JANUARY 2010

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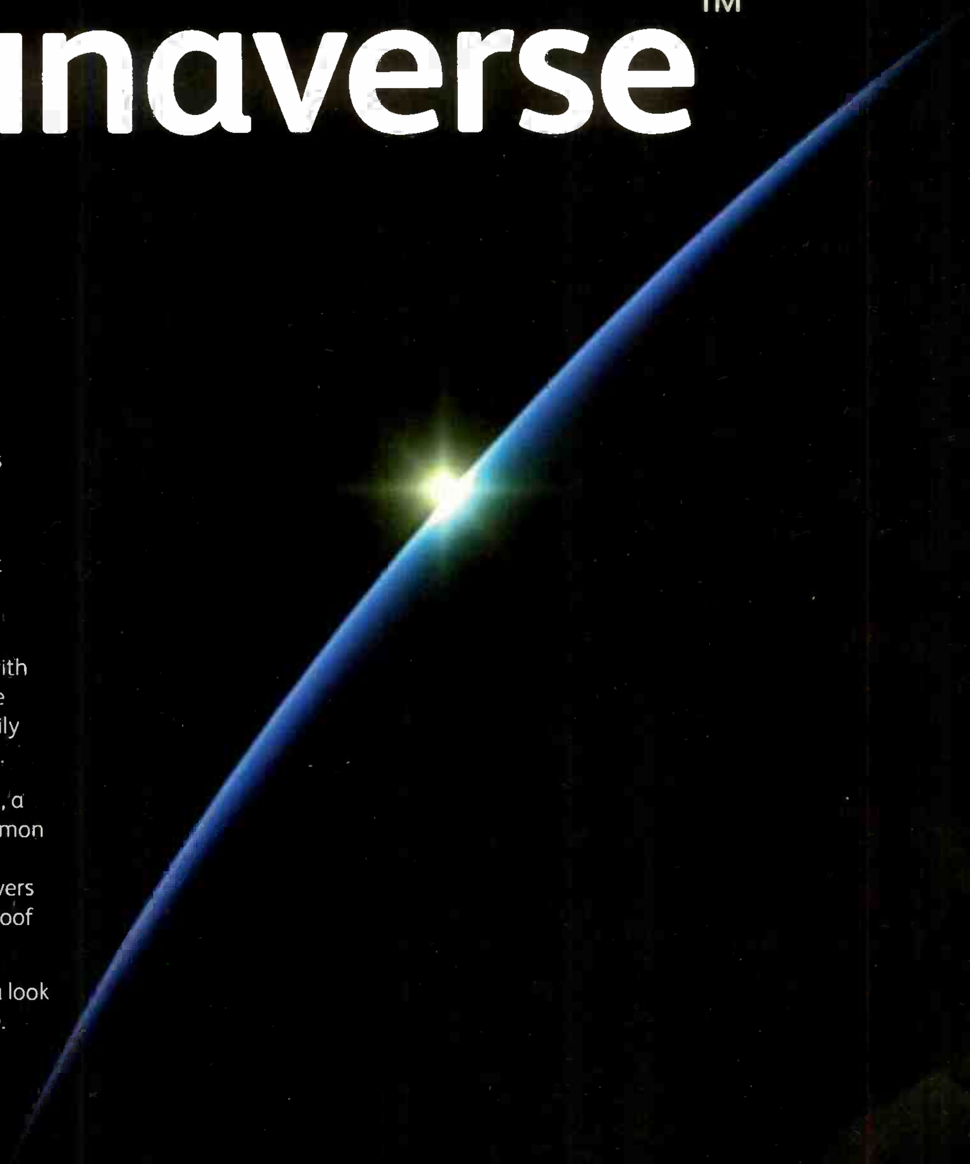

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BroadcastEngineering®

FEATURES

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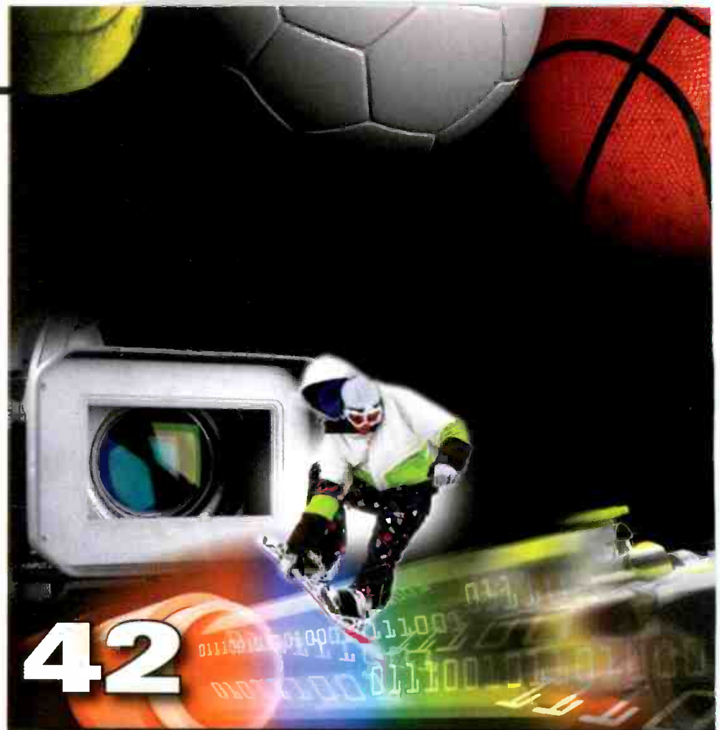
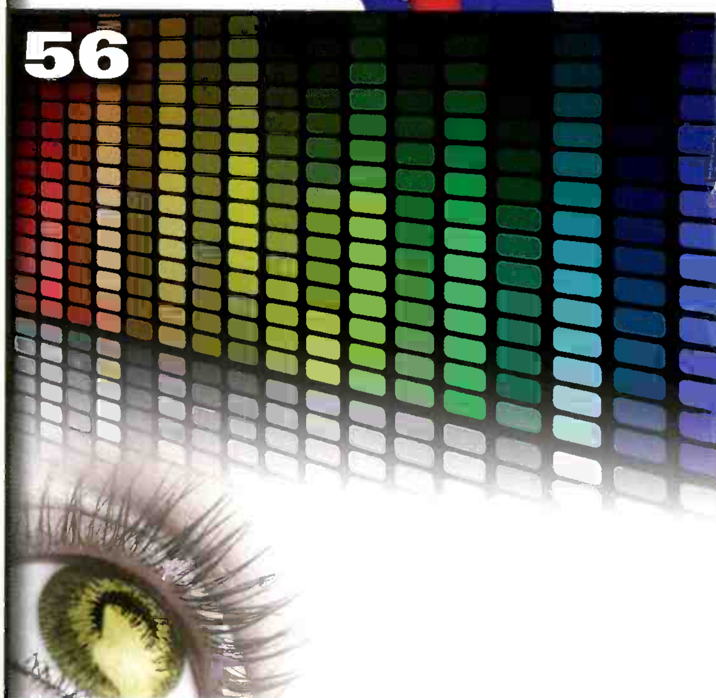


ON THE COVER:

Handling video clips as digital files is a necessity in today's highly competitive sports production environment.



