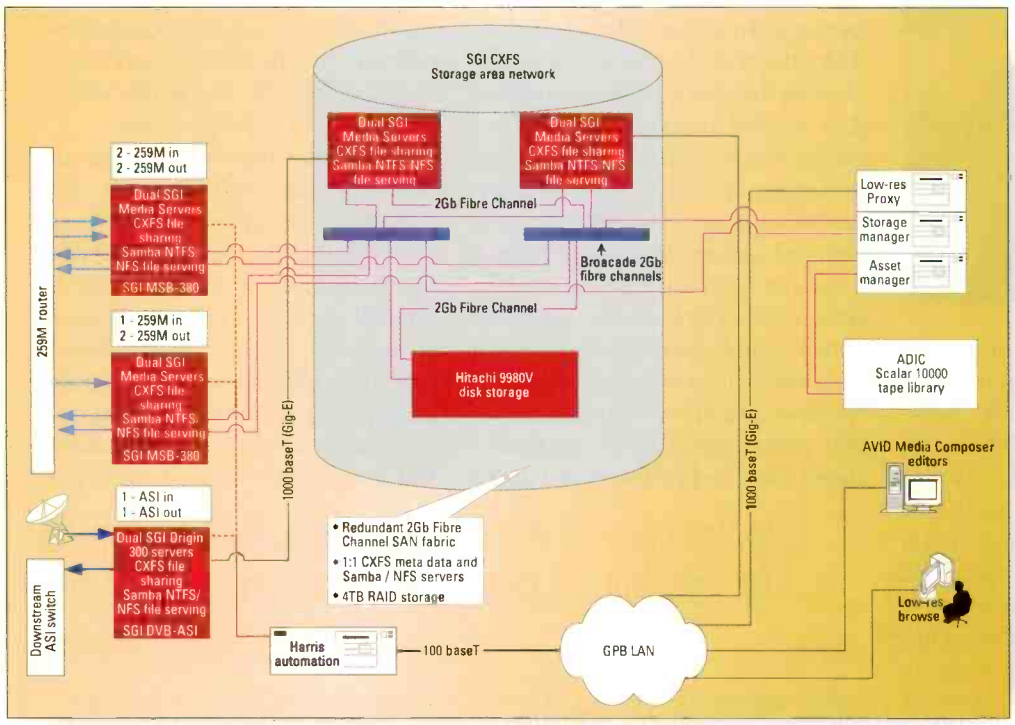


Figure 1. For GPB to eliminate as much videotape as possible, several channels of the SGI Media Server for Broadcast have been allocated for ingesting content into the centralized storage.

Post production

The station's post-production facilities utilize Avid Media Composers, Symphony and Avid Xpress editing suites. They will be integrated with the centralized storage in the next phase of the project, which is underway.

SGI is currently assisting with the evaluation of the Avid environment to determine the best methodology to interface with the centralized infrastructure. One solution may be to implement one of several interfaces SGI has developed for the Avid environment that allow easy data exchange between its storage infrastructure and

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Design team

Georgia Public Broadcasting
- Mark G. Fehlig, P.E., CPBE director of engineering
- Mike Nixon, director of IT

MCSi Broadcast Solutions Group
- Gary Hawkins, senior engineer/project manager
- Michael Wright, national sales manager

SGI Professional Services
- Bill Buhro, solutions architect
- Tony Karam, project manager
- Tom Kaye, principal systems engineer
- Doug Squire, account manager

Technology at work

- SGI Media Server for broadcast systems
- SGI Origin 300 servers
- SGI CXFS shared file system
- Miranda Kaleido display system
- Hitachi Data Systems 9980V storage
- Masstech Group MassStore storage
- Masstech Group Mass Proxy transcoder
- ADIC Scalar robotic tape library with LTO-2 tape media
- Virage media asset management system
- Avid Media Composers
- Avid Xpress editing suites
- Avid Unity storage
- Harris automation
- Brocade 2Gb Fibre Channel switches

Avid nonlinear editors (NLE). However, the facility's current NLEs use Avid's older 2:1 video compression format, which requires conversion to MPEG-2 for on-air playback. Today these conversion, or "transcode," operations can take anywhere from four to 10 times real-time. This may be acceptable for cutting 30-second spots, but is impractical for long-form programming. In the interim, the NLEs will ingest and playout using SMPTE 259M through one of the SGI Media Server for broadcast systems.

The next phase also will include the integration of the Virage media asset management system for broadcast operations and educational media projects. SDI-based contribution material is passed via a Virage logger under Masstech control to provide keyframes for media management and subsequent low-resolution browsing and editing over LAN. The resulting media is stored on SGI CXFS SAN, allowing complete integration with an NLE system based on Avid Unity, the streaming of multi-resolution copies, and the inclusion of data sources. Edited program material is stored on the SAN until it is forwarded to the redundant on-air servers under Masstech and Harris control.

The SGI Origin 300 video server is controlled by Harris automation. Harris also controls the SGI Media Server for broadcast MPEG-2 video servers.

Virage integration is especially important for the current educational media organization's multiyear project detailing the history and restoration of the Fox Theatre in Atlanta. GPB is very excited about this portion of the project, as the Fox Theatre was one of the great movie palaces constructed during the 1920s. The station is collecting archive video, film and still images, as well as shooting new footage showing the progress of the theater's restoration. It has already started the process of indexing and cataloging all the video, stills and other media assets using the Virage cataloging/indexing product and media asset management system. SGI will integrate the Virage system with the central infrastructure, which will allow all programmatic information to be available in the central storage environment. Media assets will include "proxy content" – searchable, retrievable and viewable on any desktop throughout the facility –as well as high-resolution, or master, digital elements that will be stored for eventual post production of the documentary. The station will also use the Virage system for cataloging and indexing their existing educational programs and providing search capability to teachers in the field.

The next step: HD

In addition to building a new digital television workflow at the station, SGI also is assisting with the next evolutionary step, beyond standard definition into high definition. SGI – using its Media Sever for broadcast system – developed a customized server that will allow for the capture of both SD and HD feeds (via a DVB/ASI stream) from national PBS transmissions. Provision is made to encode SMPTE 292M (HD), conforming finished programs from HD sources, encoding HD to DVB/ASI for storage, and subsequent back-to-back HD replay via the new HDTV feed they anticipate bringing on line in 2004.

In this next step, Harris automation will control an SGI Origin 300 video server for HDTV service and redundant MPEG-2 video servers to provide the additional SD channels and embedded data services.

In conclusion

The MCSi and SGI solution was chosen for the project because it was the only solution that presented a completely open digital infrastructure. GPB will begin broadcasting with the new dataflow in mid-2003. BE

Bill Buhro is a solutions architect with SGI Professional Services.

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SYSTEMS DESIGN SHOWCASE

Turner Studios' TS2 sports production truck

Adaptable and efficient

BY BOB MCGEE AND JIM BUDKA

Turner Studios' new 53-foot TS2 truck covers home and road games for the Atlanta Braves (MLB), the Atlanta Hawks (NBA) and the Atlanta Thrashers (NHL), as well as other sports and special events that are broadcast by Turner networks.

Such a diverse range of programming requires that the trucks employ high-quality equipment that is flexible and can integrate well with other equipment. And, like every other company in the broadcast industry, Turner is exploring its options in its migration to digital television and HDTV.

The centerpiece

The audio console is the centerpiece of any mobile truck, and Solid State Logic has been providing Turner with large-format consoles dating back to 1982. When Turner decided to replace its SSL SL6000 analog console, it was confident that the company's MTP digital audio production console was the logical next step. The console features 208 inputs, 192 active processing channels and 80 outputs, and is configurable for 5.1 surround mixing.

The console is strikingly similar in many ways to the SL6000, which helped to greatly reduce the learning curve for the truck's operators. The console's in-line architecture is familiar to engineers and allows them to get up and running quickly. In addition to its intuitive presentation, the dedicated knob-per-function control surface allows immediate access to all channel functions and provides an excellent overview of all of the console's settings. Also, the fact that the console provides 192 faders in an efficient footprint was key, considering the limited amount of usable real estate in any truck.

Moving quickly from sport to sport requires the use of different settings for each venue. Certain configurations such as announcer booths and sideline interview positions remain fairly constant, but the placement of effects microphones in figure skating, for example, can vary greatly from those used in baseball or other sports. When the truck's crew goes back to its baseball or basketball setups, the ability to precisely recall all of the settings is an incredible time-saver.

Moving quickly from sport to sport requires the use of different settings for each venue.

The 53-foot TS2 truck covers home and road games for the Atlanta Braves (MLB), Atlanta Hawks (NBA) and AtlantaThrashers (NHL), as well as other sports and special events. Photo by Dave King.

Total recall

The console's total recall and proprietary DSP technology simplifies setup for specific games. Projects can be saved for each venue or event. When the truck comes back for baseball season, the crew just loads its baseball project right in again, and the settings are where they left them six months before.

This came in handy after a recent Braves game at Turner Field lasted 16 innings, obviously running much

longer than anticipated. The truck was scheduled to do a figure-skating event at nearby Philips Arena immediately following the game. The truck crew simply loaded in its baseball project and then made changes to create the proper setting for figure skating and resaved it. Thus, they were able to create a project for a completely different sport that was actually built from a baseball project. The ability to quickly and easily reconfigure the entire console by simply loading a new setup file makes these quick turnarounds between events a simple procedure.

Knob per function

In addition to the console's recall capability, the knob-per-function design provides quick access to all routing and processing functions. There's a lot to be said for being able to reach up inline on the channel strip above a fader and make the appropriate changes. Many digital consoles force you to operate the entire console from a master-control area in the center of the console with one set of knobs. The console's design greatly improves the speed and flexibility of setting up routing for output feeds to other locations inside the truck, such as announcers' IFBs or camera programs.

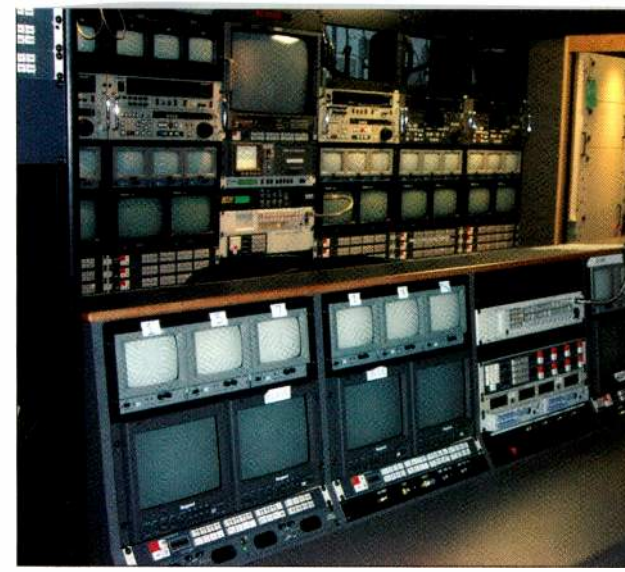
DAC

The console's digital-to-analog converters (DACs) allow the crew to feed prefade mics to other trucks and store them in a project for reuse in the future on a similar event. This way, when they are feeding the visiting team's truck, they know that certain DAC outputs will always be the same effects mics, prefade.

Audio routing

The crew often needs to create mirror-image feeds for ESPN. There are also quite a few times (with the Braves being as good as they are) when there are as many as three trucks at Turner Field for a 3-way broadcast. The console has a built-in digital audio router, which means that if ESPN or FOX comes in for a game, the TS2 crew can

Solid State Logic's MTP digital audio production console, installed in Turner Studio's TS2 truck, allows for faster recall of settings between events, more flexible routing, and also helps to add more realistic audio elements to a broadcast.



The truck's tape area features 64 routable monitors that center around a Thomson Grass Valley 3000 production switcher. The area also includes four Sony Beta slo-mo decks and five Sony Digital Betacam decks.

easily make all of its microphones available to other trucks. In such cases, the crew can give these other trucks its outfield wall mics.

Routing setup for channel inputs, mix busses and multitrack busses uses a central control section for speed and convenience. The crew can make routes individually or in arrays, and the console always displays each input's source and bus routing on the meter bridge above the associated channel. This way they always know where their signals are going.

The crew uses the console's 48 multitrack busses to feed recorders, generate clean feeds/mix-minuses or even extra FX sends. The console also has 12 aux busses, which can be mono or stereo, and which are fed simultaneously from both upper and lower fader paths. Alternatively, any channel aux control can be split from its aux bus and feed any of the 48 multitrack busses. This can be useful in providing an individual resettable level control to a clean feed output for a channel.

Capturing the sounds of the game

The average Braves' home baseball game can feature up to 14 effects mics across the field and surrounding areas, including the dugouts and bull pens. There are also 10 mics around the outfield wall that start at the left-field tarp area and stretch all the way to the right-field tarp area. In addition, there are mics pointed at first base for the toss-over,

The console's total recall and proprietary DSP technology simplifies setup for specific games.

or when the pitcher throws over to first with a man on base. There's a similar mic at third base, and two positioned behind home plate on either side to capture the "crack" of the bat hitting the ball, as well as other sounds of the game.

In a recent game, Braves' centerfielder Andruw Jones was seen on camera walking back into the dugout, taking a drink and then flipping the cup onto the ground. You could hear

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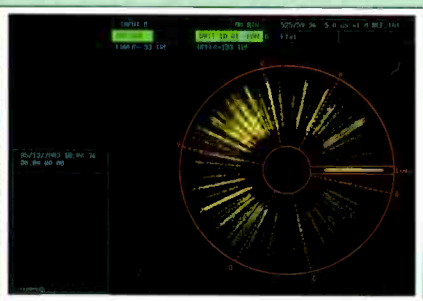

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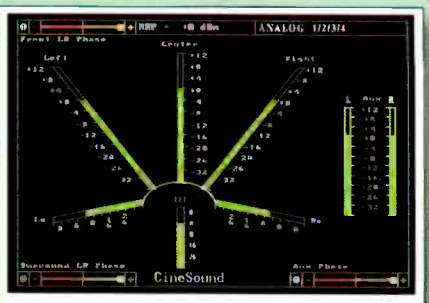

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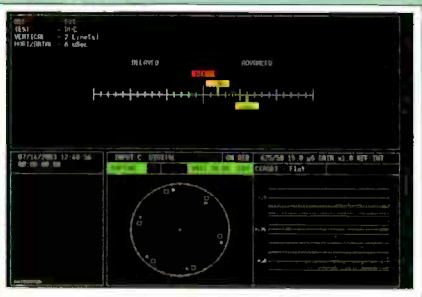

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the sound of the cup hitting the ground. Also at Turner Field, when an outfielder is going back on a fly ball and hits the warning track, you can hear his spikes hit the dirt, followed by him hitting the wall. That's the type of detail the TS2 crew strives for in its broadcasts, and the fans appreciate it.

But such in-depth audio coverage also has its pitfalls. In another recent game, both opposing pitchers were upset with umpires' calls at different times, and both were caught on camera uttering an expletive. Upon hearing it, one announcer turned to the other and said, "This place is really wired!"

Obviously, TV is first a visual medium, but audio can play just as big a part. Instant replays started out as just a video-only enhancement to a game's coverage. With the audio quality Turner is getting from its trucks, many times it'll run an instant replay for the sound only. For example, there was recently a dispute over whether or not a ball hit a batter. The TS2 crew played it back at normal speed, and the viewers could clearly hear the ball hitting the batter's arm. The key is to show the viewer the most complete "picture" of a game possible, whether it's video or audio.

The layout of the console has made setting up for games easy. The crew has the console arranged so key signals such as bat cracks and base mics are on group faders. The left and right bat cracks may be at the extreme left side of the console in the first eight faders, but the operator will have a group master fader right in front of him. Any fader can be a part of a group or a group master. It's possible to create a setup where one channel on the console opens every other channel. The ability to arrange different inputs and control them as a group from anywhere on the console is a useful feature.