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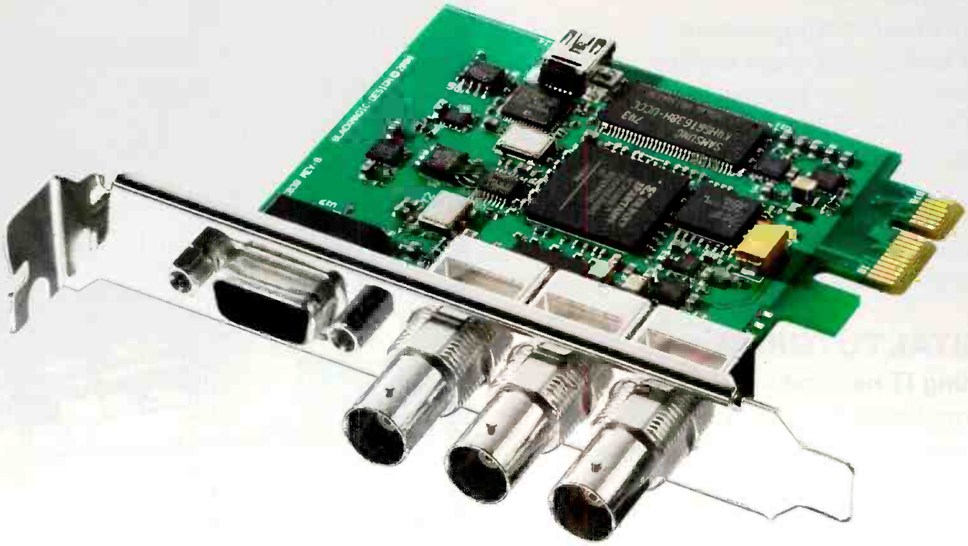

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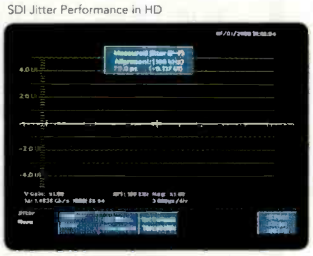
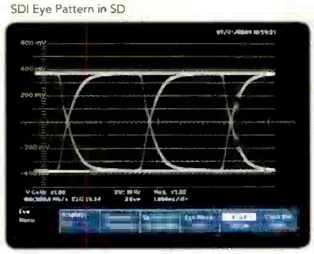
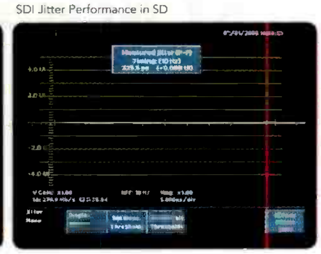


SDI Eye Pattern in SD



SDI Jitter Performance in SD



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SYSTEMS INTEGRATION

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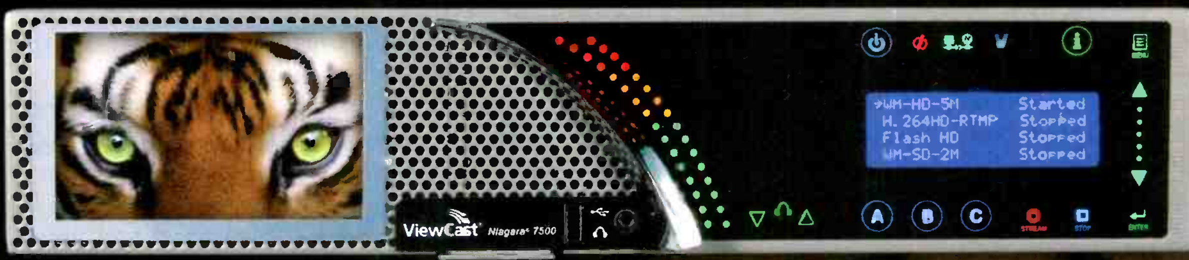
NEWS

Sports network ESPN plans to launch a 3-D TV network this summer called ESPN 3D, which will carry a minimum of 85 live sporting events during its first year.

Learn more at *www.broadcastengineering.com*

Beauty on the outside.
Beast on the inside.



It's easy to be enticed by the alluring good looks of the Niagara® 7500 – the newest HD streaming solution from ViewCast. On the outside, its sleek, innovative design and responsive touch-control interface will excite you. Its brilliant high-resolution HD display will dazzle you. But on the inside, it's a beast.

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The Niagara 7500 from ViewCast. Beauty on the outside... a beast on the inside.

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Stop farding

I was cruising along to work one morning when a small VW Bug whipped up beside me on the right. Looking over, I noticed it was being driven by a young female, perhaps 20-something years old. But that's not what caught my eye. It was that she was farding at 65mph! I couldn't believe it. Here we are, blasting along at highway speeds, and this woman is farding!

Her driver's side mirror was pulled down, and her left hand was holding her eye open while she applied eye shadow or liner to it with her right hand. I can only assume she

was driving with her legs! I asked some women in my office if they fard (that is, apply makeup) while driving. "Of course," was the most common answer.

Men don't fard, but they can be just as distracted with other things. They talk on the phone, text, eat, drink or twiddle with the radio — sometimes all at once. Those tasks aren't illegal everywhere, yet, but farding while driving can get you a ticket in Washington, D.C.

Cut the distraction

A meeting took place last month between Department of Transportation Secretary Ray LaHood and FCC Chairman Julius Genachowski in which they announced a campaign to evaluate technologies to help curb distracted driving. The DOT-FCC partnership will include public education on the dangers of distracted driving, which includes texting and talking on cell phones — and farding.

A study by AAA showed that the risk of a car accident increases by 50 percent for people who text while driving. A study conducted by Nationwide Mutual Insurance found that 19 percent of all drivers — and 37 percent of drivers between the ages of 18 and 27 — text while driving. Texting while driving at 55mph equates to driving the length of a football field with your eyes closed.

A study by professors Redelmeier and Tibshirani, "Association between Cellular-Telephone Calls and Motor Vehicle Collisions," showed that motorists are four times more likely to cause accidents when engaged in cell phone conversation than when not talking on a cell phone.

Another study showed that "the relative risk of being in a traffic accident while using a cell phone is similar to the hazard associated with driving with a blood alcohol level at the legal limit."

The key is that cell phone-using drivers actually extract less than 50 percent of the visual information that non-cell-using drivers do. A University of Utah study showed that the reason is "inattention blindness." Drivers look directly at road conditions but they don't really see them because they are distracted by the cell phone conversation. "Looking and seeing are not one and the same," said the study's authors. By contrast, the researchers found that listening to the radio or conversing with passengers is not as hazardous.

Maybe LaHood and Genachowski can together come up with some solutions, but the most obvious one is to legislate against phone use while driving. Make all the arguments you want about how similar eating, drinking and listening to the radio are to the use of a cell phone, but nothing compares to the distraction resulting from a cell phone conversation.

Soon, we'll have mobile TV on our cell phones. One can only wonder how much more enticing it may be to watch the news, weather and "Judge Judy" while driving. Some clever entrepreneur will probably offer a convenient cell phone dashboard mount.

Farding doesn't seem so bad in comparison. BE

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

Rethink automatic loudness control

Excessive loudness variation is probably the most common viewer complaint, and it's now something you can eliminate entirely. Our Automatic Loudness Control for our Densité interfaces is designed to address all typical loudness problems, including audio jumps between programs and commercials. To ensure effective loudness control without adversely impacting program content, we've incorporated the latest proven technologies from our partners, **Linear Acoustic** and **Jünger Audio**. It's time to rethink what's possible.

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Broadcast TV industry becoming extinct

Dear editor:

I just received my December issue of *Broadcast Engineering* and read your editorial with interest. "Perfect storm" seems to almost parallel an article I've started called "Behind bars." Here is my crude outline. I feel strongly about the direction "traditional" broadcasting is headed.

Confinement

I've spent 40 plus years, my entire engineering vocation, toiling and laboring behind bars. Witnessing more radical revelations within the past few years than all of television broadcasting history since the very beginning, I've come to the convincing conclusion that we are fast approaching extinction of the broadcast television industry. Thankfully, I've served my time.