The complete picture

The MTP console forms the core of TS2's audio operations and capabilities and works with the array of equipment that completes the truck. This equipment includes 12 Ikegami cameras (seven HK-377s and five HK-377Ps); a Thomson Grass Valley 3000 production switcher with 64 inputs, three M/Es, EMEM and frame store; a Thomson Grass Valley 7000 (96x128) video router; and a dedicated 64x64 router for tape-room monitoring.

Digital video effects include a 4-channel Accom DVEous system with Ultrawarp, 3-D light sourcing, com-

Design team

Mobilized Systems
- Bob Giesman, senior lead engineer
- An Nguyen, mechanical engineer
- Michael Price, electrical engineer

Turner Studios
- Fred Beck and
- Jeff Morris, principals
- Bill McKenna and
- Javier Hernandez, project engineers

biner and Orbital FX; and a Feral Key West 2-channel DVE. The truck is also equipped with two Chyron iNFiNiT!s with version 10.0 software, and a Pinnacle FX Deko II CG.

Replay equipment includes four Sony BVW-75 Beta slo-mo decks, five Sony DVW-A500 Digital Betacams (each with Lance slo-mo controllers), two Fast Forward Omega 2-channel DDRs (with removable hard drives), a 4-channel EVS DDR, and VHS and DVD machines.

Enabling communications between the truck's different production areas and among the crew is an RTS ADAM intercom system with 11 KP-32 master stations, 18 MKP-4 user stations, 12 2-wire channels, 16 IFB channels and a 2-channel TIF and 8-line Partner telephone system.

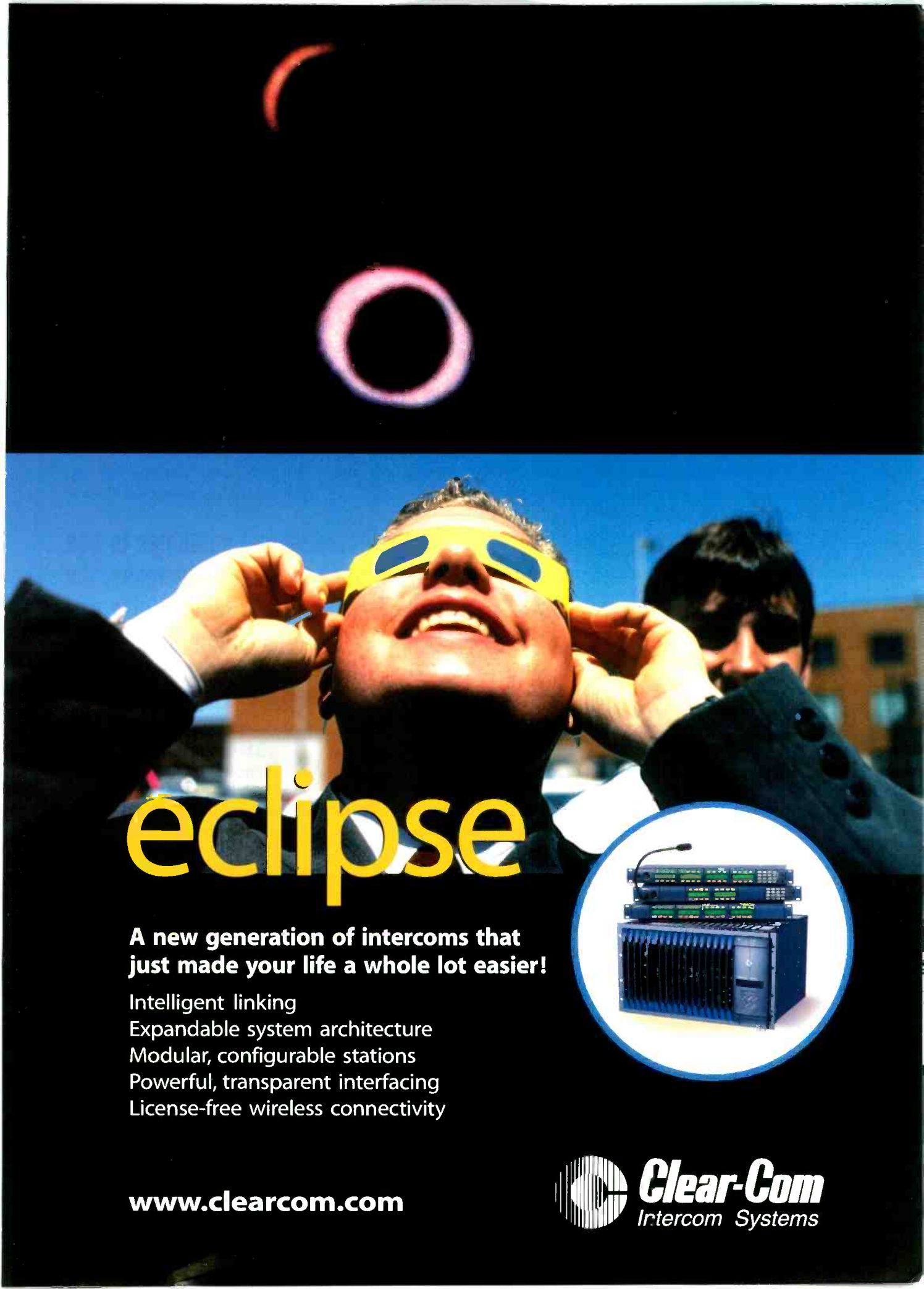
The truck also can be configured with a variety of other equipment available on request, including an eighth Ikegami HK-377 camera, Panasonic 3-CCD LPS cameras with Fujinon lenses, Lectrosonics and Vega wireless microphone systems, and a Motorola wireless IFB system.

The end result of all this technology —the audio quality of the MTP console, the placement of the field-effects mics and the range of state-of-the art equipment in the truck — is a "you-are-there" experience for viewers at home. BE

Technology at work

- Thomson Grass Valley
  - 3000 production switcher
  - GVG series 7000 (96x128) video router
- Accom Abekas DVEous/MX DVE
- Orbital FX effects system
- Feral Key West two-channel DVE
- Chyron iNFiNiT! 060 CG
- Pinnacle FXDeko II CG
- Sony
  - BVW-75 Beta slo-mo decks
  - DVW-A500 Digital Betacam
- Lance slo-mo controllers
- Fast Forward Omega two-channel DDR
- EVS DDR
- Telex/RTS ADAM Digital Matrix Intercom system
- Ikegami
  - HK-377 cameras
  - HK-377P cameras
- Lectrosonics wireless microphone system
- Vega wireless microphone system
- Motorola wireless IFB system
- Fujinon 66:1 and 20:1 lenses

Bob McGee is director of technical operations, and Jim Budka is an audio engineer for Turner Studios.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Keeping it running

BY DON MARKLEY

Now that the summer season of thunder and lightning is ending, it is time to prepare for the lovely winter season of sleet, freezing rain and ice. We are well aware of the problems caused by lightning strikes on or near power lines. They can cause power outages that can take the station off the air as well as doing real physical damage to the station's equipment. They also may get blamed for wiping out the entire East Coast.

However, it may well be that the winter months, at least in the northern states, are more worrisome. For stations in the South, you miss out on all the ice but have hurricanes to worry about. Like a divorce, they can take your house, your car and your tower along with the power lines. In addition, as so many stations were recently reminded, the power grid is not totally safe from a massive failure. Indeed, as the infrastructure continues to age, electrical loads continue to increase, and we continue to have an irrational fear of nuclear power plants, the odds of massive power failures will continue to increase.

Just how does one handle this problem? The subject of UPS power systems has been discussed previously in this column. Either a battery-powered or a flywheel type system can tide the station over for a brief period of time, usually measured in a few minutes. Then, an auxiliary power system must be brought online to meet that continuing power drain.

As the infrastructure continues to age and electrical loads continue to increase, the odds of massive power failures also will continue to increase.

All modern power systems have automatic start and monitoring systems incorporated into their control systems. On sensing either a failure of one or more phases or the line voltage falling below a predetermined level, as in a "brown-out," the generator will start automatically. An automatic transfer relay will then switch from the incoming mains to the output of the generator. Usually, the length of time between generator start-up and the actual switchover is adjustable. That allows the generator to warm up a bit before accepting the load. In some applications, this time delay is necessary to allow the load to stabilize before the switchover takes place.

If synchronous motors are in use, applying full line voltage out of phase with the motor's instantaneous electrical phase position can place destructive loads on the rotor. To avoid that, it is better to let the system come to a complete halt and then restart from scratch. Thankfully, that is usually not a problem with the normal induction motors found in broadcast transmitters. Even though that may be the case, letting the generator have a few seconds to stabilize before switchover is still a good idea. The start-up itself is fairly routine on newer systems. In cold parts of the country, the engine is normally heated, either by an engine block heater or by a combination of engine block and oil heating. For a good diesel engine that results in the actual start being almost instantaneous, all the necessary systems will be included to shut the system down in case of low oil pressure, over temperature, etc.

One standby power plant recently viewed by the author consisted of a generator bolted to the floor in the

FRAME GRAB A look at the consumer side of DTV

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Type of television	Percent of consumers who expect to buy the technology
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Widescreen TV	32%
Flat panel TV	30%
Plasma TV	10%
LCD TV	7%

SOURCE: Consumer Electronics Association *www.ce.org*

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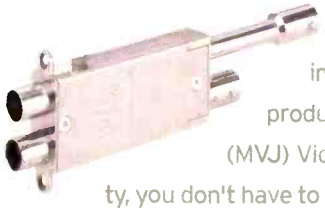

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utility room of the station. A shaft with a universal joint was routed through a hole in the wall. In a lean-to type of shed attached to the back of the building was an old international model "M" farm tractor with the power take-off attached to the other end of the shaft. In the case of a power failure, the on-duty operator simply would go out into the back room and fire up the tractor, engage the power take-off and open the throttle. Once inside the building, he would operate a big manual transfer switch. While it might have been crude, it was inexpensive, and it worked very well. A little trickle charger was used to keep the battery on the tractor full and the tractor was started once a month and run for a little while to keep it ready to work.

Either a battery-powered or a flywheel type system can tide a station over for a brief period of time, usually measured in a few minutes.

Once the generator has started, the major failing by stations is being in a big hurry to switch back to the mains. There is no reason for this other than to save a little fuel. When the mains come back, as everyone has experienced, the voltage often fluctuates somewhat over the next few minutes and may even fail again. The generator should be allowed to continue carrying the load until the time that the main power has returned and is fully stable. It's not a bad idea to wait five or 10 minutes before switching back to mains. Next, give the generator some time to run without load to cool down a bit before switching off. This is particularly true with big diesel engines. They should never be switched off immediately after operating for some time at full load. The heat buildup inside the engine block can cause significant damage in such cases. In complete genset packages, all of these timing functions have already been

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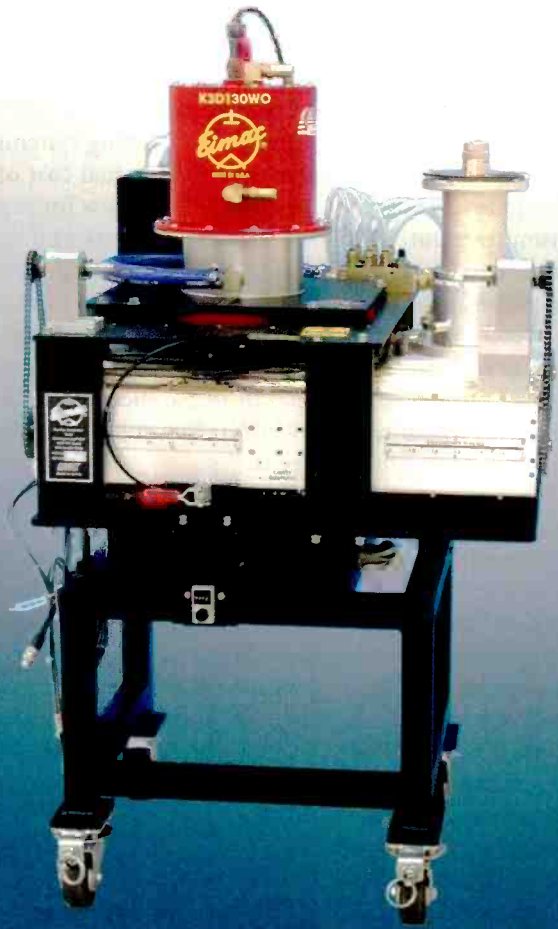

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Now, it's decision time. Just where do you do the switching, and how do you size the generator? The answer to these questions will vary somewhat depending on whether it is a new system or adding standby power to an existing system. For a new physical plant, it is possible to pick the loads that should stay on the UPS. Obviously, the transmitter and terminal equipment should not be interrupted. It won't hurt the air handling or HVAC systems to be interrupted. In fact, most of the mechanical portions of the station will not be bothered by a short shutdown, including tower lights, building lights, water systems, etc. Remember, this shut down is going to be measured in seconds, not hours. Therefore, everything in the plant can return to normal in a reasonable fashion without having to provide UPS capacity.

On the other hand, once the cost of the UPS system has been determined to handle the transmitter and terminal equipment, it may not add significant cost to leave the whole station ride. That is especially true for an existing system where breaking off part of the systems will require a major rewiring of the transmitter plant. The cost of that rewiring, along with the additional breaker panels, new conduit, etc. may run in excess of simply adding another 10 kw or so to the UPS.

In a separate but related area, remote sites often have a problem with three-phase power. Even when single-phase power is available, the cost of upgrading to a full three-phase feed can be totally prohibitive for a station. In the past, various types of converters have been implemented to change the single phase supply into a three phase system. The most popular has been rotary converter systems.

Those systems are fine for fixed loads such as big motors. However, they have a tendency to either create large transients in high voltage supplies or to have a third phase that varies in voltage and phase angle. That can wreak havoc in solid-state systems unless a proper regulator is used. A solution is to use a UPS to actually drive the load with the rotary converter driving the UPS. The UPS doesn't have any difficulty dealing with the "wild leg" of the incoming three phase and will provide clean service for the transmitters.

A possible new solution is available from Phase Technologies. It has a solid- state digital phase converter. Models for up to 30KW are available with 1 percent phase balance, electronic power factor correction and very little harmonic distortion. Their efficiency is from 95 percent to 98 percent which is really very good. The units can be located in outdoor enclosures to avoid adding any heat to the transmitter room.

To summarize, in a new system, break the system so that the necessary components are on the UPS and the rest of the equipment is only on the standby power plant. That is, those systems that can experience a short amount of down time are fed separately from the on-air critical systems. For existing systems, do an analysis of the actual cost of rewiring the plant to allow for separating the critical systems and compare that to the cost of simply providing a large enough UPS to run the whole place. You may well find that the additional cost is like putting a 100K resistor in parallel with a 1K. It has an effect, but you won't really notice it.

Finally, remember when installing a UPS or a standby power system that it must not be possible to get the generator online at the same time as the main power supply. Unless you are trying to feed power back to the power company, the result will be large amounts of smoke, noise and flames if the systems try to self-parallel. BE

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

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Digital audio networking

The gigabit solution

BY PATRICK WARRINGTON

In the '80s, organizations realized that computer networks improve productivity. In the '90s, the same became true for the public at large. The emergence of computer networks has allowed organizations and individuals to communicate and share information with unprecedented ease and speed.

This fact is not lost on those who design and operate production facilities with multiple studios and control rooms. For years, mixing consoles have shared sound sources using distribution amplifiers and miles of expensive cables that offered reliable, if rudimentary, connectivity.

More recently, digital audio routers have allowed more elegant audio networking, with greater capacity and computer control. Many console manufacturers believe the next logical step is to make the network part of the mixing console, so that sharing inputs and outputs across any number of mixing consoles becomes an easy and natural process — no more complicated than plugging a microphone into a stand-alone console, and just as reliable. Figure 1 shows a block diagram of a practical audio network.

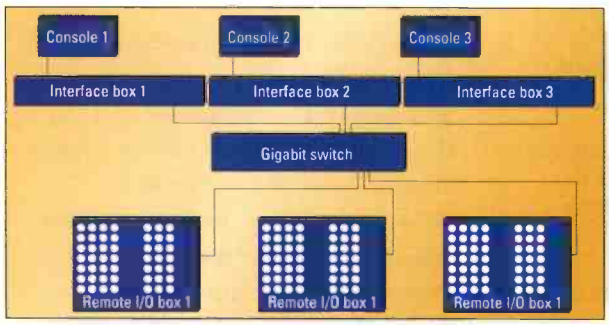


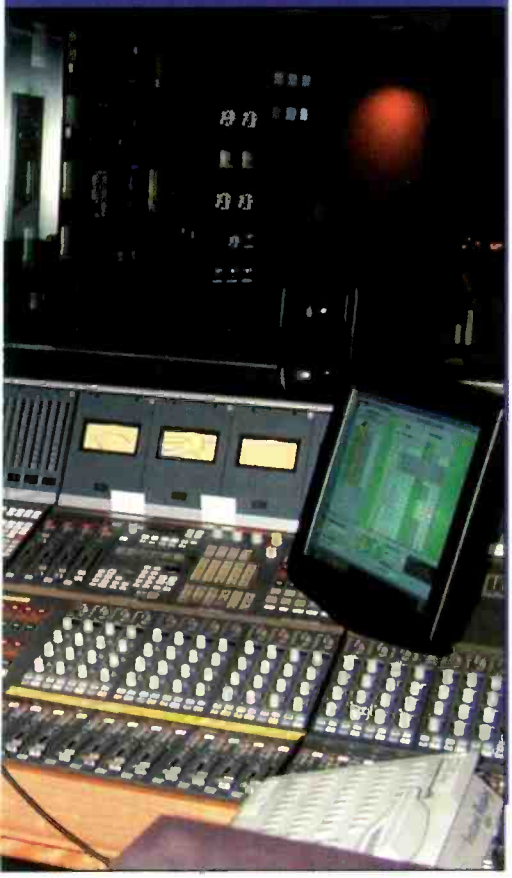
Figure 1. An example of a number of mixing consoles and remote I/O units connected, in star formation, around a gigabit switch.

Using Ethernet

You can simplify the task of building a data network by designing it around one the many existing communication standards. Gigabit Ethernet is a natural choice because it provides the best balance between bandwidth and cost-effectiveness. Inexpensive chip sets are available for making network interfaces, and low-cost components are available for constructing the network fabric.

The Ethernet standard defines a frame of information comprising a header (containing source and destination addresses) and a variable-size data payload (see Figure 2). There are no restrictions on the nature of the payload, the frequency of the packets, or on the time they take to reach their destination. Ethernet networks are sometimes compared to the postal service — you drop a letter in at one end and, sometime later, it emerges at the

Calrec Audio's Alpha 100 digital console, shown here in Studio 3A at NBC Television Network Operations in New York, is the largest of the three Calrec models that can be networked through the Hydra networking system.



destination address. You can't always predict how the letter gets there and, more crucially, how long it takes. But this unpredictability is not intrinsic to Ethernet — it is due more to the way that higher protocols deal with the dynamic loads of large networks.

To use Ethernet for communicating real-time audio information, you must either eliminate the causes of unpredictable behavior or mitigate them with buffering and retransmission strategies. The nature of audio networking and its context directs us very firmly to the former approach. More on this later, but first some details on

how Ethernet can move audio around.

Packetization

Any scheme for moving digital audio over a packet-based network must pack audio data into a frame, transmit it and then unpack it into its original form. But a packetization strategy involves a number of trade-offs. To make best use of the bandwidth, you must maximize the ratio of payload data to header data. You can accomplish this by using the largest possible payload of 1500 bytes. However, a single channel's worth of 32-bit audio data packed into such a frame would contain 8 milliseconds of material. This introduces a granularity that, given the inevitability of buffering, possibly at multiple points in the transmission chain, would impose a delay on the audio path amounting to many tens of milliseconds. This may be acceptable in some applications, but certainly not in live broadcast.

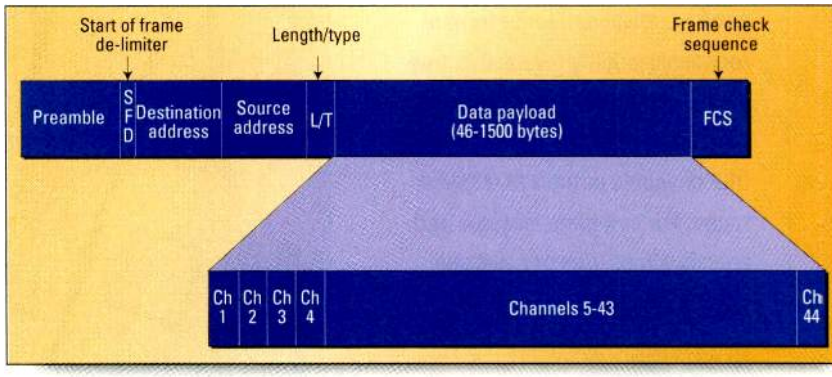


Figure 2. Maximizing payload by keeping protocol overhead to a minimum. Any Ethernet layer-2 switch can handle this frame.

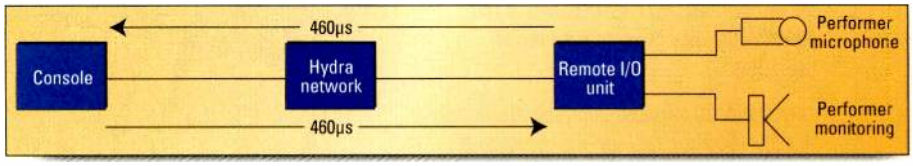


Figure 3. Low network latency is crucial when a performer is listening to a mix that includes his own voice because the signal makes two trips across the network as part of a foldback mix. The total delay is less than 1ms.

Payload, granularity and latency

When you network mixing consoles, it is likely that groups of signals, rather than individual signals, will route together. This helps ease the packetization problem, since multiple audio signals can group into the same packet, which tends to maximize the payload data while minimizing the audio granularity and hence the latency. The network attempts to balance these factors by using a variable frame size. (see Figure 2). Such a frame can accommodate eight 32-bit samples of anything from one to 44 audio channels, depending on network demand. At 48kHz sample rate, this sets the audio granularity to around 160 microseconds. The console-to-console network latency is equal to two lots of frame buffering delays (one at the transmit end and one at the receive end) amounting to 360 microseconds, plus delays from the network-interface circuit to the console audio backplane. Experimental measurements have shown that the total latency in each direction is approximately 460 microseconds (see Figure 3).

Guaranteed on-time delivery

Having established a mechanism for the efficient movement of audio through the Ethernet fabric, you need to ensure that it will deliver every packet, without fail, under all loading conditions. This brings up the need for deterministic network performance. Those familiar with the origins of Ethernet understand that it was designed to be anything but deterministic. In early Ethernet-based computer networks, multiple nodes connected to a single cable segment. If two nodes attempted to transmit simultaneously, the network detected the collision and both nodes backed off for a random amount of time before trying again. If a segment were particularly busy, it could delay frame transmission many times. This resulted in unpredictable link performance. A real-time digital audio application that is intolerant to delays and relies on the timely reception of all frames requires much better performance.

Star-shaped topology

Since Ethernet's inception in the early '80s, things have improved greatly: link speeds have increased from 10MB/s, to 100MB/s, 1GB/s and even 10GB/s. But the problem of predictable behavior has been affected most significantly by the development of cost-effective switches. These devices have allowed network topology to change from shared segments to star-shaped, with a single node on each point of the star. The switch routes traffic directly from source to destination without affecting any other nodes. In non-blocking switches, the hardware can continu-

Many console manufacturers believe the next logical step is to make the network part of the mixing console.

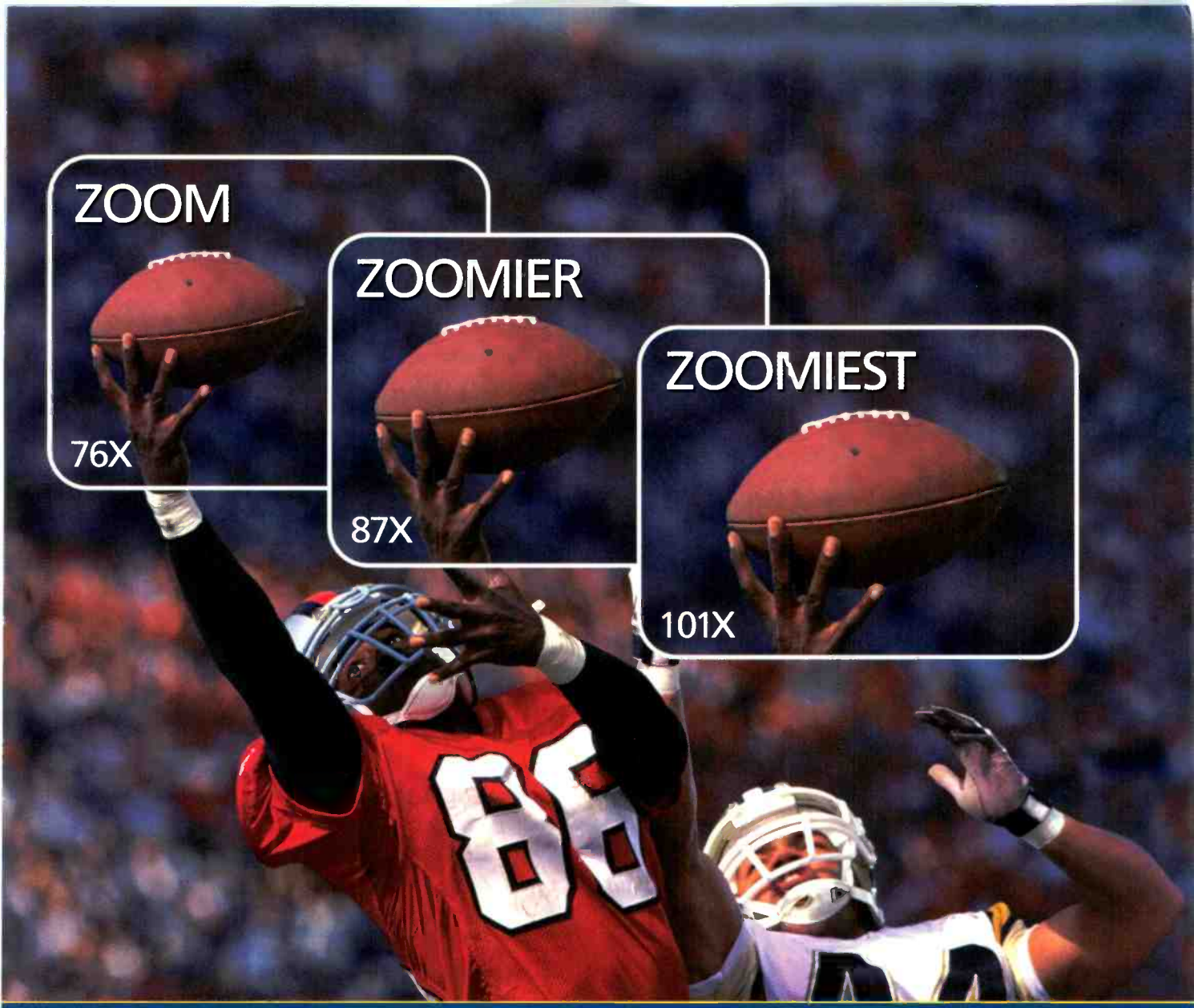


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Photo 1. The front panel of the Hydra interface box, which interfaces the mixing console to the network.

ously receive data at one port and route it to another at the maximum data rate, irrespective of what traffic other ports are handling. This kind of network provides a suitable fabric with which to build an audio network. To guarantee fully deterministic performance, it is necessary to apply the further restriction that we keep the network private. This means that we must not make it carry any data other than that generated by the audio network.

Capacity

A useful consequence of designing the network to have deterministic behavior is that it can disregard much of the protocol baggage of standard networks. By abandoning the TCP/IP transport and network layers, we remove the need for 24 extra header bytes, leaving a data payload from 46 to 1500 bytes. Given a 32-bit audio word size and an efficient packing strategy, it follows that it should be possible for a single Gigabit Ethernet connection to transport in excess of 600 channels of 48kHz digital audio. In practice, a somewhat lower maximum load is prudent to allow for some non-audio communication. The Gigabit Ethernet network has successfully carried loads of 585 audio channels in the presence of heavy control (non-audio) traffic.

Control

An audio network differs from typical computer LANs in that there is no central server. In fact, the relationship between network devices is peer-to-peer, although each mixing console has characteristics of both client and server because it is capable of both requesting and responding to requests for audio data. This arrangement has a useful resilience because no single part of the network is essential for control of the network. The network system has been designed for devices to be added or removed (or even to stop working) without affecting anything else. The control software on each mixing console uses the network to constantly audit connected resources, so every device is aware of every other device and the connections it offers. If resources change, the rest of the network becomes aware, very quickly. This information may be used to automatically switch to alternative hardware, should a redundant system be available, as well as to update the list of available resources.

Gigabit Ethernet is a natural choice because it provides the best balance between bandwidth and cost-effectiveness.

For a network to be truly useful, it must be easy to use and maintain. This requires control software that constantly monitors the network and performs essential administration functions, leaving users free to creatively exploit network resources as easily as if they were locally connected.

For reliability, the network should use proven high-quality switch hardware with redundant power supplies. For belt-and-braces reliability, the network designer may duplicate some or all of the network fabric (cabling and switch hardware) and the network-interface hardware. That way, if the network soft-

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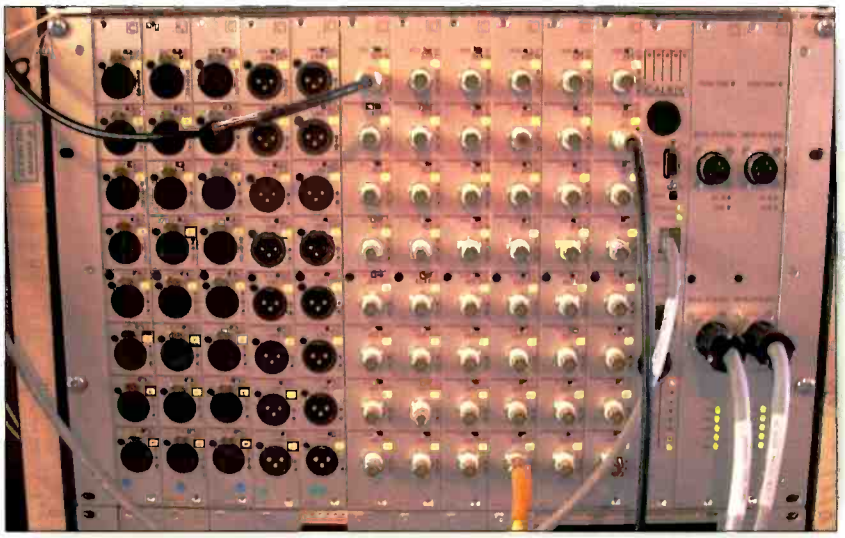

Photo 2. A remote I/O box with ADCs, DACs and AES I/O modules.

ware detects any failures, it deploys this redundancy automatically.

A practical audio network

Calrec Audio has developed a technology based on Gigabit Ethernet for constructing large-scale, low-cost, real-time networks designed for connecting mixing consoles and remote I/O sources. The Hydra audio network allows production facilities to connect any number of digital consoles to share input sources, buss outputs, direct outputs and clean feeds. In fact, you can share every signal on a console with any other console on the network. In addition, you can connect remote I/O units, with up to 96 inputs and 96 outputs, analog or digital, to the same network. This provides remotely located sources and destinations that any or all mixing consoles can use. Photo 1 is a photo of the front panel of the Hydra gigabit console interface. The model shown provides two separate duplex gigabit ports that can be used as a pair in which one port functions as a "hot" redundant spare to the other, or in parallel to double the interface bandwidth. Photo 2 is a photo of the remote I/O box and its network connections. The independent I/O unit, which may be located remotely, provides general purpose I/O to the network. It also has two gigabit ports intended to provide an option for connecting redundant switch fabric.