Black-and-white to color, film to videotape, land-line distribution to satellite, analog to digital and next IPTV ... Broadcast television has survived, even thrived, through all these difficult transformations. The near future will likely present the most formidable challenge broadcasters have ever faced.

Death row

The condemned occupants of death row are short-timers and fat targets:

- Terrestrial broadcasting, including transmitters, towers, antennas and all ancillary equipment, will become obsolete as the spectrum becomes repurposed.
- Call letters, a key "branding" element for broadcaster recognition, could go by the wayside.
- Over-the-air (OTA) viewer reception via rooftop antennas, rotors, coax, etc., is in danger.
- Free TV will be gone! A new budget-busting monthly cable or satellite invoice will fill the vacuum.
- Analogous to the "housing bubble," broadcast property value is largely linked to the FCC license to broadcast and not the facility equipment. Broadcast TV licenses will likely cease to exist. Current broadcast facilities owners may become video information providers, feeding program content via fiber to cable systems, satellite to satellite distributors, podcasts to Internet service providers, or they may simply turn off the equipment and go home.

Redefining broadcast TV will involve a change of mindset. The accepted moral compass, "If you don't have something nice to say, say it often," must change.

Last wish

I hope that remnants of residual television spectrum remain in the hands of FCC licensed broadcasters and not the highest bidder, etc.

Execution

How imminent is the termination of terrestrial broadcasting?

Leo Demers

The end is near

Dear editor:

I have been involved in building and maintaining broadcast antenna systems for more than 30 years. In response to your December editorial, "Perfect storm," on the end of OTA TV, I have the following observations:

- The telecoms have been trying to break the broadcasters for a long time, and the Telecom Act of 1996 was the turning point of this assault. It spearheaded the selling of spectrum as a money maker for the federal government.
- Selling off spectrum is a breach of trust with the government. Their role is to protect our resources, not cash them in. If the loggers were let into the national parks, the greens would be livid, but spectrum is not a visible resource to most citizens.
- The last big spectrum sale led to the current state of the cellular buildout. Zoning for the sites then became a major issue, and the feds were called on by the winning bidders to intervene with the local regulations. One response was to lease out land at the local post offices for cell sites. At this time, the cell sites are full, so more towers — around 100,000 — will be needed. This current thinking will lead to more federal control of local issues, so it is really a power grab and a budget short fall repair. It's a win-win for the federal government, and a lose-lose for the states and citizens (except for having an IP address on the fridge so it can e-mail you to get more milk).
- If this trend continues, I guess the new EAS message will be: "Citizen, you are in danger! To hear this full message, swipe your credit card now!"
- Lastly, the end of OTA would remove the lever that the elected folks now have for access to the public. No more minimum base rate spots, and no more interruption of prime-time for a message from the Big Giant Head.

We need to do what we can to support our customers, the broadcasters.

Richard Wood
President, Resonant Results

Green TV playout

New single-card processors can generate up to a 90-percent savings in power, space and materials.

BY MARCO LOPEZ

As broadcasters strengthen their environmental credentials, and also look ahead to potentially higher electrical costs under cap and trade, they are now widening their perspective on energy savings to address the whole television process, from creation to transmission. This new emphasis on energy and space efficiency is now even impacting areas with lighter electrical consumption, such as playout equipment.

Traditionally, power savings at television stations has focused on transmitters and production studio lighting, as these represent the biggest offenders when it comes to power consumption. For instance, a single production studio can consume 400kW in lighting alone. Unsurprisingly, this heavy power usage has driven demand for lower consumption transmitters and innovations like LED studio lighting, which can save more than 90 percent of electrical costs.


A card-based multiviewer provides energy and space efficiency, with 20 multiviewers in 3RU, consuming just 300W.

Green values

This move toward greater energy efficiency has become broad-based, and is evident at local television stations, the major networks and many playout centers. It's happening by a process of ongoing upgrades, and most strikingly at new greenfield site facilities, which in some cases are even incorporating alternative energy production, including wind and solar power generation.

The worldwide television industry may not have been an early adopter of green technology, especially when compared to other industries such as mobile telephony, but it's now catching up fast. This shift toward green values has not gone unnoticed among broadcast equipment vendors, and they have responded with more energy- and space-efficient products for the breadth of the television playout process.

The latest generation of playout products is now delivering higher, 3Gb/s/HD/SD video performance, with substantially lower power consumption and greatly improved space efficiency. These new devices are also bringing many other diverse environmental benefits. For instance, they demand less cooling, they generate less noise, and they demand fewer resources for manufacture.

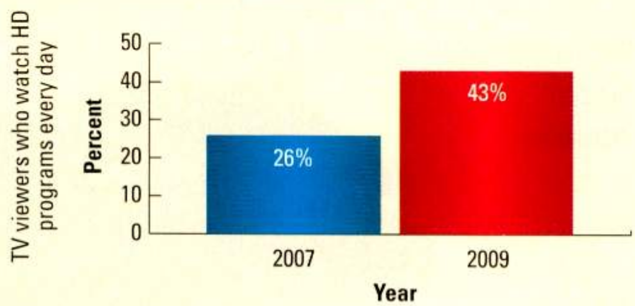
The cooling required by high power consumption isn't just another cost and energy consideration for broadcasters; it often demands a big, mechanical system that's often high maintenance, noisy and space consuming. Hence, reducing the cooling requirements of television equipment can lead to wide-ranging benefits.

The substantial improvements in energy efficiency of the latest generation of broadcast equipment have been made possible by ever more powerful chipsets, including FPGAs and CPUs. Over the last product cycle, this change

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

HDTV viewership is increasing

In 2009, 43 percent of consumers watched an HDTV program every day, compared with 26 percent in 2007.



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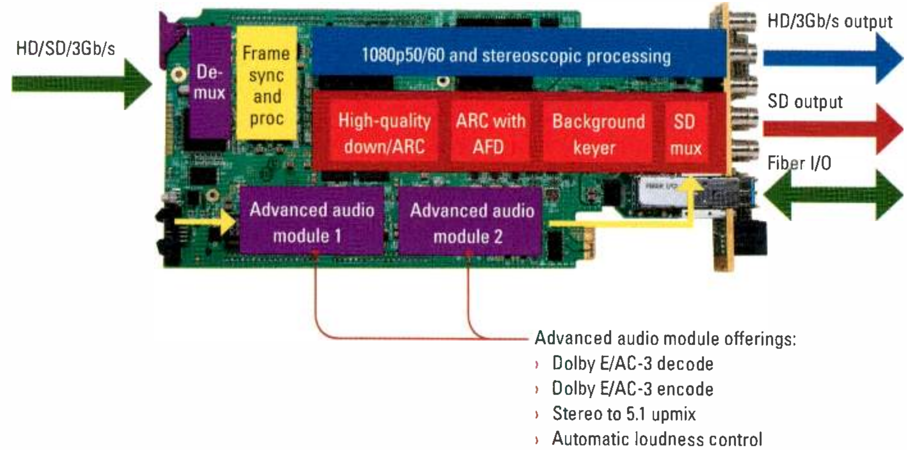


Figure 1. An up/down/crossconverter with an audio processor requires fewer parts.

has resulted in many core playout devices moving from dedicated 2RU or 1RU boxes, based on multiple boards, to single-card devices.

This process of moving to card-based solutions has spurred other nonenvironmental benefits, such as easier installation and maintenance, reduced cabling, and better integrated control systems, as well as fewer parts to fail. (See Figures 1 and 2.) In fact, power supplies have long been regarded as the most failure prone part of television equipment, and hence relying on fewer, lower-power PSUs should promote greater overall system reliability.

Specific savings

To be more specific about the potential savings in power, cooling, rack space and raw materials, let's consider a typical 10-channel playout facility and some of the key devices used for playout. Let's look at a cross section of essential devices at every facility: signal processing, channel branding and monitoring.