The audio network is built on Gigabit Ethernet technology (IEEE Std 802.3-1998) and the network fabric is made using low-cost, off-the-shelf hardware. The network topology is similar to an office LAN, using a central switch with connections to each mixing console in a star formation. You can make connections up to 90 meters with Category 5e UTP, or up to several kilometers with optical fiber. BE

Cost-effective switches have allowed network topology to change from shared segments to star-shaped, with a single node on each point of the star.

Patrick Warrington is technical director of Calrec Audio.

The future of features

BY PAUL MCGOLDRICK

The travel industry is very fond of the word feature. Every restaurant and bar, every weightlifting room and sauna in any of the Caribbean resorts is a feature, and the travel planner's small print will inevitably say, "No refunds for unused features." Of course, we will usually go to the trouble of selecting our destination according to the sort of activity we want to get involved in: I'm not about to go to a golf resort for a vacation, for example.

But there are many places where we cannot select the product to suit our involvement. Just look at the word-processing application that I have open at this very minute. Generally speaking I want to open a new document, start typing, save the document and close the application. Several times a week my needs get more complicated because I have to put other people's work into a format that I can use, but that generally only requires a couple of keyboard actions that I have managed to learn. How many other features in that application will I never need? Thousands, I suspect.

Yes, I can hear you saying that someone out there – a more advanced user than myself, no doubt – will be using features that I would never know existed. But why should I be paying for a product that does far more than I am capable, or desirous, of using? The additional product development time and effort was at my cost, but not for my benefit.

There are similar parallels that can be drawn: I live in a city that is quite small, but we are fortunate to have a fully equipped hospital and a total of about 10 physicians. Apart from the city population there is a fairly large catchment area to draw patients from and we are fortunate to have a major tourist attraction in the form of a couple of dozen miles of 500 foot high sand dunes. Every summer they are filled with three- and four-wheel all-terrain vehicles. The combination of sharp fall-offs, lack of visibility over hills, inexperience, speed and alcohol keep our two ambulances quite busy. Unfortunately, more and more, these idiots are uninsured. They get treated, x-rayed, bound and patched up, stitched, etc., but people like me are carrying more and more of the costs.

Why should I be paying for a product that does far more than I am capable, or desirous, of using?

There are also many parallels in our industry. Look at the products you use every day and think about the features that you don't use – but that you paid for. And think how the selling of those products is often based on the features you never end up wanting.

I'm as guilty as anyone else in approaching a sale that way, but we all know that the majority of products are set up for use in a particular arena and that's the way they stay. The reason those products influence us is because the engineer in us keeps escaping the bottle and going out of control. If we thought more about the operators of the equipment, we would demand simpler, cheaper equipment with far fewer features.

When you look at the rows of monitors in a control room, how many of them – in most applications – are working on different line standards, or different composite or baseband standards? When did you last see an operator look at anything but a vector display on a vectorscope? Or a two-line (or two-frame) display on a waveform monitor? Have you ever seen an operator use cursors on a waveform monitor to measure voltages? Probably not, but as engineers we look at products that do more than just give us a simple display. There is some kind of precise measurement instinct in us that is difficult to squash.

There certainly are reasons to look at equipment that may be easily switchable to DTV formats in the near future, but only if it is really in the "near" future for you. If you are two or more years away from such changeovers, you're probably over-paying for the flexibility you think you are getting.

Bigger things attract humans. The number of SUVs on the roads is a testament to how consumers can be fooled by size. What percentage of those vehicles ever leave a public road is imponderable, but small. What percentage of 4x4 trucks ever leave the road either? These are features we have no real need for, but people are paying for them every day.

If I ever get a four-wheel drive vehicle to go up the logging roads to my transmitter sites – instead of the slow climbs on foot – it will be a well-used, beat-up thing that I will be ashamed to leave parked in my driveway. But it will have the feature I most need. And its acquisition will allow me to have more pennies to spend on the features offered in that thatched resort in the Grand Caymans. BE

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

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CHIEF ENGINEER...JOB REFERAL #: 152 EXPERIENCE AND SKILLS NECESSARY: WWAY is seeking a Chief Engineer. WWAY is a well-established, well-equipped ABC affiliate in the nation's 142nd market. Leading candidates will have superior technical proficiency in studio and transmitter operations/maintenance. Strong computer skills and strong communications skills are necessary. Three to five years' experience as a chief or assistant chief is preferred. If you are a leader, a manager, and a problem solver, we want to hear from you! **OTHER INFORMATION:** Mail or fax resumes and salary history to WWAY, P.O. Box 2068, Wilmington NC 28402. Fax (910)762-8367. Email: kimf@wwaytv3.com No **Telephone calls please. Include above reference number. PERSON TO CONTACT AT WWAY-TV: Human Resources**...It is the policy of Liberty Corporation (WWAY NewsChannel 3) that employment shall be based on merit, qualification, and competence. Employment practice shall not be influenced or affected by virtue of an applicant's or an employee's race, age, sex, religion, color, national origin, or disability. Females and minorities are encouraged to apply.

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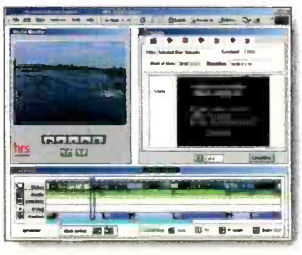

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Encoda A7000D series: New configuration for broadcasters needing to run fewer channels; expandable from a single channel to 1000 on-air channels; provides functions for playout, automatic caching and systemwide alarm management; includes content and delivery management; ingest and media preparation.

303-237-4000; *www.encodasystems.com*

UTILITY ROUTER LINE

Thomson Grass Valley Acapella router: 16x4 matrix; designed to support SD, HD and analog video and AES digital and analog audio in a single-format and variety of dual-format configurations; synchronous glitch-free switching; looping reference; serial interface and support for Grass Valley Net Central SNMP-based remote monitoring system.

530-478-3000; *www.thomsongrassvalley.com*

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Orad CyberGraphics: Titles and tickers/crawls, "over the shoulder" and full-frame 3-D graphics, three channels of digital video effects and presentation on studio walls; interfaces to industry standard newsrooms; user-friendly API for creating dedicated control.

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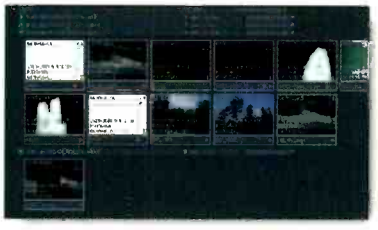

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800-869-3504; *www.discreet.com*

much as from below 19Mb/s to at least SMPTE 292M at 1.485Gb/s. This is a great idea, but it also leads to the temptation to build large monolithic router systems when smaller islands would suffice. Most broadcast stations can easily live in 32x32 to 64x64 for HDTV capability for several more years, and most need 128x128 SD or less. A single 256x256 router would cover both and could perhaps be "short loaded" to keep cost down.

But the 256x256 frame represents 65,536 crosspoints, where the smaller layered router approach would amount to 20,480 crosspoints and achieve the same thing at lower cost. The control system can make both look identical, and it is nonsense to maintain that ultimate flexibility is worth the cost without carefully considering the likely growth pattern that is expected. It will be a long time before HDTV system rebuilds begin in most markets. The layered approach also permits installation in small facilities to proceed without the inclusion of nearly as many analog conversion devices (both directions), by admitting composite analog is here for a long time and instituting a layer that deals with analog devices that can and should stay analog. Here again, complexity is reduced, and signal integrity is maintained. Building a digital plant by converting all of the composite analog signals to digital using less than stellar converters is not improving quality by converting to digital.

When selecting a new routing system, it is important to consider the capabilities of the staff who must (presumably) run and maintain it. Sales demonstrations make router programming and operation look pretty simple. I have seen our staff struggle with new control systems as they are introduced and we implement them for customers for the first time, and it "ain't pretty" ... sometimes. The move to IT-based systems means that the long-term care and feeding of the system must be done by those who have training sufficient to understand the failure modes and how to at least get around them. Manufacturers offer in-depth training, but make sure that those attending are up-to-speed on IP addressing, data routing, VNETs and such. Without that layer of base knowledge, you will end up with disconnects and a lot more long-distance charges troubleshooting minor misunderstandings.

When selecting a new routing system, it is important to consider the capabilities of the staff who must run and maintain it.

The future will certainly hold much change, as it always does. Look for slow movement to IT interfaces carrying content streams in the same way our friendly BNC connector analog and digital video systems do today. High bandwidth copper and fiber interconnections are inherently as reliable as our usual interconnection strategies, and they are bidirectional as well. BE

John Luff is senior vice president of business development for AZCAR. To reach him, visit www.azcar.com.

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

Routing systems

BY JOHN LUFF

Dictionary.com defines a system as "a group of interacting, interrelated or interdependent elements forming a complex whole." In the context of broadcast and television hardware, routing systems have become interactive, interrelated, interdependent and certainly complex. It is not unusual to find IT-based control solutions that bridge the gap between having pieces and parts from many manufacturers, each selected to achieve specific system goals and woven together into a seamless whole from the perspective of the operator.

The concept is not new. In the late 1980s, I visited London's ITN, where an early windows interface controlled the routing system, treating it like a virtual drawing with drag and drop implementations for "electronic patching." Modern systems may well have drawn on those and other innovative implementations and have layered high-tech IT approaches to the issues of control.

Complexity is a major problem in modern facilities. Because routing often touches nearly all facets of the business, in many facilities it is clear that managing that complexity is critically important. Building a plant that is inexplicable and controllable only by cognoscenti who have the television equivalent of an advanced degree is poor design. Adding control panels and smart screens that provide the operator with a manageable selection of options is critical.

It is equally important that the control system allow the flexibility to layer the best from many manufacturers into the seamless whole. For instance, TDM audio switching is growing in importance, in part due to the ability of many such audio routing switchers to accept analog or digital inputs and freely route them to any output. However, there are manufacturers who make those products without great match-ups in RS-422 and video switching options. The conclusion might be to find an acceptable set of compromises by limiting the amount of deployed technology, but if the control system can interface to all of the elements, the issue is moved to the operator interface plane, where issues are easier today.

Generally, routing is moving to a more flexible signal interface. In the last six months, many products have emerged that have auto-sensing inputs that accept everything from analog video, through SMPTE 259M and SMPTE 292M HDTV baseband signals. Just as TDM switches are revolutionizing audio system design, a flexible and wideband router using this technology would be a major building block in station rebuilds where existing analog facilities must be updated. As it stands, a layered approach can be created with wideband digital routing and a layer of composite analog combined by the control system to look like a single router. The operator does not need to know that he is switching analog crosspoints or digital crosspoints, or even that via path finding he is switching both. A "unisex" analog/digital router could bring great simplicity to the design of modern plants and permit flexible use in the future.

Telefónica, located in Madrid, Spain, provides cable television services and employs routers from PESA.

Perhaps a word about layers, sizing and wide bandwidth would be useful. Many manufacturers have designed "future-proof" routers by making them wide-bandwidth, covering as

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redefining television

AKG C4500
has many applications

BY ROB FRITTS

If you're in the market for a microphone that can deliver a big sound at an affordable price, then read on. At first glance, the AKG C4500 B-BC looks like the right fit for any broadcast announcer, and that's exactly where this microphone shines; however, that is not its only application.

The C4500 is a large diaphragm condenser microphone that can operate on a variety of phantom power supplies ranging between 9 and 52 VDC. The C4500 has a 20 dB preattenuation pad that increases its Sound Pressure Level (SPL) range. To prove this theory, I placed the microphone just inches from a Marshal guitar amp, and had the guitarist play to his heart's content. The microphone handled the SPL's with no problem. However, I was not overwhelmed with the sound at first; it was too "boomy." I then backed the microphone up so the total distance to the amp was 12 inches. The microphone recorded a sharp sound with a tight low-end response. This mic would be a good choice in this application. Another fine application for this microphone would be when you're recording a bass drum. It handles the sharp attack without any distortion and delivers a low-end response of which any mixer would be proud.

I recorded a variety of professional voice over talents using the C4500 B-BC and really fell in love with the performance. The sound was well rounded with a smooth bottom end and great presence in the upper midrange frequencies. This gave the impression of a big sound that could cut through the music and effects of any radio or TV spot and still deliver great presence with a clean, intelligible response.

As I recorded each voice over talent, I tried different micing positions. The first position was just off axis of the subject's mouth about six inches away.

This microphone is a must have for any radio or television studio.

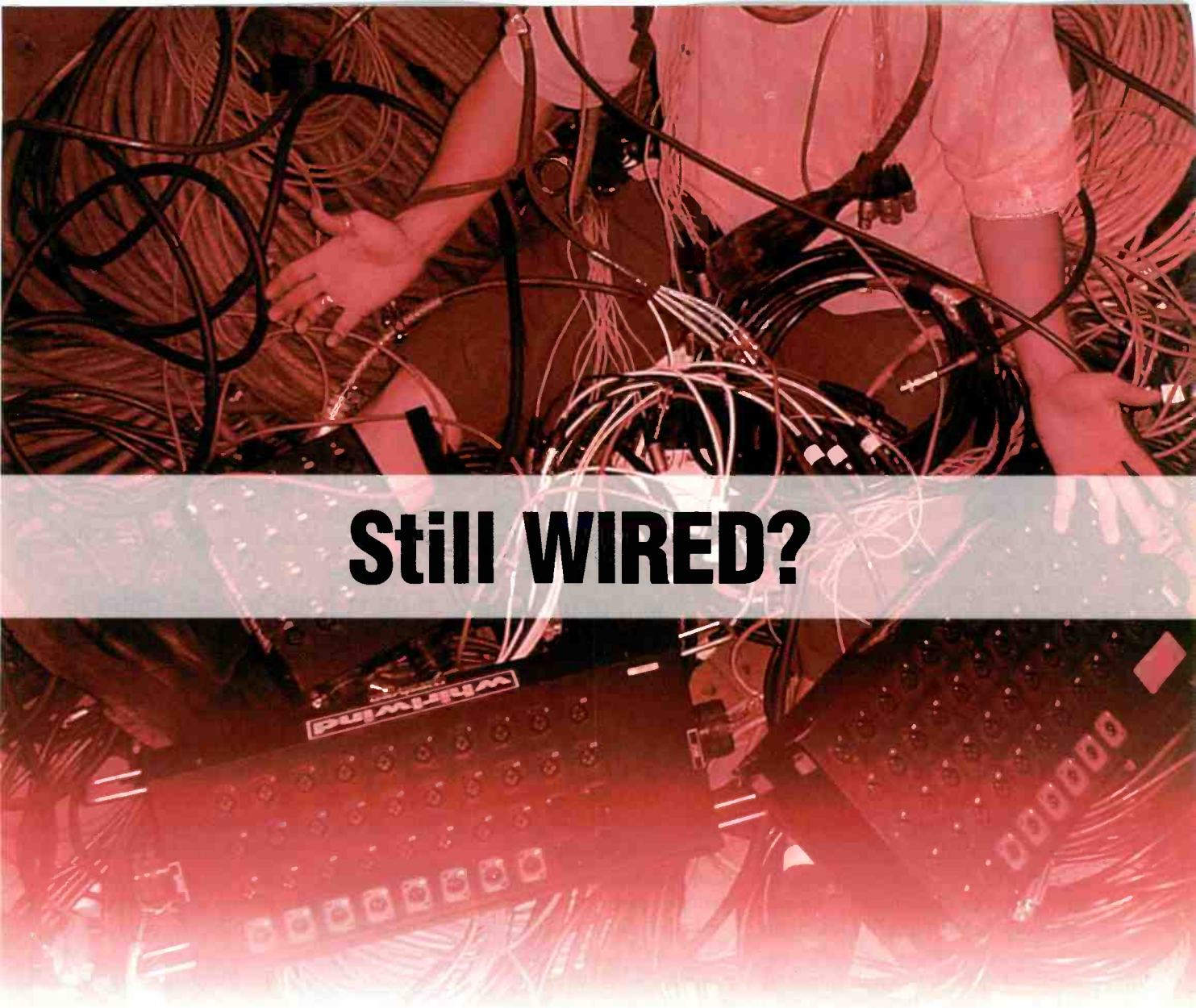
This position responded well, but lacked ever so slightly in clarity. The second position was six inches directly in front of the subject's mouth. This position had the best overall frequency response compared to other positions and also did not obstruct the talent's view of scripts. Although, if I placed the microphone level with the voice over talents chin and pointed it upwards toward the mouth, I found the siblance factor to be slightly less. This position came in handy when recording female voices that sometimes spike in frequency around the 5 KHz to 7 KHz range.

One of the studio booths I happened to be recording in had a low rumble present. That proved to be a problem when recording until I switched the bass cut filter on the AKG C4500 B-BC. This filter starts to slope at 120 HZ using a 6 dB per octave scale. This filter not only reduced the low rumble in the studio booth but also reduced the rumbling wind outside. Furthermore, I tried this microphone as a public announce mic on a small outdoor stage and it performed beautifully.

The AKG C4500 B-BC handled a variety of recording applications from musical instruments to voice overs and public address settings. This microphone is a must have for any radio or television studio. It's reliable and can handle the toughest of situations. Moderately priced and backed by the AKG reputation, how could any engineer go wrong? BE

The C 4500 B-BC was developed for digital broadcasting. It is immune to electrostatic and magnetic fields and provides a wide range and low self-noise.

Rob Fritts is senior sound designer/mixer for Henninger Digital Audio located in Arlington, VA.



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Pinnacle servers
at Turner Entertainment

BY JACK GARY

When ground was broken in March 2000 on a 198,000 square foot facility in Atlanta, housing Turner Entertainment Networks' new Network Operations Center, the engineering staff was given the mandate to streamline its capability to ingest and playout content for improved efficiency. By September 2003, this new facility will be home to 19 Turner Entertainment Network feeds including TNT, TBS, Cartoon Network, and Turner Classic Movies.

The Entertainment Division of Turner Broadcasting had been using server-based operations using JPEG and MPEG servers since June of 1996, but had outgrown the infrastructure of the previous facility. Physical limitations of the older facility forced the creation of multiple system islands requiring multiple ingest stations. The team wanted to create a single ingest point that could ingest material once and make it available for playout on any server throughout the new building. Their choice of server would need to reliably perform 24 hours a day with minimal down time.

Their decision was to purchase 16 MediaStream 900 servers, based on Palladium networked storage, from Pinnacle Systems. Each server's reliability is insured by RAID protected drives, dual controllers, and redundant power supplies.

Each channel is equipped with two air chains, an 'A' and a 'B'. The chains are identical, with an individual switcher, server, automation, and processing chain. The systems run in parallel. Any type of failure on one of the air chains can be bypassed with a switch to the other with the simple push of a button.

Turner's server technology needs to be able to reliably perform 24 hours a day with minimal downtime.

A key requirement for the new network operations center was that content must be available simultaneously to all the broadcast services in the building. The system concept the engineers devised is called "BIM" for "Broadcast Inventory Management." BIM can store and keep track of ingested material while making it available via file transfer to any server at any time. A mirror image resides on redundant disc storage, and DVD jukeboxes holding a third and fourth copy back this up. BIM was designed with the ability to copy program content to archive for later use.

By September 2003, all of the 19 network feeds sent out from the network operations center will have been standardized on Pinnacle MediaStream 900 server technology with back-up redundancy in every case.

The engineering staff is already looking toward future improvements to support the worldwide movement of audio and video as files throughout the organization. This is challenging given the many different types of MPEG-2 files produced by equipment manufacturers, mixing them in one facility could be difficult. The Pinnacle Palladium platform will assist in the effort. This architecture can support the movement of many types of files between users.

Also, the new MXF file interchange format being developed by the Pro-MPEG Forum and due for standardization by SMPTE this summer offers a universal wrapper in which to transport all of MPEG-2 files. Pinnacle's MediaStream servers will be some of the first to store MXF files on their disks in their native format. Once equipment manufacturers adopt MXF, Turner Entertainment's servers stand ready to be used to facilitate transporting MXF files throughout the company. BE

Any type of failure on one of the air chains can be bypassed with a switch to the other with the simple push of a button.

Jack Gary is director of projects and integration engineering for Turner Entertainment Networks.

The Blue Mouse

It's no lightweight contender

BY FLAWN WILLIAMS

First, discard any associations you have for the word "mouse". The BLUE Mouse mike is no kin to the "mike mouse" windscreens. And it can't double as a mouse for your computer. Instead, it's a clever way to rig a large condenser mike diaphragm in a swivel yoke.

Swiveling the capsule allows the mike to be used as a side-address or end-address, or anywhere in between. This gives a lot of positioning flexibility. Tiny stubs prevent turning the capsule more than one rotation to protect the wiring from stress. And the front mesh has a higher gloss, so it's easy to know which side to speak into.

Although the capsule can pivot, the yoke is fixed to the cylindrical metal body. So, any rotation in other directions must be done by moving the mike body.

At the opposite end is an XLR output jack, plus a threaded hole for easy attachment to a boom arm or floor stand. This thread is great for quick setups, but for better isolation from structure-borne noise get the optional elastic shockmount. This cage needs to be strong to support the weight of the mike, which includes a hefty output transformer, so generic isolation mounts probably wouldn't be much help. The Mouse is also available in a transformerless model.

We installed the mike in Studio 4B, home of "Performance Today" and other NPR shows. Host Fred Child put the mike through its paces alongside that studio's "old faithful", a Neumann U87 with aftermarket optimizations for announcer voice by microphone guru Klaus Heyne.

The results were impressive. The BLUE Mouse provided a tailored response similar to the modified U87. The Mouse had somewhat more low bass, and the frequency range of its presence lift was a bit higher than the Heyne.

Its output needed 6dB more gain for equal loudness, but its self noise was still inaudible after raising the gain. And lower output would be an advantage for many broadcast consoles, where preamp clipping is a greater concern than noise when close-miking. But the most important factor was: Fred sounded clear, warm, and assured.

The mike's tailored response makes it useful for many instrumental miking needs as well as great-sounding announcers.

Having aced that test, the Mouse took to the road with NPR for a taping with the Shanghai String Quartet in Richmond VA. Here the mike would capture Fred's hosting voice in front of a large studio audience.

The Mouse has an optional pop screen. But this wasn't included with the review mike. After our initial checks in Richmond, I opted not to add a generic mesh screen, and instead miked Fred from a bit off to the side, out of the range of his plosive blasts.

The Blue Mouse provided a tailored response similar to the modified U87.

Twice Fred caught me by surprise, turning directly to the mike just as he let out a loud breathy laugh. But otherwise, the mike did fine with only its built-in pop protection. Good advice: get the stylish custom popscreen, or use a generic mesh pop stopper.

Typically we mike spoken voices at 6 to 8 inches, with the mike about thirty degrees off the axis of the mouth but with the mouth on the mike's axis. To see how the mike would fare in more typical "jock" use, I listened with the mike much closer.

The proximity effect of the mike behaved well when worked as close as three inches, with bass buildup becoming noticeable, but not overwhelming the tone of the voice. Worked closer than that, the mike sounded a bit tubby on male voice. For such close miking, some bass response tailoring may be needed to compensate for the proximity effect. No roll-off switch is provided on the mike, so use a mike processor or console EQ.

Overall, the BLUE Mouse is an excellent performer. It brings the sonic advantages of a large diaphragm cardioid condenser in a package that's much lower profile than many of its competitors. That's useful in studios where larger mikes block the announcers' line of sight. Its tailored response makes it useful for instrumental miking needs and great-sounding announcers. **BE**

Flawn Williams is the Technical Director for Music and Entertainment Programs at National Public Radion in Washington.

Return on IT, Integration, and Investment

A World Leader in Customer Support and Systems Integration
SGI has a sterling international reputation for the efficiency, responsiveness, expertise, and dedication of its Technology Solutions group. There are more than a thousand SGI service professionals and four major SGI support hubs around the world. As an open-system computer manufacturer, SGI can draw on dozens of hardware and software technology partners to assemble cost-effective broadcast solutions for its customers.

We apply years of experience in working with broadcast operations to transition your workflow into an effective dataflow. We do this by matching your needs to the most appropriate tools in the industry and then seamlessly integrating those tools into a digital infrastructure.

The Bottom Line: ROI for Broadcasters
SGI workflow-to-dataflow solutions deliver superb return on investment in broadcast production environments. These solutions leverage the best technology in the broadcast industry and the latest advances from the IT world. These solutions use open standards and open platforms to interface with broadcast and IT leaders such as Avid, Pinnacle, Sony, Discreet, VizRT, Hitachi, StorageTek, Oracle, and Brocade to create the most powerful site-specific solutions in the industry.

SGI solutions provide return on integration, bridging the digital islands in your operation. They reduce the reliance on proprietary black boxes and vendor-specific formats and protocols. They simplify and accelerate. They optimize broadcast workflow, increase collaboration, and improve results.

For a limited time, SGI is offering a free white paper titled Broadcast Media Management in a Data-Centric Workflow.

The television industry is changing again, this time leveraging IT advances and transitioning to a more cost-effective workflow based on open standards and media management software. This white paper describes how broadcasters in Europe and the United States have deployed this new data-centric workflow.

Visit *www.sgi.com/go/mediapapers* to register and download the Broadcast Media Management in a Data-Centric Workflow white paper.

To discuss your workflow and digital infrastructure needs, call SGI at (800) 800-7441, prompt 1.

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the latest IT advances in networking speed into the broadcast facility. Much of the secret to all of this is the most powerful, filesystem used in broadcast today: SGI® XFS™ and its shared version, CXFS.

SGI's expertise in integrating these servers with best-of-breed hardware and software into an open-system environment enables production staff to access and share large files over high-bandwidth networks. It is the secure sharing of video as data files across high-speed networks that enables the real transformation of the broadcast workflow.

The Cornerstone of InfiniteStructure

The SGI XFS filesystem is a robust, high-performance, 64-bit filesystem able to massively scale to 18 million terabytes. That's 2,400 years of 50Mb broadcast material. Although filesystems routinely impose limitations on broadcasters, the SGI filesystem provides an essentially limitless growth path. File transfer speed will not be an issue again either. Multiple Fibre Channel connections enable roughly the equivalent of 300 simultaneous 50Mb streams within facilities today. The XFS file-journaling technology guarantees high reliability and restarts in less than one second after an unexpected interruption, regardless of the number of files it manages.

CXFS adds to XFS the capability of sharing the filesystem and storage directly with other SGI IRIX systems and with other operating systems, including Windows NT®, Windows® 2000, and 64-bit and 32-bit Linux® (Mac® OS X available late 2003). True file sharing means unnecessary data motion and replication is eliminated, thus reducing network traffic, congestion, and storage needs.

Timeline (continued)

2001 to present: Danish Broadcasting Corporation (DR), Denmark's oldest and largest public-service radio and television network, is now using a completely integrated digital workflow system architected and implemented by SGI. It handles the complete content cycle from capture and ingest to playout to air. The solution will support 300 journalists in many departments and locations, serving two national networks and several stations.

DR now enjoys all-digital workflow for ingest, logging, indexing, browsing, editing, transmission automation, media management, and news system interface. Archived video storage, in Panasonic DVCPRO-DIF format, resides on SGI® TP9500 RAIDs and a StorageTek® tape library. It is accessed over Gigabit Ethernet.

From their desktops, users control ingest, search archives, perform low-resolution edits, and move soft clips to the Pinnacle Liquid blue or Liquid purple editors. SGI Media Server for broadcast systems provide parallel playout. Broadcast-resolution clips move between servers up to 30x real time. The production team can view and change the playlist right up to and during broadcast.

2002 to present: France Télévisions Publicité chose SGI to implement a centralcasting vision that fundamentally changes the methodology of television advertising placement, broadcast, and tracking.

2003: At Georgia Public Broadcasting, both broadcast and IT data reside within the SGI InfiniteStructure environment. Automation commands ingest and playout via multiple SGI MSB 380 systems. The Virage VideoLogger® and Avid Technology Media Composer® are additional sources for content. MassTech's MassProxy™ transcodes MPEG-2 into MPEG-4 proxies used for stream ng-and LAN-based edits. Once MPEG-2 files are no longer needed online, they are transferred to an ADIC® Tape Library for Archive.

InfiniteStructure:
The SGI Digital Infrastructure

It Starts with the Architecture

SGI is implementing third-generation digital broadcast solutions. They create a true bridge between the broadcast environment and the swiftly advancing world of IT technology. SGI helps you convert workflow into simplified dataflow in an integrated, vendor-neutral architecture.

Industry-leading SGI video processing and secure storage technologies move and store content efficiently throughout the broadcast workflow. Using Fibre Channel and Ethernet topologies, digital file transfers move media across the facility at many times faster than real-time rates. Theis reduces time to air and improves presentation by enabling news, sports, weather, feature programming, advertising, and post-production personnel to more efficiently share content for collaboration and more rapidly access archived material. This allows for automating the total process from ingest through edit to playout, reducing the total cost of ownership of broadcast production systems and improving reliability and on-air quality.

Distribute Data, View Video

SGI's third-generation broadcast server technology, the SGI Media Server for broadcast system is based on the modular SGI® Origin® 300 platform. SGI Media Server for broadcast has up to eight standard-definition video channels, with up to eight audio channels per video channel. It supports MPEG-2 long GOP and "I" frame profiles from 3Mb to 50Mb per second. It provides flexibility in the choice of picture quality and editing formats. DVCPRO™ 25, DVCPRO™ 50, DIO/IMX, and MXF formats can be supported in the same system.

But more importantly, SGI Media Server is also a gateway to an open-system IT world in which video flows easily in the form of data files. Optional networking connections include Gigabit Ethernet and ATM, enabling faster than real-time file transfers of media files locally or over wide area data networks. Within the storage area network, video files can move even faster with 2Gb-per-second Fibre Channel connectivity. Instead of a proprietary system that simply holds and serves video clips, SGI Media Server for broadcast systems integrate

It is the secure sharing of video as data files across high-speed networks that enables the real transformation of the broadcast workflow.

Timeline (continued)

1998: Tektronix develops digital infrastructure for Profile™ video server installations around SGI® Origin® servers.

1999: Panasonic® develops Digital News Automation system using SGI Media Server for broadcast systems fully integrated with Newsbyte™ editors.

2000 to present: Sveriges Television (SVT), the Swedish public broadcasting company, has installed 35 SGI Media Server for broadcast systems. Its all-digital news production facility is designed entirely around an SGI® Origin® 3400 central content file server as the hub for all servers on the network. SGI Media Server systems provide ingest, low-resolution browse, asset management, and playout-to-air functions.

SGI Media Server for Broadcast

Edit

Working with video as data in the SGI architecture accelerates workflow dramatically for producers, journalists, and editors.

For advanced editing, voice-overs, and effects, editors can choose popular editing platforms such as Pinnacle Systems, Avid Technology, or Panasonic. The SGI® CXFS™ shared filesystem can easily accommodate 20 Pinnacle editing systems directly across the 2Gb-per-second Fibre Channel fabric. Hundreds of additional edit systems can be interfaced with Gigabit Ethernet into a seamless broadcast dataflow. Journalists can choose desktop browsing from ANN, ENPS, I-News, Octopus, AutoCue, and others.

Editors and journalists can shave precious time off the editing process by working simultaneously on the same content. Semi-complete news stories no longer need to be carried or copied to the edit suite for completion, because the edit suite has simultaneous high-speed access to the broadcast-quality versions of the files.