The performance of the latest generation of 3Gb/s/HD/SD signal processors is quite astounding. An earlier generation of equipment for processing 10 channels would have comprised multiple dedicated devices for video conversion, audio de-embedding/embedding and Dolby encoding/decoding to name just a few tasks. Typically, this equipment would consume around 45RU and 3000W of power. Now, with the latest single-card processors, this 10-channel system can be condensed to a single 3RU frame that consumes just 300W — a savings in power, space and materials of around 90 percent.

With channel branding, the traditional solution for a 10-channel playout system involves using 10 1RU frames, consuming around 1500W. The latest card-based design delivers greater graphics functionality, and yet a 10-channel system requires just 3RU and 300W. Here the savings in energy, space and materials equals 80 percent.

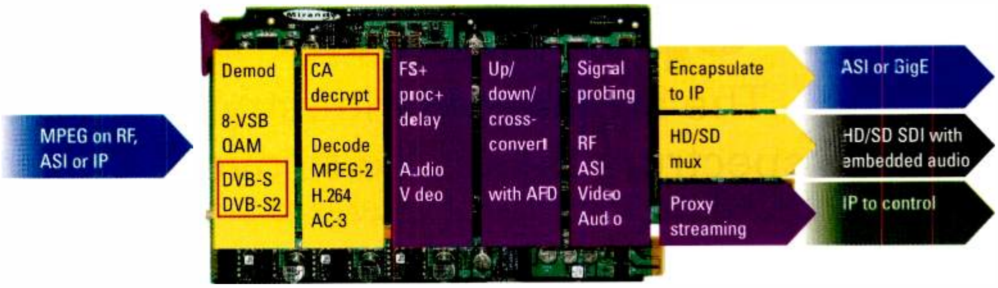


Figure 2. An MPEG decoder card with DVB-S/S2 demodulation and conditional-access support means easier installation and maintenance.

A similar pattern of savings is also evident with multiviewers, with savings of around 75 percent on power, materials and space for a 10-channel monitoring system. This calculation is based on 20 multiviewer displays, driven from a 3RU frame and consuming just 300W.

In each of these cases, the new lower-power solutions require less cooling, both within the hardware and for the facility building. The result is lower air-conditioning bills and less noise. And when this latest generation of products reaches the end of its natural life, in maybe 10 years, it will represent far less electronic waste for disposal.

In these demanding economic times, there's no premium for being more environmentally friendly when it comes to buying greener television equipment. In fact, it seems that the reverse is true, as the latest products offer more functionality for a smaller upfront investment, and they deliver savings on an ongoing basis. Simply put, going green in playout is a win-win for all parties involved. BE

Marco Lopez is senior vice president, interfacing, monitoring and control for Miranda Technologies.

TV spectrum under siege

The broadband industry aims to take over spectrum dedicated to over-the-air television.

BY HARRY C. MARTIN

The broadband industry is mounting an offensive to take over all or part of the spectrum dedicated to over-the-air television.

This effort began officially in September when the FCC invited comments on the adequacy of available spectrum for broadband deployment. The wireless industry, which had already been agitating for more spectrum, filed responsive comments citing the enormous growth of traffic on mobile networks after introduction of the Apple iPhone and other smartphones. This, it declared, demonstrates that the public demand is clear, and it is time to find spectrum to accommodate anticipated future explosions in demand. The principal target is TV spectrum.

The large spectrum segment reserved for TV was already pared way down as part of the digital transition, but the wireless industry wants what is left. The argument is that 90 percent of the public watches TV via cable or satellite. Thus, there is no need to tie up airwaves when the public no longer relies on such transmissions.

The prize is worth fighting for, even if the wireless companies can seize only a limited portion of the television band. TV channels 14-51 currently occupy 228MHz (from 470MHz-698MHz). Compare this with the 160MHz now available to cellular and PCS services.

The wireless initiative falls on fertile ground at the FCC. Chairman Julius Genachowski, speaking to a sympathetic audience at an international meeting of the wireless industry, declared that "the biggest threat to the future of mobile in America is the looming spectrum crisis." And senior FCC staff members have cited the large sums of money paid at spectrum auctions as evidence of the value of spectrum for wireless. Moreover, the principal focus of the FCC under Genachowski is broadband deployment. The "underused" TV spectrum is a prime target given this overriding policy goal.

Even the Consumer Electronics Association is siding with the wireless interests. The CEA wrote to the FCC urging it to comply with its obligations under Section 336(g) of the Communications Act to conduct a study to determine whether the TV industry really needs all of the spectrum. This obscure section mandates an assessment 10 years after the DTV licenses were first issued to determine whether the amount of TV spectrum can be reduced based on a lack of consumer use of DTV over-the-air signals.

Broadcast interests vigorously opposed these positions. MST, NAB, large group station owners and public broadcasters pointed out that the nation's TV stations, not to mention the American public, had just spent billions transitioning to high-quality digital television. The broadcast industry argued that without national television, our society would lose its thread of common daily experience, thereby further fractionalizing our nation as everyone ends up watching channels matching only their niche interests. The local emergency news and information uniquely available from over-the-air television also was extolled.

As has become common in Washington, each side is promoting its own interests, framing arguments as an "either/or" zero-sum game in which one side must lose if the other wins. That makes the FCC a referee, a role it should be reluctant to assume given its poor track record in court. The industries involved are so big and the stakes so high, it is unlikely wireless and broadcast interests will come up with a compromise. For this reason, the looming battle for the TV spectrum is likely to go on for many years and down the road produce results that do not serve the interests of either group. BE

Harry C. Martin is a member of Fletcher, Heald and Hildreth, PLC.

Dateline

- Jan. 11 was the deadline for the filing of biennial ownership reports for all commercial broadcast licensees. LPTV and Class A TV stations, whether operated commercially or noncommercially, were also required to file reports by Jan. 11. Check the FCC's Web site for any changes to this deadline.
- For noncommercial TV stations in Kansas, Nebraska and Oklahoma, the biennial ownership report deadline is Feb. 1.
- Feb. 1 is the deadline for TV stations in Kansas, Nebraska and Oklahoma to electronically file their broadcast EEO midterm reports (Form 397) with the FCC.
- Feb. 1 is the deadline for TV stations licensed in the following states to place their annual EEO reports in their public files: Arkansas, Kansas, Louisiana, Mississippi, Nebraska, New York, New Jersey and Oklahoma.

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


PORT 1
Utah Scientific

Correcting lip sync errors

Potential remedies to this frustrating problem are within our reach.

BY ALDO CUGNINI

Audio/video synchronization, or lip sync, is a frustrating problem for both broadcasters and viewers. The complexity of the broadcast plant has not made for any simple solutions, but potential remedies seem to be within our grasp.

The heart of the problem

First, a recap of the perceptual aspects of the problem. Subjective testing has shown that the detectability of an A/V sync mismatch covers a small spread in time, in the tens of milliseconds, and is asymmetric. This appears to be a consequence of human acclimation to the laws of physics, which set the speed of light and sound to be widely different. As a result, we are conditioned to expect light and sound from an object to reach us virtually instantaneously when it is nearby, and the sound to be delayed when the object emitting the sound is at a distance. For this reason, humans are accustomed to conditions where the A/V delay is zero, or somewhat skewed in the direction whereby the sound is delayed with respect to the image. (See Figure 1.)

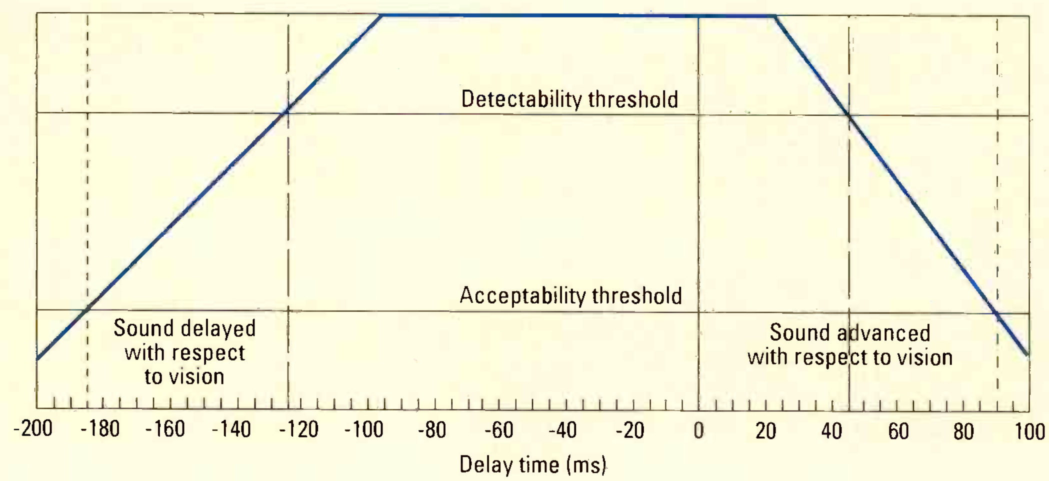


Figure 1. A/V sync error tolerances, from ITU-R BT.1359-1

Digital processing equipment requires a different processing time for video and audio content, primarily due to the disparate bandwidth of the digital data. With baseband SD video sampled typically at 13.5MHz and audio at 48kHz, any equipment processing the signals will produce a delay in the signals that is different for video and audio. Process HD video and throw in compression too,

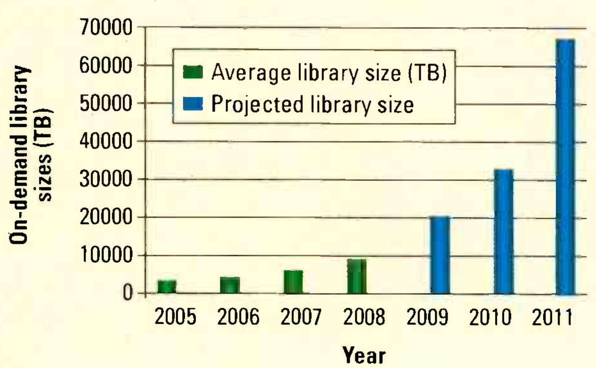
We are conditioned to expect light and sound from an object to reach us instantaneously.

FRAME GRAB

A look at tomorrow's technology

VOD libraries and usage continue to increase

In the last three years, VOD libraries have tripled in size.



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and the problem gets worse. While good equipment design can minimize the problem, what is also needed is a good way to measure and correct it — ideally back to zero — once it occurs.

A feasible solution

Numerous tools are available that can be used offline to measure and correct A/V sync error, but what is really needed is an unobtrusive way to manage it on live signal paths. One solution is to apply watermarking to the audio and/or video. An encoder analyzes the envelope of the audio signal, and from this generates a watermark that embeds timing information into the corresponding video. At a downstream point, the video and audio are analyzed, the watermark is decoded, and a corresponding measure of any intermediary A/V sync error can be produced. As such, the encoding must be done at a point with known (preferably ideal) A/V sync.

Some years back, Tektronix sold just such a system. Unfortunately, sale of the device was discontinued, in part due to an insufficient market. But there were technical challenges too. Two key requirements for successful operation of a watermarking system are the invisibility of the watermark and the robustness of the watermark after signal processing. Video processing can damage a watermark, and audio processing can alter the signal envelope. Anecdotal information regarding watermark systems includes a mix of positive and negative experience; noise reduction (denoising) is known to be particularly damaging because it can obliterate a watermark.

An alternative to watermarking is a fingerprinting technique. As with watermarking, the video and audio are processed at an upstream reference point, but in this case, a pair of signatures (or fingerprints) is produced from both the video and audio at the sampling point and time. (See Figure 2.) These signatures are then combined to produce an A/V signature that can be sent asynchronously on a different path (or even at a different time) than the program content; offline storage of the video, audio and signatures is also possible. A downstream device extracts a similar pair of video and audio signatures; comparing the upstream and downstream signatures produces a measure of the intermediary A/V sync error.

Some constraints on the use of fingerprinting

In order for such a system to work, the signature generation algorithm must reliably produce the correct signature despite video and audio processing, including bit rate compression, time compression, noise reduction and resolution conversion (resampling). Typically, the signatures are generated using what are called hash functions, which are similar to those used in cryptographic systems to process and manage encryption keys.

A key characteristic of a hash function is that it can convert a large amount of data into a small data set. By using an appropriate hash function, small changes to the video and audio signals, as expected by signal processing and compression, will not change the hashed result. The robustness of the system will ultimately be a function of the amount of intermediate signal processing, as well as the complexity of the A/V signature. In principle, an acceptable level of

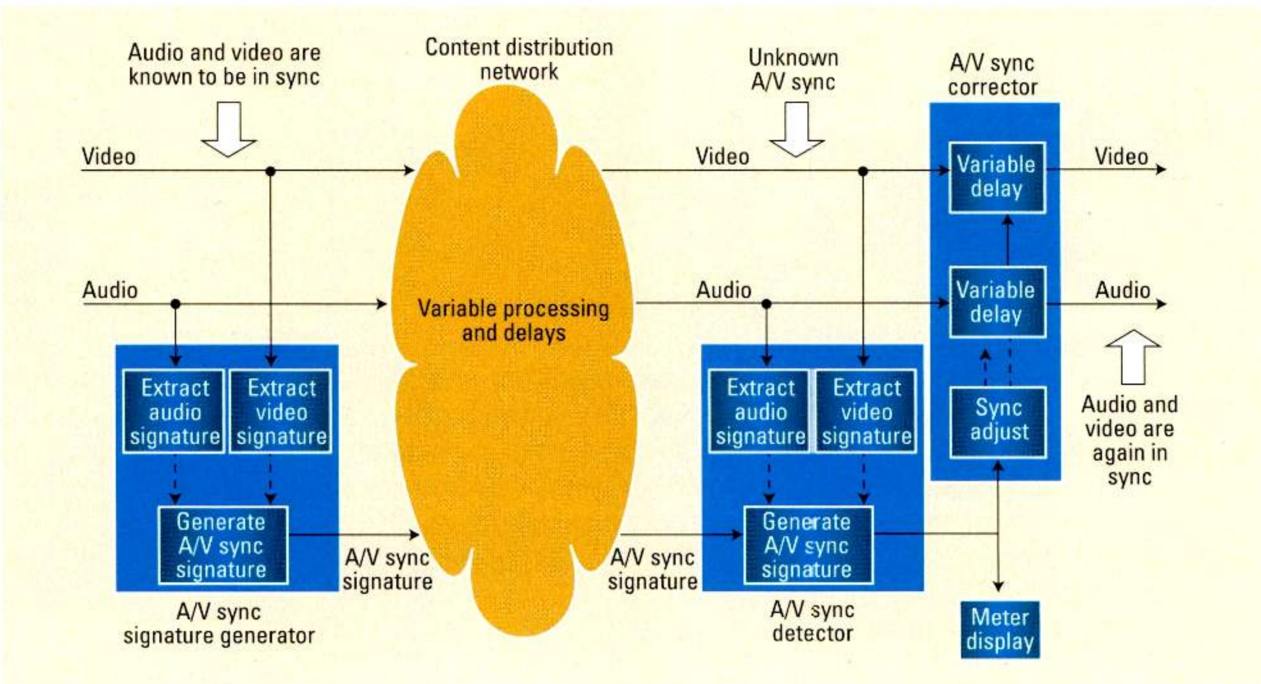

Figure 2. Real-time A/V sync signature system. Courtesy Dolby Laboratories.

robustness should be achievable with the processing typically done after post production, at a data rate of less than 4kb/s for the signature data.