Playout

Content ready for air, with its graphics and metadata, is transferred from the shared storage to the SGI Media Server system for playout to air. The SGI solution can combine SGI graphics hardware capability with third-party software to create a simplified, fully automated graphics and video playout system. When bandwidth demand strains network capacity, SGI Media Server for broadcast preserves and protects playout channel integrity while still allowing breathtaking bandwidth for concurrent file transfers.

Distribution

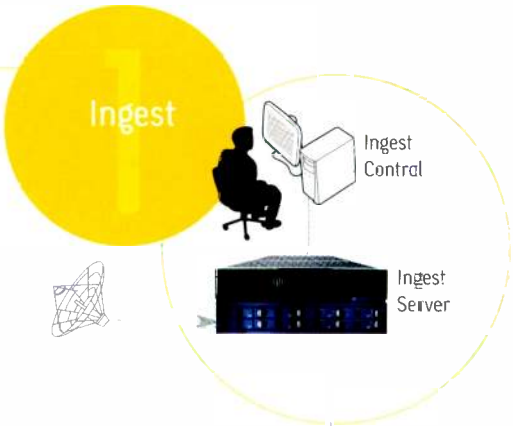
Content as data can be more reliably distributed across inexpensive leased lines or faster than real-time fiber networks using push or pull technologies and standard FTP or Internet protocols. Transferring video as files also eliminates encode/decode and audio/video sync problems. Facilities across the country begin to work as a single seamless environment.

The SGI Broadcast System:
Turning Workflow into Effective Dataflow

Ingest

Incoming SDI video from live feeds or tape playback is ingested into an SGI Media Server™ for broadcast system. This is similar to the process provided by proprietary systems; but from this point forward, the advantages of the third-generation architecture become obvious. Video content that is already in a digital format can be simultaneously ingested at speeds up to 30x real time via FTP and sent directly into a storage server for access by journalists and editors across the SGI shared storage. Simultaneous multichannel SDI and SDTI ingest is automated; material can be viewed on the desktop even while ingest is still in progress. Operators are automatically alerted to incoming, background FTP feeds.

Each segment of ingested video is converted to three data files: a broadcast-quality file (25Mb to 50Mb MPEG-2 or DVCPRO™), a low-resolution MPEG-1 or MPEG-4 browse version, and a metadata file, which enables clients to find material easily and identify specific segments frame accurately within a clip.



2 gigabit (Gb) per second transfer rate

Archive

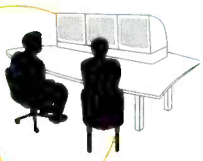
Metadata is inserted at ingest, and industry-leading media management applications from Masstech, Blue Order, and Ardendo enable journalists to find archived clips quickly for review and editing.

Hierarchical storage management software applications from SGI, IBM, and ADIC manage the storage of content assets across disk and tape libraries, maintaining a constant user interface by managing content location via a metadata file server.

SGI® Data Migration Facility (DMF) software automatically moves files between online, near-line, and offline for efficient use of storage and optimal access for clients. It interfaces smoothly with libraries from StorageTek, Sony, IBM, and ADIC, as well as SGI storage.

InfiniteStructure™:

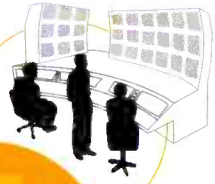
The SGI® InfiniteStructure™ solution provides simultaneous high-speed access to remote data across all media devices in the broadcast facility and across the multiple operating systems used in broadcast. The SGI broadcast system incorporates a hybrid data access approach, balancing shared storage area network (SAN), network-attached storage (NAS), and direct-attached storage so that all devices in the facility have the access speed they need and your storage budget is optimized. This flexible use of IT connectivity allows for seamless upgrades as the broadcast facility needs change.



2 Edit

In urgent situations, with journalists and editors working with a single tape, recording voice-overs and editing story segments is often a hurry-up and wait scenario. When video clips reach a tape-based facility, each story or program must be edited in turn.

Nonlinear editing greatly speeds the process but also moves the bottleneck to the ingest stage. It often takes longer to get footage into individual edit rooms than it does to edit the piece.



3 Playout

Automation systems are unduly cumbersome and expensive because of their need to interface with and control all the separate digital islands in today's broadcast environment. Play to air already involves server technology at most broadcast organizations, but getting the content to the playout server remains unduly complex because of the proprietary file formats and systems involved. It requires the coordination of multiple servers for commercials, news, sports, graphics, and programming.

4 Distribute

Transmission used to seem quick, moving video in real time. But in today's fast-paced world, real time is feeling slower every day. In a multistation environment, content is shared in one of two ways. Both of these methods—dubbing tapes and microwave/satellite transmission—usually require the intervention of personnel at both ends and across several time zones; manual intervention can become expensive. Dubbing and shipping tapes between stations is also time-consuming and slow while microwave/satellite transmission systems are costly to purchase and maintain.

SGI Broadcast Project Timeline

1995: Avid Technology develops the first digital broadcast workgroup edit system using the SGI® Challenge® server. The system, which allowed up to eight Newscutters, MediaRecorders, and AirPlays to share content from the SGI server in real time, was installed at CNN and across Europe.

1996: CNN, using open-standards, works with SGI to design and install the first large-scale browse system at CNN headquarters in Atlanta, Georgia. The 24x7 system ingests up to 40 satellite or VT feeds, integrates to the news automation system, attaches metadata to the video files, and streams them to 300 client workstations throughout the news center. Journalists can select clips with frame accuracy and send the timecode selects to the edit rooms for final edit.

1997 to present: SGI has installed thousands of media servers at U.S. cable head-ends, including over 1,200 localization servers for the Weather Channel and another thousand caching servers for Internet media streaming. Additionally, there are now 1,300 sites throughout the world where Kasenna MediaBase software on SGI media servers is streaming MPEG video. SGI servers and video streaming technology are also the VOD servers for the two largest telco television services to go live this century: SoftBank/Yahoo! BB Cable in Japan and Chunghwa Telecom in Taiwan.

Today's Workflow Bottlenecks

Usually with a journalist or editor waiting impatiently, content flows into newsrooms and sports departments as satellite, microwave, VTR, or live studio feeds. Tape operators must identify, select, and switch feeds to a loaded tape deck or ingest server. The video clip must be hand-carried to the tape library for labeling and bar coding before it is dubbed and delivered.

If you don't know what's available or can't find what you want when you need it, content is valueless. Video clips may be archived digitally on a server, with metadata added by a tape operator. The challenge of proprietary archive systems is attaching enough metadata to make the content easily retrievable.

sgi®

SGI® Broadcast System Solutions

A Simpler Broadcast Environment

Implementing a variety of proprietary technologies has made the broadcast production world a very complex place. New standards will help, but they will take time. And without the right partner, transitioning can add yet another layer of complexity. The challenge now is to simplify.

Maureen Craig, programmer, (right) for The Hallmark Channel teaches Sara Hardesty, scheduler, about the Perspective integrated broadcast management system.

it provides critical information such as music rights and sponsorship packages, and also links directly to program acquisition. The commercial library adds further features, including links for our clients and their products for enhanced CRM, a purge list, and a banner insertion function for ads streamed on the Web.

As well as interfacing with all third-party products, which was invaluable not least for secure data conversion from our legacy systems, the integrated broadcast management system also features ActiveX, which allowed us to customize our graphical user interface to a Windows-based configuration with familiar drop-down menus, minimizing the need for technical training and offering further economy.

MSA Focus has worked closely with us throughout the installation and implementation of Perspective and has been instrumental in achieving our goals.

Now, using one system instead of five, our efficiency and uniformity of operations has increased and our ad sales generation has increased at many of our facilities. We now perform more tasks with fewer resources than before and are reaping the benefits of our investment. BE

Mark Thompson is senior vice president, finance and IT, of The Hallmark Channel.

The Hallmark Channel centralizes management with MSA Focus

BY MARK THOMPSON

The broadcast industry is the same as any other in terms of its needs to purchase material, turn out products and services, and sell efficiently to customers. It requires additional flexibility from the hardware and software companies that serve it because of its global nature and the rapid changes and expansion it undergoes.

Using one system instead of five, our efficiency and uniformity of operations has increased.

The Hallmark Channel, for example, began as a small, entrepreneurial service and has grown to serve more than 100 million customers – 50 million in the United States and 50 million in 120 countries – with 26 channels.

As recently as two years ago, the channel relied on separate, internally developed systems for critical functions such as scheduling, programming, media management, pricing and ad sales. Suddenly, with six offices in the United States – and more around the world, including in the UK, Australia, China, Singapore and Taiwan – having separate systems meant that data from the international offices had to be entered three times into the different machines, none of which could talk to the others.

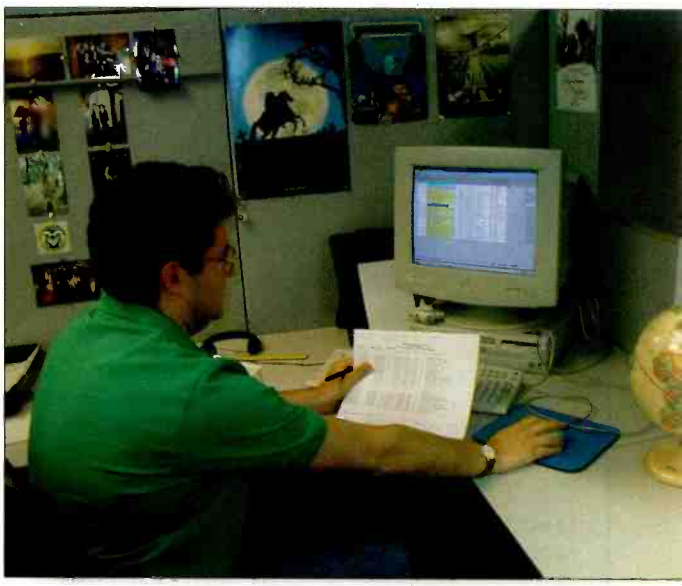
Mistakes were not uncommon, and it was clear that the channel required an integrated, updated solution that fit its processes. A solution was needed that would encompass content preparation and management, scheduling, and ad sales, and that would function within our new territories. This included areas such as South East Asia, where extra linguistic characters were required in addition to currency conversions for more sophisticated ad sales. While the requirements stipulated a product that matched our needs precisely, we also had a preference for a robust product that would work almost out of the box.

Among several options available at the time was the Perspective (v5.2) integrated broadcast management system from UK-based MSA Focus. Understanding workflow and strategic planning are central to the system's architecture, and MSA Focus collaborated closely with us to ensure accurate input into the system model.

Fundamental components that feed overall asset management are program, promotional, commercial and media libraries, all of which are located at the Denver HQ and can be accessed remotely via a broadband VPN from any of the channel's global offices. A crucial component of the system is an audience ratings monitor that reports into both the program library and ad sales module to determine the consequent program and commercial schedules accordingly and automatically process ad sales invoices.

The program management system requires constant updates, and Perspective provides this with support for PPV/NVOD. It also displays full TX history and amortization updates, as well as conducting comprehensive content searches and including metadata such as rights management on programs.

Similarly, while the promotional library uses separate scheduling rules,



Mike Rosen, a scheduler for the Hallmark Channel, uses the new Perspective integrated broadcast management system, which has content preparation and management, scheduling, and ad sales all in one system.

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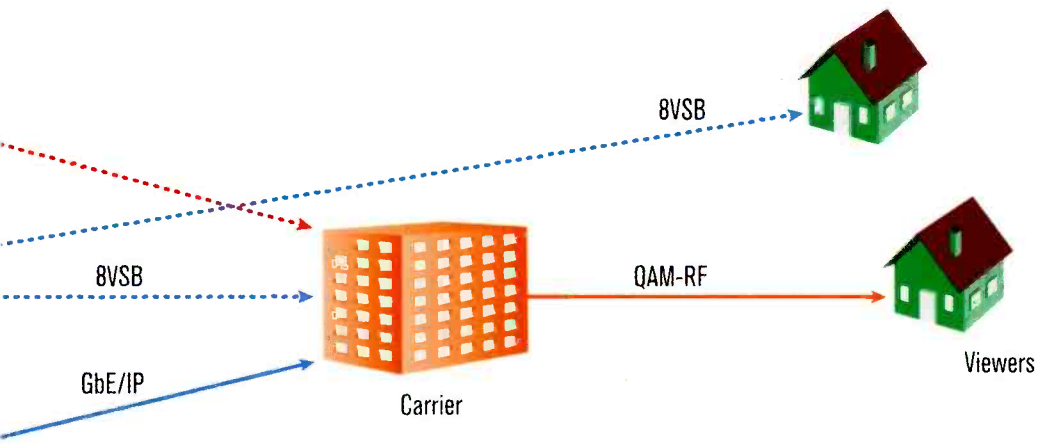

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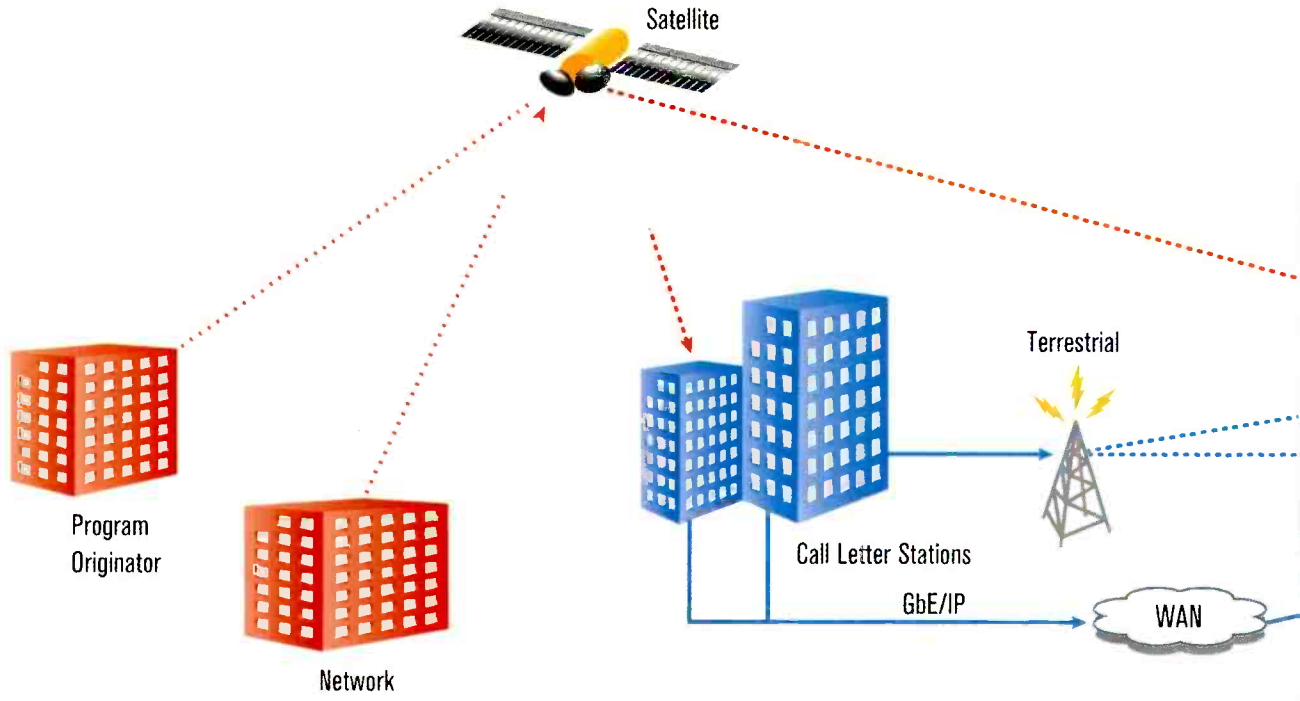

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Introducing
the Personal Navigation System

BY GIL DUDKIEWICZ

Ask viewers how many channels they get and you might hear: "Way more than I watch." The frustration not only stems from channel overload, but from the more than 300 channels per household and the difficulty in finding appealing shows.