Systems based on fingerprinting are available or have been demonstrated by several different manufacturers. Although fingerprinting systems have been shown to work reliably, the make-up of the fingerprint has so far been proprietary, without a common definition. The SMPTE 22TV Lip Sync Ad Hoc Group, chaired by Graham Jones of NAB, is now investigating the possibility of producing a SMPTE standard for the fingerprint signal and/or the methods of metadata carriage. Readers are encouraged to contact Jones at gjones@nab.org for more information, or to participate.

Decoding equipment needs attention too

While a fingerprinting system can maintain accurate A/V sync, it can only do so at the point where fingerprint decoding equipment is deployed. In order to solve the A/V sync problem over the complete extent of the content distribution chain, attention must be paid to equipment, including consumer electronics. It is known that some implementations of MPEG decoders do not accurately maintain A/V synchronization, because mere compliance with the MPEG and ATSC standards does not by itself assure perfect A/V sync. Professional decoders, of course, should handle synchronization to the best state of the art. Consumer electronics, however, are often developed with performance limitations driven by cost. To address the issue, the CEA last year published CEA-CEB-20, "A/V Synchronization Processing Recommended Practice," which outlines the steps that an MPEG decoder should take to ensure and maintain audio/video synchronization.

Among the recommendations made in CEA-CEB-20 are the continuous monitoring and processing of all Program Clock References (PCR), Presentation Time Stamps (PTS) and Decoding Time Stamps (DTS) available in the stream. Also described are the various timing mechanisms that should be present in a well-designed decoder, including startup, adjustment and steady-state conditions. Of particular interest is the discussion of packet timing, which can aid in the understanding of similar mechanisms in professional encoders and multiplexers — but that's another topic. BE

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Computer architecture

Grasping the basics of computer technology is important for operating broadcast systems.

BY BRAD GILMER

Many broadcasters find that they are expected to maintain specialized broadcast equipment and be well-qualified in a wide variety of IT technologies, including computer architectures, operating systems, networking, routing, system design and security. This is a pretty tall order, and many broadcasters need to update their knowledge on a continuous basis. This month's column begins a series of tutorial articles that will focus on these areas.

Computer architecture

Computer architecture is the field of internal computer design. Understanding this field is important for the broadcaster because video applications, especially real-time HD applications, push computer technology to the limit.

Personal computers of the mid-1980s and early 1990s were relatively simple. They are a good starting point for understanding where we are today. Actually, many of the design decisions and naming conventions today (serial ports, for example) were derived from older mainframe designs that evolved in the 1960s and 1970s.

Figure 1 shows a simplified drawing of an early personal computer. At the center of the computer is the central processing unit (CPU). At its base level, all the CPU can do is simple binary addition. Binary means that the values the CPU deals with are either zero or one. From this base level, computer designers have been able to construct computers that perform extremely intricate calculations.

The CPU contains registers, which are places to hold numbers used in operations. Operations are functions the CPU knows how to perform. One operation might be to compare two numbers to determine if they are equal. The idea of processor operations is at the heart of the performance measurement floating point operations per second (FLOPS) and is a measurement of the computational power of a CPU. At the moment, the fastest CPUs are rated in the PetaFLOP range. One PetaFLOP is 1 quadrillion calculations per second, or one followed by 15 zeros.

The relationship between the number of operations a CPU can perform and the clock speed of the CPU is not straightforward. Generally speaking, for the same CPU, if the clock frequency is higher, the CPU can perform more FLOPS. But if you compare two different CPUs, then the comparison needs to take into account many other factors.

Once a CPU has completed an operation, it needs to store that result somewhere. Registers will not suffice because they may be used immediately by the next operation. The CPU stores the results of operations in memory. Data is moved from the CPU to memory over a bus. As Figure 2 on page 24 shows, there are actually two buses. The first bus is called the address bus, and the second bus is the data bus. (One bus may serve

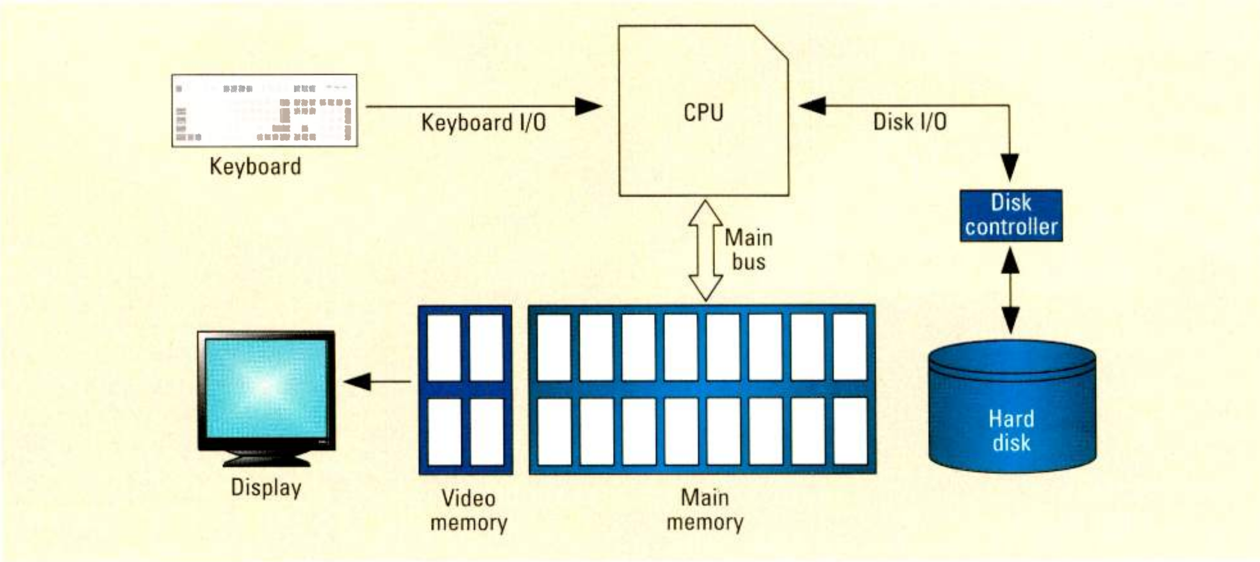

Figure 1. A typical early personal computer consisted of a central CPU, main memory, video memory and peripheral I/O ports.

planting the seed...

Outfitted with dual DM2000's, Record Plant Remote's "The Lounge" digital truck has been busy making waves at numerous live recording events across the country.

We caught up with Kooster McAllister, Owner and Chief Engineer of Record Plant Remote, to gather his thoughts on his Yamaha gear. Here's what he had to say...

"Coming from an analog background, having a lot of faders in front of me is comforting. All 96 tracks can be viewed and accessed on just two layers. Having the two consoles tied together make the DM2000's perform as one large format digital desk. It also gives me the added functionality of being able to call up effects, routing, auxes, etc. from either center section making it easy to get around quickly.

In my line of work where you only have one chance to capture a live moment on stage, you must be able to count on your equipment not to fail. These consoles have withstood being bounced down the road from gig to gig and have always come through for me.

Most importantly, they sound great. Orchestral recordings I have done with them sound simply amazing."

— Kooster McAllister

both purposes in some CPU designs.) When the CPU wants to read a value from memory, it sets the memory address on the address bus and then reads the value in memory on the data bus. This is a parallel operation, because address and data buses are typically 32 or 64 bits wide. When the CPU wants to write a value into memory, it sets the write address on the address bus, sets the data on the data bus, and then pulses the write strobe, which causes the data to be written into memory.