The mystery of "what's on TV" is not lost on programmers or cable operators who know the dilemma viewers face when they grab the remote. Fighting an average annual churn rate of 40 percent in digital cable by adding more channels would be counterproductive and more confusing.

The problem isn't about choices; it's about selection — or rather, how to make one. Existing Electronic Programming Guides (EPGs) with their traditional time-channel grids are poor navigation tools. Designed to handle far fewer channels, EPGs resemble a spreadsheet. With a maximum of 10 to 15 channels per page, consumers scroll through 20 to 30 pages to see what's on, sometimes sifting through inaccurate content due to last-minute programming changes.

On the horizon is a new paradigm for locating the right content quicker and with precision unimaginable with a traditional EPG grid. The Personal Navigation System – or PNS – is a "smart" programming guide. Its user-defined "search and alert" function fetches metadata and delivers it to the viewer on the fly, even if he or she is watching a different channel. With PNS, viewing habits can be sorted by preferences rather than by channel number. Personalized programming lets viewers allow PNS to surf for them and deliver selections that are relevant and meaningful.

The ramifications are significant. Not only will viewers be able to watch what they want, but cable and satellite operators and programmers will have a targeted vehicle for promotions, including VOD, PPV and premium channels, and thus new potential revenue streams. It's a win-win-win situation.

With PNS, a consumer navigation tool, or "agent," enables consumers to enter their content preferences via over 1,000 categories, or by entering keywords in a simple one-minute process. (Consumers can update it on an ongoing basis.)

The agent lets viewers watch TV dynamically. A pop-up notification is offered for advanced notice, even if they are watching a different channel. Or, viewers can refer to a program list built entirely on their own preferences on as granular a basis as imaginable. Viewers won't miss out on content of interest, without surfing through hundreds of channels.

PNS takes only seconds and solves the problem of a lack of or changes in information.

PNS also solves the problem of last-minute programming changes. With the old EPG system, if you find something interesting, you face the prospect that the information is a day or a week old since these guides are usually only updated once a day. The PNS real-time connection to the content provider enables sending schedule changes on the fly to the set-top box (STB). Yet, another problem with existing guides is the lack of metadata about the content. Sift through the guide, and much of the data you'll find is generic, such as "news" or "sports".

PNS, however, goes end-to-end, taking metadata directly from the source at the content providers' facilities, analyzing it and sending it in real-time through the head-end to the consumer's STB. This takes seconds and solves the problem of a lack of or changes in information.

A 6-month trial at a large cable operator proved that once consumers invested the time to personalize their cable systems, the likelihood of churn reduced significantly. This successful trial was acknowledged in July when The Fox Cable Networks, Mulitchannel News & CTAM Summit Retention Case Study Competition honored the provider with an award. The PNS trial reduced churn rate by 35 percent.

For programmers, trials showed that PNS can:

increase ratings — by driving targeted viewers to programming from all channels: 84 percent of viewers switch to channels or programs that an alert directed them to.

improve retention — by having pop-ups promote brand image and loyalty: 51 percent of viewers use alerts so they don't miss programs of interest.

offer sampling — or promotions that expose viewers to new programming: 52 percent of viewers were sent to programs they otherwise would not have known.

For advertisers, PNS provides an infrastructure that supports true personalization of advertising. And viewers can use their time to "watch" TV, making content king once again. It beats getting trapped in a 1980's-style EPG time-channel. BE

Gil Dudkiewicz is founder of MyDTV, a California-based software company.

you can't make any significant design changes. There are no specific rules for planning a storage subsystem, but here are some general guidelines:

• Measure the amount and significance of current data. It should not be difficult to convert current VTR tape needs to data needs. Look for ways to consolidate and simplify. Look for pockets of data that are not part of you current operations. Can they be integrated? Work closely with other departments to clarify and quantify the scope of the project.

• Plan for growth, carefully. Once you have carefully calculated your data needs, you must predict as accurately as possible your future growth for the next few years. Make sure that you are aware of any special project or consolidations that your organization may be planning in the next few years, like massive archiving and digitizing projects. But don't purchase too much storage capacity in advance if you don't need it. You will probably be able to purchase higher capacity storage at less cost in the future.

• Allocate excess capacity. How much excess capacity should your organization provide the first year of a news storage system? To keep the system running smoothly, you should plan on 15 percent to 25 percent more capacity. Depending on your growth rates, you may want to purchase additional capacity for any anticipated growth for the second and possibly third year. The system may grow beyond its initial configuration, so make sure that the components needed for expansion are likely to be available in the future.

• Assess return on investment. New, smaller and cheaper storage technologies constantly arise and offer greater benefits than the system that you purchase today. Keep realistic expectations on how long your storage system will last before it needs to be replaced. A five-year life span is typical for these systems before technology changes (new tape drives, robotics, storage, etc).

When choosing an RSL solution, proper design and configuration can play a huge role in its performance and, more importantly, its cost-effectiveness. Poorly sized and designed systems result in wasted resources and money. You, the customer, along with consultants and integrators, must work together to define the number of clients, required throughput, system architecture, disk types and sizes, drive types and so on.

Once the parties involved have specified and agreed to a system, the next step is to run an analytical model of the system components and try to collect as much "real performance" data as possible. To accurately evaluate and predict the system's performance, you need to estimate workflow and workload, which are a function of the particular application at hand. Such information is user-specific, and includes details such as a request for archive and restore, deletes, defragmentation, distributions of data-access interaction among different applications, and many more.

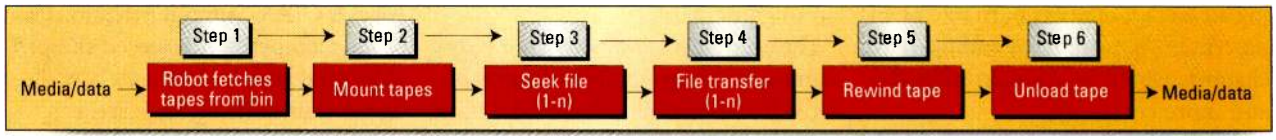


Figure 3. An example of the typical workflow of an RSL.

Risk analysis

When selecting an RTL or storage subsystem, carefully measure the risk of failure for each alternative. Start with a mental model of the system that initially seems to match the current or future workflow, and then work though design changes that both increase and decrease reliability. Weigh the cost implications of the design alternatives against their relative risk factors and the impact of downtime to the organization. And finally, keep in mind the following goals:

• Preventing data loss
• Scalability
• Fast data access to data without interruptions
• Preparation for equipment failures
• Use of cost-effective technologies

The success or failure of the system will be determined by how the media is managed throughout the system. It is important to assess how the possible failure of one component or subcomponent can affect your day-to-day operations. Be sure to consider the following factors:

Productivity losses — Many, if not most, of the different departments in your organization will not be able to carry out their normal activities. In a busy news environment, having constant access to archive material is the key to success.

Asset-recovery cost — When data is lost, recovering data requires an effort by the technical staff. Re-archiving irrecoverable data can be a massive undertaking.

Loss of revenue — If your organization depends on a storage environment to support daily programming, both long-form and short-form, you may not be able to generate revenue during the period of failure.

It is relatively easy and cost-effective to design a storage system that works 99 percent to 99.9 percent of the time. Eliminating the last few points of downtime possibilities can double or triple the cost of your storage system. The investment your organization makes toward enhancing reliability operates much like an insurance policy. The financial value of the organization's operation guides the expense you can justify for reducing the likelihood of downtime and reducing the recovery time from failures. BE

Pablo Esteve is a systems engineer and project manager for Thomson Grass Valley. Contact him at: pablo.esteve.thomson.net

Given the (potential) order of magnitude differences in performance and cost of complex storage systems for real-time broadcast applications, it is worthwhile and often necessary to invest a great deal of effort in their design and configuration. There are at least three reasons why it is essential to hire an engineering/consulting firm to design such systems:

- Designing and understanding the system requirements
- System sizing and configuration
- Predicting and evaluating the performance of the resulting storage system

Designing and integrating an RSL into a complex storage subsystem involves a multitude of issues and tradeoffs. These include configuration-related issues such as the number of levels in the storage subsystem, what devices should communicate with the RSL, device configuration, distribution (I/O channels and/or communications networks), data allocation, etc.

General considerations

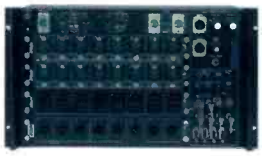
The point at which RSL storage becomes necessary is an economic tradeoff. Currently it seems that RSL is needed to manage more than a few hundred terabytes of data. Software from companies such as AVALON, SGL and others, provide the illusion that the RSL is an extension of the file system. Since RSL data volumes and access latencies fall between those provided by on-line and off-line storage, RSL is often referred to as near-line storage.

When considering large storage systems, look at the following issues:

- Capacity — The system must be able to handle current storage needs and the needs of expected future growth (usually a three to five year look ahead). It is almost impossible to plan a good storage strategy without having detailed knowledge of the quantities of data involved now and in the foreseeable future.
- Scalability — The system must be designed from the beginning to scale to larger data capacities without major upheavals. Outgrowing the system can cause very costly disruptions.
- Cost — Select the least-costly approach that effectively meets your initial objectives. You must consider many cost issues, including the initial purchase cost of the hardware, the productivity cost related to down time, and ongoing hardware and software maintenance. The more complex a system is, the more attention it will require from administrators and operators, which can translate into hiring more staff.
- Performance — The system must be able to deliver data as per specifications and design. Designing a system with high bandwidth requirements at high data rates that can still deliver high throughput can be a challenge.
- Reliability — All systems rely on components that will eventually break down. It is possible to design a system with enough redundancy to ensure that, even if individual components fail or malfunction, no interruptions will occur. Such high availability comes with a price both in terms of the cost of the equipment and in the complexity of the operation. In most cases, it is relatively simple to build a system that it is available 99.9 percent of the time. Adding additional reliability is complex and expensive.
- Manageability — Once the system has been designed and implemented, it must be maintained. If your staff is not very familiar with large storage systems that required complex networks and configurations, aim for a system with the simplest operational concerns. As systems increase in complexity, it becomes increasingly important to be able to monitor their performance, preempt failures and manage media with as little effort and interaction as possible. In some cases, this may require additional staff and/or expertise.

Design and proof of concept

The development of a storage strategy involves planning for the quantity of storage and the level of performance required. The "build it and measure it" approach to system design is inappropriate because, after the system is implemented and its performance measured,



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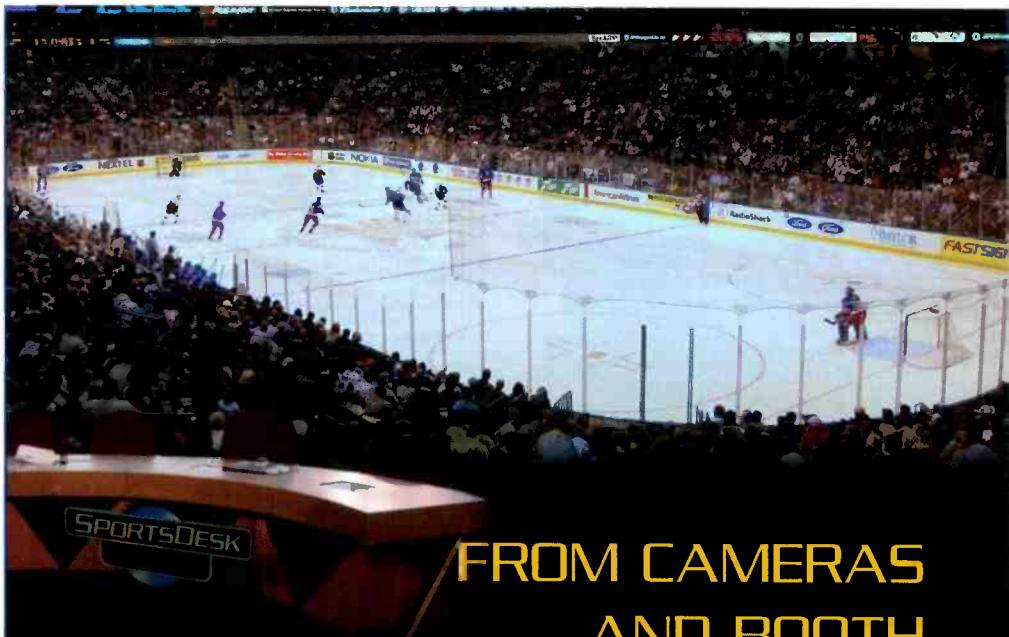

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this limitation can lead to fragmentation of the data written to the tapes. The second limitation is the delay, or latency, in data access.

Latency, also called performance overhead, is the most serious limitation of RSLs. There are three RSL procedures that cause latency. First, there is the latency of loading tapes into the drives (mounting) and preparing them for access (tensioning). This delay can be considerably long if there is no tape drive available at the time of the request (due to a queuing delay). Future technological advances will probably reduce this latency. But, since it is a mechanical preparation procedure, it will always be enormous relative to computer speeds and magnetic-disk access times.

The other two RSL procedures that cause latency result from the intrinsic linear-access nature of tapes. One is fast-forwarding and rewinding. It takes time to search through the tape and locate the beginning of the file containing the required data. A fair estimate of the latency imposed by this process is the time required to seek half way through a tape from the beginning. The third latency-causing RSL process is the search inside the file for the required data. The time it takes for this procedure is determined by the read rate of the tape drive and the file offset. With careful organization of data on the tapes, this latency can be minimal.

In tape-based RSLs, the tape technology employed is either linear or helical scan recording. Linear tapes have their tracks parallel to the tape's axis, and can be read in batches as the tape moves forward or backward (e.g., serpentine drives). Helical scan tapes have their tracks at an angle with the tape's axis, and can be read by a drum that rotates in one direction only. This can result in slower search times. Also, tape cartridges differ in storage capacity, with typical values ranging from a few GB up to few hundred GB. High-capacity tapes are often longer and can add to search time.

The latencies caused by these three procedures will probably improve in the future, but they are likely to remain the primary issue broadcasters must address when integrating RSLs into their facilities. There are a few strategies that broadcasters can employ to address latency problems. The first and easiest is to use caching to reduce the frequency of access to the RSL. The simple way to add caching to the RSL is to use magnetic disks attached to the same host as the RSL or very nearby in the HSM chain. Other strategies for reducing the effect of latency involve adding high-level structure or organization to the data, affording structured access.

Designing and integrating an RSL into a complex storage subsystem involves a multitude of issues and tradeoffs.

Economic considerations

There is a common misconception that storage systems are cheap. What is getting relatively cheap is the storage space; there is still a great deal of cost in achieving reasonable performance characteristics (such as reducing latencies and increasing throughput) and developing (and maintaining) custom, high-performance systems.

When considering a storage system, be sure to consider the cost of the following items:

- Capital for hardware — disk drives, controllers, servers, networking equipment, tape drives, cables, etc.
- Media cost — tape cartridges, magnetic and optical
- Software — utilities, backup, media management
- Installation cost — vendor installation cost, internal personnel cost, consultants, etc.
- Ongoing cost — hardware maintenance, software maintenance and upgrades, technical support, etc.

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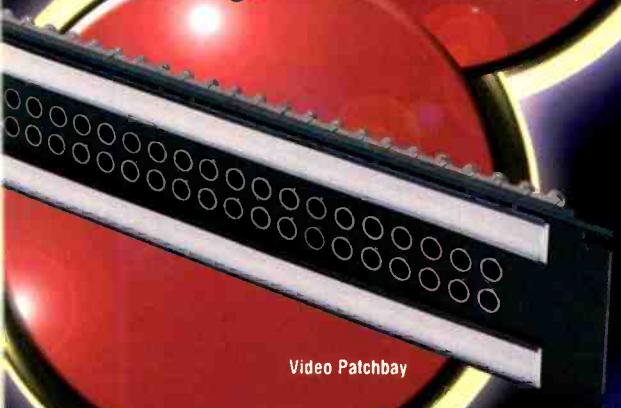

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jobs into the request queue. Each job corresponds to a request to load files from a particular tape. When a job reaches the head of the queue and a drive is free (typically there are multiple drives), a robot arm fetches the requested tape from a storage rack, transfers it to a local drive and mounts it on the drive. The drive then positions the tape at the beginning of the requested file. For each file, the drive must seek to the start of the file and then read the file. The system transfers the file being read to the online storage subsystem, which is sometimes referred to as the disk cache since it behaves like a cache or extension of the RTL. Once the system has transferred all the blocks that make up the file, the drive rewinds the tape and the robot removes it and places it back on the storage rack.

Like any other storage subsystem, the file-system management application purges some data whenever the storage occupancy exceeds a user-defined high-water mark. This process uses certain selection criteria, which are based on user-defined criteria, residence time on the system, file size, etc. The purging process ensures that both the online storage and the RSL storage always have a certain amount of free space to process incoming requests.

Technical difficulties

Broadcasters need lots of bandwidth and storage, and their RSL performance and reliability requirements differ profoundly from that in the IT world. One challenging task in designing end-to-end broadcast storage subsystems is satisfying the real-time requirement of continuously moving a file object from the storage subsystem to the play-to-air server.

When an RSL is integrated into a larger data-storage system, requests coming from different parts of the system can compete for these three resources, which can cause queuing delays. A queuing delay for media occurs when a request for the media cannot be served (even though there may be available drives and robots) because the desired media is already serving another request. A robot queuing delay occurs when there is a queue request that requires a robot arm that is not available. Finally, queuing delays for drives occur when there are no available drives to be used by waiting requests.

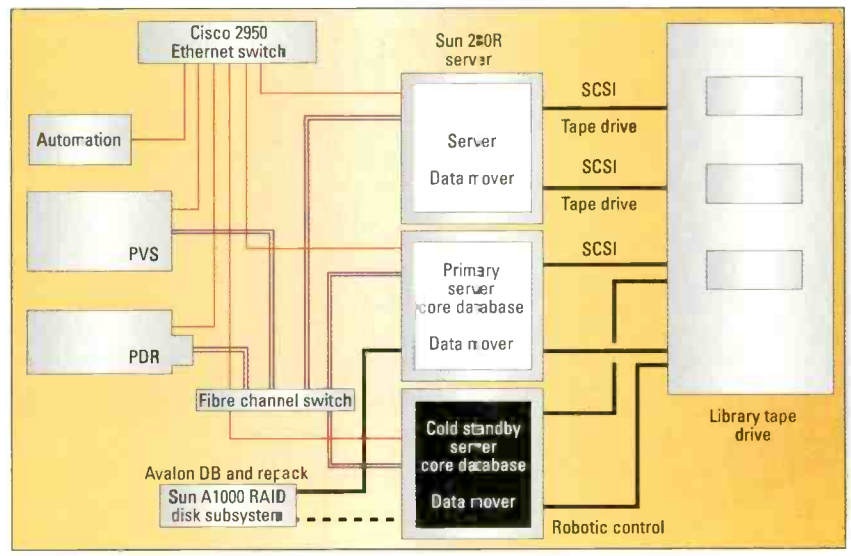

Figure 2. The elements that make up the Profile Network Archive system offered by Thomson Grass Valley.

When integrating tape-based RSLs into a broadcast environment, you must also address the two inherent limitations of tape storage. The first is the limited reliability and convenience of writing to tapes rather than magnetic disks. Unless carefully managed,

tomer-defined business rules. Usually, this tier employs a tape or DVD RSL.

In contrast to this three-tiered IT HSM, broadcasters usually implement HSM as a two-tiered system consisting of a high-throughput, online RAID storage system on the video server(s) and an off-line tape-storage system used mostly as a temporary, low-cost storage system with some deep archive for news and long-form material.

An RSL forms the lowest level of many large-scale data storage and backup systems. Figure 1 shows an overall view of a broadcast data-storage system, and the RSL's place within it. Figure 2 on page 76 shows a block diagram of such a system offered by Thomson Grass Valley.

In any distributed- or shared-server environment, the distribution of data among the storage devices can significantly affect the system's overall performance. It's important to manage the data properly so that it is stored in the appropriate tier.

Inside an RSL

An RSL consists of three key resources: drives, robot arms, and media (tapes or optical disks). The robot arms perform three fundamental tasks: load, unload and move the media to and from the shelves inside the library. The drives perform five operations: load, eject, search, read (playback) and write (record).

To accurately evaluate and predict an RSLs performance, you must understand its workflow and workload. Figure 3 on page 81 shows the typical workflow of an RSL. Archiving or retrieving a file to or from an RTL requires a number of processing steps. A request from an external managing application puts a job or batch

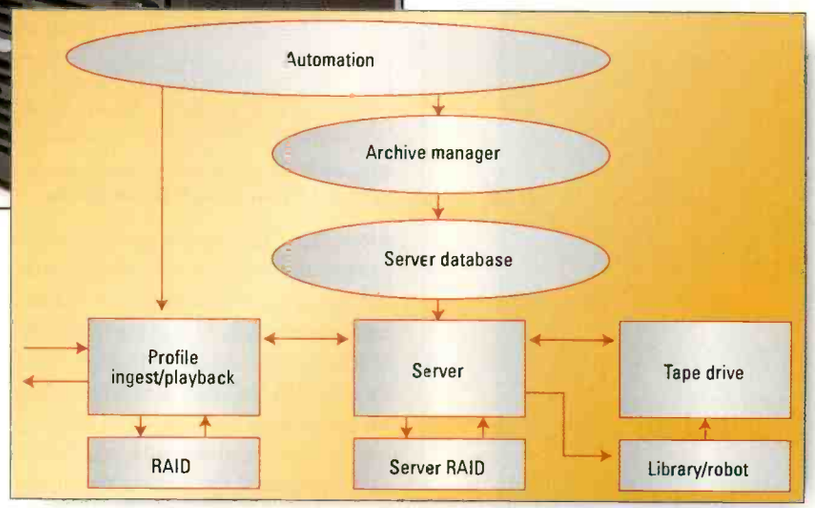

Figure 1. An overall view of a broadcast data-storage system and the RSL's place within it.

Robotic storage libraries

Saving content — and money — on tape

BY PABLO ESTEVE

Television technology is becoming more sophisticated and complex, and broadcasters' resources are becoming more limited. As broadcasters deploy highly sophisticated media-storage systems, they need to fully understand, evaluate, optimize and manage the content they create and deliver.

With storage devices, there is always a trade-off between access speed and the costs of the device and the physical media. Magnetic storage devices have rapidly decreased in price and increased in storage capacity, but they still cannot compete economically with tape-based systems. The capital cost for tape storage is less than 3 cents/MB, while that for high-end, magnetic-disk arrays cost about 30 cents/MB or higher. And that's just the capital cost; it doesn't include cost for the occasional maintenance of disk-storage components. (Maintenance on RAID controllers, for example, is reported to be about $7/MB.) And magnetic disks alone cannot satisfy the storage and delivery needs of broadcast applications.

The capital cost for tape storage is less than 3 cents/MB, while that for high-end, magnetic-disk arrays cost about 30 cents/MB or higher.

Information-technology (IT) companies developed robotic storage libraries (RSLs) to minimize storage costs and help archive non-essential data files. Now, tape-based RSLs are rapidly gaining popularity with broadcasters because they can reduce the costs of administering and storing the numerous, large files that broadcasters generate when compressing high-resolution video and audio. If you want to take advantage of the low cost of tapes while providing reasonable performance in data-intensive, real-time applications, tape-based RSLs are the best choice.

HSM

In the IT world, data files migrate along a hierarchy of storage subsystems called hierarchical storage management (HSM). HSM provides an intelligent way to move files among storage devices. It ranks the devices in terms of cost per megabyte of storage, speed of storage and retrieval, and overall capacity limits. The HSM rules are tied to the frequency of data access and the archival process. HSM classifies data according to a three-tiered data hierarchy:

CNBC uses the Grass Valley Profile Network Archive (PNA) system as part of its infrastructure. The PNA supports multiple Profile systems per archive with a RAID-protected archive database.

Tier One — consists of data that must always be readily accessible and reside on the primary server storage system or attached storage.

Tier Two — consists of data that needs to be accessed occasionally and/or as backup for tier one and reside in a less-expensive data array.

Tier Three — consists of archive data that is accessed infrequently and/or needs to be kept according to cus-

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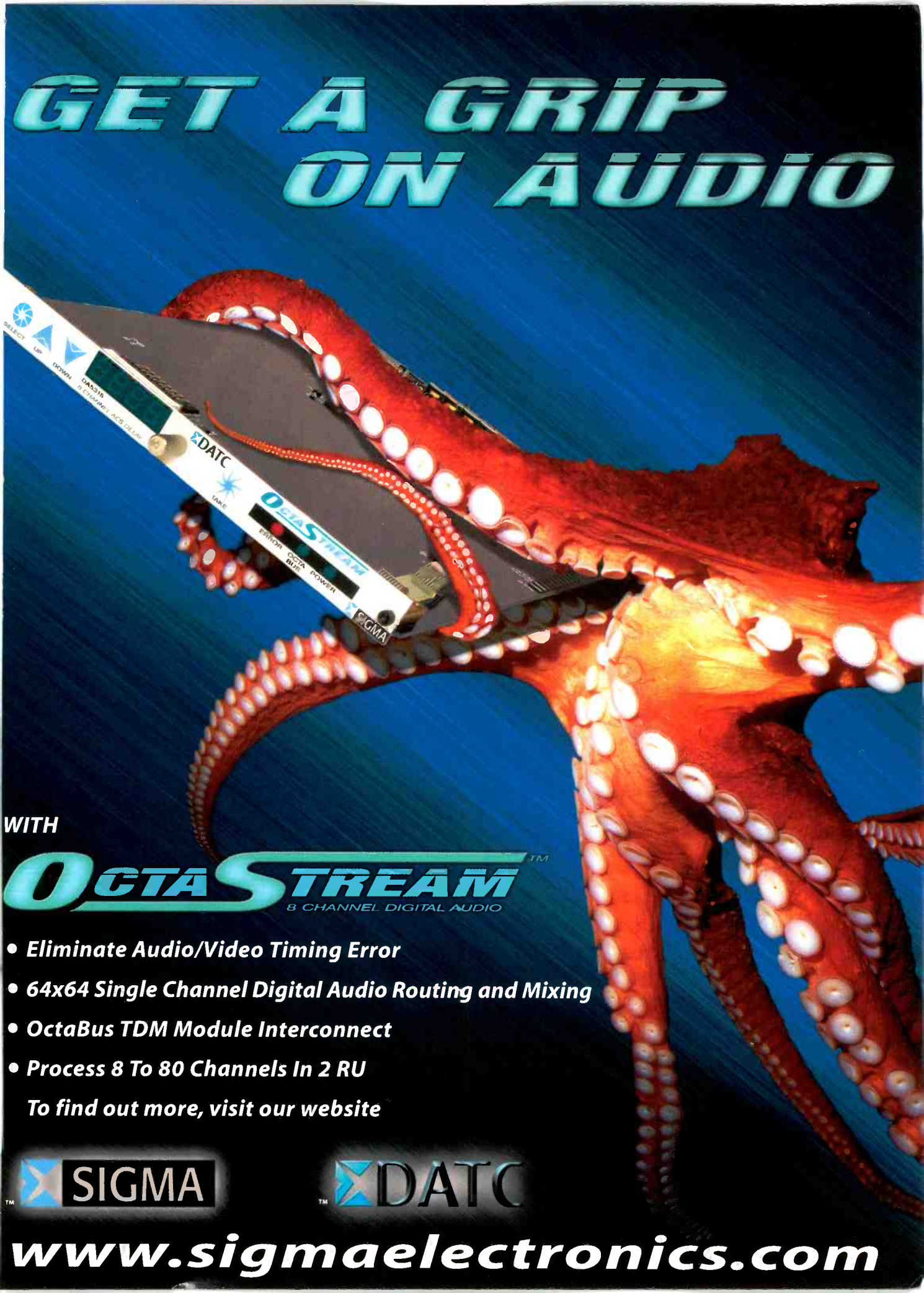

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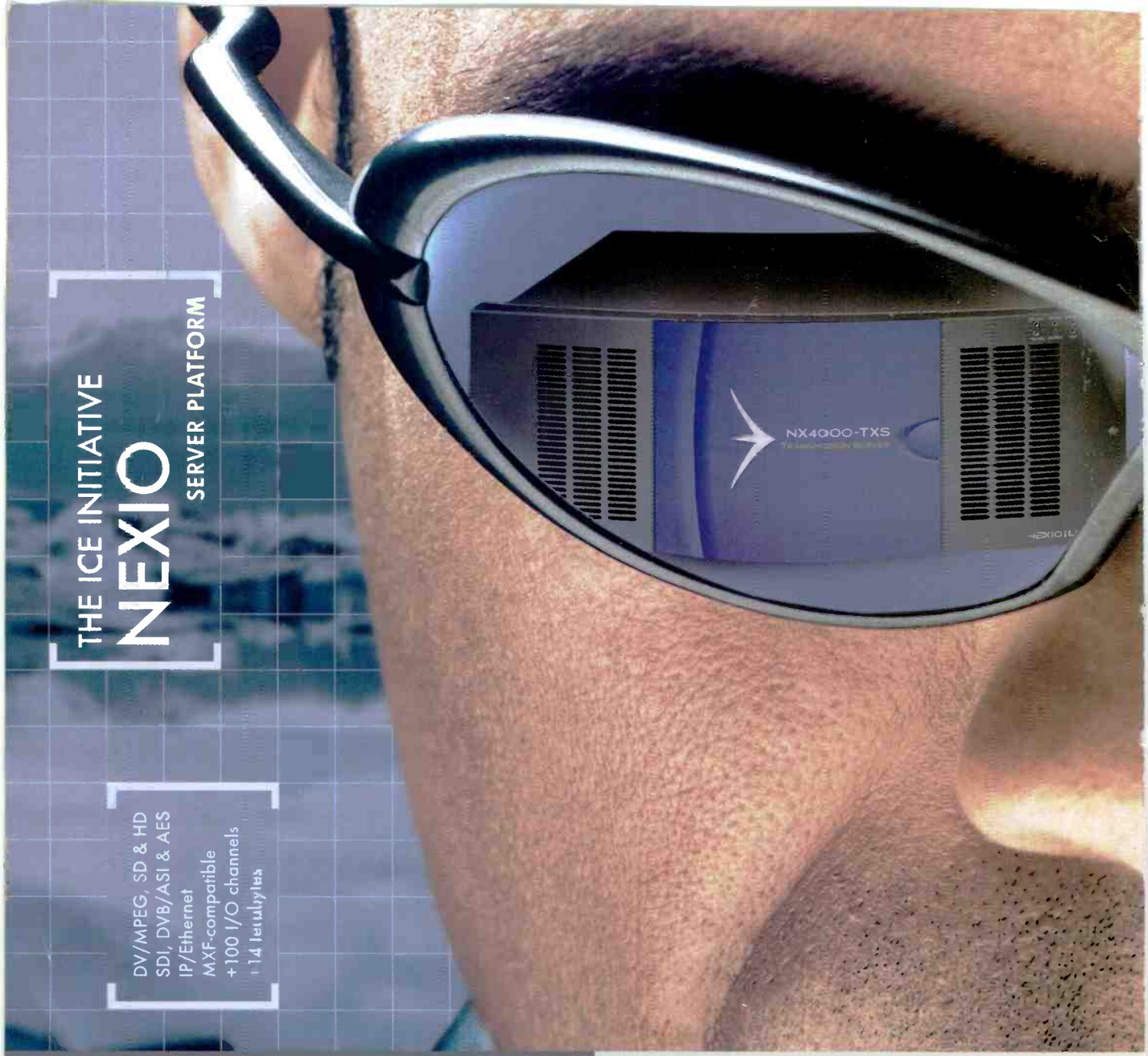

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