Bus width is a key specification when purchasing a computer. You may have heard that a system is a 32-bit machine, or that you need a 64-bit processor to run a particular high-end graphics program. This number refers to the number of parallel lines on the bus inside the machine. There are several buses inside a modern computer. The address/data bus between the CPU and the memory is the one referred to in sales literature. A wider bus allows data to be moved more rapidly inside the machine.

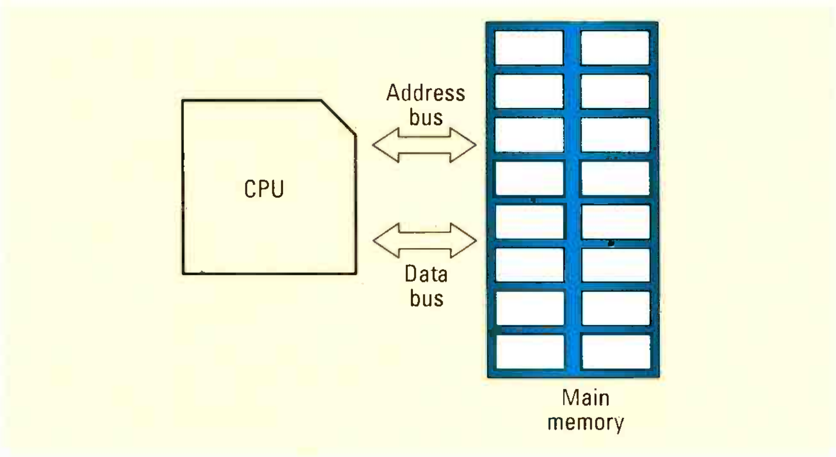

Figure 2. A CPU transfers data into and out of memory across a bus. This bus typically consists of 32 or 64 parallel connections.

Almost all modern computers have user interfaces — typically a mouse, a keyboard and a display. The keyboard and mouse connect to the CPU via a port. In early computer systems, the computer was connected to a terminal. In the *really* early days, this terminal was a teletype machine. The teletype machine connected to the first port was the main console of the computer. This convention carries through today on Linux machines, where /dev/tty0 can still be configured as the primary user interface. TTY0 stands for the first teletype machine connected to the system. The computer communicated with the teletype over a serial line. The data was serialized into eight-bit words.

The next advance in technology was to connect a video terminal to the computer. Data to be displayed was written to specific areas of computer memory. The display card then read the data out of memory and displayed it sequentially on the video terminal. The process was simple: Write information into a location in memory, and it will appear on the video display.

This display method was limited to displaying text. More complex systems were created, whereby graphics were made using line drawings and vector mathematics. As these techniques became more computationally complex, it quickly got to the point where the CPU was spending so much time on the graphics display that it did not have enough horsepower left over for core computational tasks. To address this problem, engineers created graphics processors so that graphics calculations could be offloaded from the main CPU onto a separate CPU. This is now the only way new computers operate. Even if you do not have a separate graphics card, your motherboard includes a separate CPU, which is tasked with processing graphics and sending them to the video screen.

The keyboard and mouse operation remains pretty much unchanged from the original design. When a key on a keyboard is pressed, this creates an interrupt signal that is sent to the CPU on a specific port. You may have seen the terminology IRQ, which is short for interrupt request. This is a request for the CPU to stop what it is doing and pay attention to a specific I/O port. The CPU reads the data on the keyboard I/O port and then goes back to what it was doing before the interrupt was received. Because the modern processor is so fast, it can execute thousands of instructions in between each keystroke, allowing the computer to continue with other tasks while you type.

Disk I/O is handled by a hard disk controller. In one configuration, the disk controller connects to the main bus of the computer. When the CPU wants to read from or write to disk, it simply hands a file name to the controller and then waits for the controller to retrieve the information from the disk and present it at the disk I/O port, or the CPU writes data to the I/O port. Computer designers quickly realized that there were performance problems with this approach, because the disk was, and still is, substantially slower than the CPU. When reading from disk, in some applications the CPU might request the same data several times within a few seconds or minutes. This results in several identical read operations, each taking a substantial amount of time. When writing, the same issue occurs. The CPU could end up waiting a substantial amount of time for a write operation to complete. For this reason, disk buffering became commonplace.

On current systems, disk controllers now contain a significant amount of memory. The CPU quickly writes the data to be stored on disk to the disk controller's memory and then continues on with its tasks. The job of getting the information on disk is left to the controller.

Similarly, the controller reads information from disk and puts it in a memory cache. From there, the CPU reads the data it has requested. If the CPU requests the same information several times in a row, there is a good chance that the information is still in the disk cache and that another relatively slow disk read operation will not be required.

Conclusion

There are a few closing thoughts that I would like to leave with you:

- Typical media applications put a lot of stress on computer systems.
- Architecture choices matter, especially when working with video.
- It pays to take time to learn about what is going on inside computers; decisions designers make regarding bus width, disk I/O and network I/O can all have a huge impact on how well a given piece of hardware will work for video applications.
- Understanding basic computer architecture will help you make sound decisions for your facility. BE

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

? Send questions and comments to: brad.gilmer@penton.com

HD monitors

Consider your needs when deciding between LCD and plasma.

BY MICHAEL BERGERON

Like many broadcast and production professionals, I have the same kind of nostalgia for cathode ray tube (CRT) monitoring as I have for film negative, baseband workflows, tape recording and even analog infrastructure. The CRT may not have been ideal: It was easily damaged, it was unwieldy, it used quite a bit of power, and it was fragile. However, it was a fixed standard, and everyone learned how to work with it and anticipate what the image should look like.

Consumers had the same core technology, so judgments could be made with confidence. Now that consumers are leaving the CRT behind, broadcasters share the same types of choices, but of course have different requirements.

For the most part, broadcasters trying to decide between LCD and plasma. With more technologies in the pipeline, the choices are driven by which of the following criteria is most important to you.

Portability and toughness

Plasma displays tend to be heavy and fragile like CRT displays. However, a plasma will still be easier to work with than a CRT of the same screen size, so if other plasma qualities are required, they are still worth any transportation difficulties.

The LCD display is most portable, of course. The LCD panel itself is susceptible to damage, so many professionals and rental houses add a Plexiglas cover for added protection. The build quality of the chassis is the differentiator between LCD display brands. A monitor built with a die-cast metal chassis makes a big difference when using monitors in dangerous territories on set.

Color fidelity

Color fidelity is driven by the display technologies and the supporting circuitry. While a plasma display still generates the widest gamut in generally available flat-panel displays, LCD displays have come a long way in recent years. LED backlighting may even raise the bar further, but some CFC backlit LCD displays have already surpassed the color gamut of the CRT. Once the CRT gamut is surpassed, a lookup table can be used to map the color possibilities into the full ITU 709 color space, as is done with master quality LCD-based displays and less expensive models. These monitors are even being mapped to reproduce larger color gamut such as Adobe RGB. Some evaluation monitors even allow for user-defined LUT settings. One color space known as P3 was developed for DLP digital cinema projectors and represents one of the widest display gamut in use right now.

Some newer LCD models, such as Panasonic's BT-LH1760, can mitigate image persistence by driving the display with a 120Hz refresh rate, as opposed to the standard 60Hz. The additional 60 frames allow the insertion of a black frame between each picture, which clears each image before the next one is displayed.

Contrast and viewing angle

Another thing to keep in mind when choosing a field display monitor is contrast and viewing angle. How much contrast does it display? How are contrast and color impacted by where the viewer is sitting?

The king of contrast is still plasma. Nothing has matched the blacks that this technology can produce. However, with new developments in LCD technology, performance has been greatly improved. Comparing contrast, black levels and off-angle viewing performance of various LCD display models is not something easily summed up on a spec sheet. When evaluating displays for contrast and off-angle viewing, bear in mind what will be most important for your application. Will many people look at the display? Will the viewing environment be dark? Knowing what specifications are negotiable can lead to a smarter decision.

Once the CRT gamut is surpassed, a lookup table can be used to map the color possibilities into the full ITU 709 color space, as is done with master-quality LCD-based displays as well as less expensive models, such as the Panasonic BT-LH2550.

Sharpness

Sharpness is a function of contrast and resolution. Some manufacturers

tend to stress the pixel counts as this is the most intuitive to the consumer, but it should be considered as just one specification rather than the single magic number for determining image performance. All else being equal, a 1080p display should be sharper than a 720p display, but all else is rarely equal. Poor contrast or a lack of dark blacks could easily undermine good native resolution.

Motion blur and latency

Plasma displays handle motion well by nature, similarly to a CRT screen, but they do have several frames of latency. LCD displays tend to exhibit more motion blur. Some of this is due to image persistence. In other words, one frame of video does not fade away completely before the next image is displayed, causing an increased appearance of motion blur. Some newer LCD models can mitigate image persistence by driving the display with a 120Hz refresh rate, as opposed to the standard 60Hz.

Noise and artifacts

Noise and artifacts tend to be more apparent in LCD and plasma displays than in CRT monitors, and many pointed this out as a shortcoming of flat-panel displays when they were introduced. This may be true for the home viewer. However, the noisiest looking display might be the most beneficial for the codec engineer trying to minimize compression artifacts and determine what the final picture will look like.

All else being equal, a 1080p display should be sharper than a 720p display, but all else is rarely equal.

Conclusion

When comparing display technology, rather than judging one as better than the other, consider the most critical need for your specific application. Perhaps a good focus assist feature trumps resolution, and, of course, the best-looking monitor in the world could turn into a doorstop if it stops working after a fall on set. Moreover, with the rapid pace of new technological developments, it pays to look at what is available at what price each time you are shopping. You might find something new. BE

Michael Bergeron is strategic technical liaison for Panasonic Broadcast.

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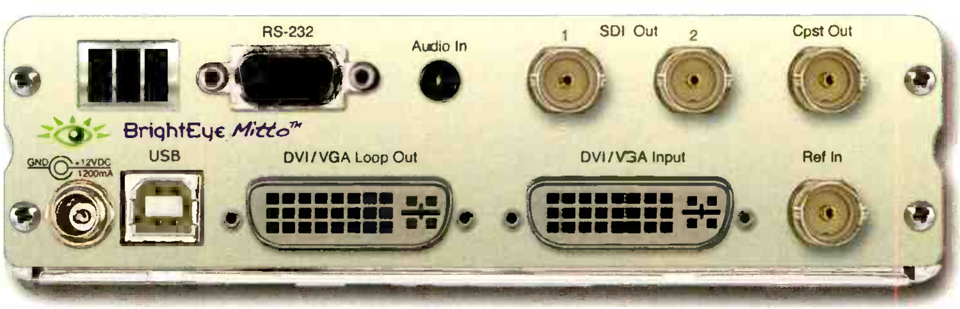

Easy-to-Use
The included Mac/PC application let's you simply use your mouse to click and drag over the specific portion of computer video that you want to output. We're all used to using a mouse – it's the easiest way to select exactly what you want to output. The region selected for output determines if Mitto acts as an upconverter or downconverter. Whether you output the entire screen or just a selected portion, you'll be able to see exactly what you are doing. And timing the video output into your system is easy, too.

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SYSTEM DESIGN SHOWCASE

Public broadcasting station WFYI

Surveying the landscape for stellar broadcast facilities built in the past two years, one is tempted to focus on the major markets, where money is more plentiful and ratings are higher. However, WFYI Public Broadcasting, in the nation's 25th DMA, has defied all convention, dreamed big and now operates out of a digital showplace that's second to none.

The television station and its sister radio properties had been operating from an aging analog studio space for years until they set out on a major fundraising initiative to upgrade the station and make it competitive. Back in 2003, when WFYI originally developed the goals for a five-year strategic plan, the station envisioned the construction of a new wing to the existing facility. However, when a prime piece of real estate became available just two blocks north of the station's

builds first-class facility

BY MICHAEL GROTTICELLI

To monitor all incoming signals, the station's engineering staff designed and built a custom monitor wall that spans a three-sided wall that includes a dozen 22in ViewSonic LCD screens on the left side, six 50in plasma screens in the middle and another 12 LCD screens on the right.

existing facility in downtown Indianapolis, its future was secured.

Four years later, in October 2007 (on the heels of a successful $20.2 million fundraising campaign), WFYI acquired its new four-story headquarters, which is located at 1630 North Meridian Street — the downtown area of Indianapolis that's frequently referred to as "broadcast row" because it's home to many of the city's commercial broadcast stations. The 94,000sq-ft property (which formerly served as the corporate headquarters for two utility giants, Vectren and the Indiana Gas Company) gives the station ample space for growth.

Once the decision was made to relocate the station's operations, the engineering team, led by chief engineer Nate Pass, created a migration plan that included moving into a state-of-the-art digital television station (PBS) and digital radio station (NPR), as well as a Learning Services Division, a free statewide reading service for print-impaired citizens (IRIS), and a full-service audio and video production facility that produces and distributes weekly local programs. The studios are rented by numerous production houses to produce commercials, streaming media and DVDs.

The engineering team, including WFYI's vice president of engineering Steve Jensen, devised a system design that enabled the station to operate simultaneously out of both facilities for most of 2008 (with master control working out of the old building), until the entire organization completed its relocation process. In order to minimize on-air disruption, the station transferred its staff and broadcast operations in stages and officially went live from the new building in the fall of 2008. It is now broadcasting three digital channels: two SD (480i) and one in the 720p HD format.

The new building includes an HD-SDI (hybrid coax cabling) video infrastructure to support its broadcast services, while audio is handled as discreet channels to make sound mixing easier and avoid the high cost of external embedders/de-embedders.

A new wing

One of the biggest challenges of the new facility was the planning, design and construction of an additional 5000sq-ft wing to house two 50ft x 50ft digital production studios. Pass and Jensen determined that because the studios required higher ceilings for the lighting grids, it was cheaper to build out two new studios than to incorporate them into the existing office space.

The new studios were added to the north side of the building and include three Ikegami 388W SD cameras in each one. Control rooms A and B can be operated individually or in tandem for larger productions. Studio A is SD-capable only and features a legacy Grass Valley 4000-3 digital switcher, which was brought over during the move and has been operational for more than 10 years. The other control room has been built for HD production and will include a new Kalypso HD switcher with four M/Es at a later date.

HD programs are mostly network originated, while SD programs are upconverted for the HD channel or distributed as SD on the station's standard-definition channels.

The WFYI facility features two control rooms, which can be operated individually or in tandem for larger productions.

Design team

WFYI
Alan Cloe, executive VP; Steven Jensen, VP engineering.; Nate Pass, chief engineer, architect, system designer, custom monitor wall designer; Steve Goldberg, custom console designer

Technology at work

Apple Final Cut Pro editing
Automation Network
- Ethernet switches

Avid
- Intelli-Sat server
- Media Composer Adrenaline editing
- DS Nitris finishing
- SIDON server
- Sundance Digital Fastbreak NXT automation

Belkin KVM network
Bittree A/V jackfields
Chyron
- Infiniti CG
- DynaCrawl graphics

Evertz
- Distribution products
- Master clocks

Grass Valley
- 4000-3 switcher
- Concerto AES router
- EDIUS NLE
- Encore control
- Infinity camcorders
- K2 servers
- Maestro master control
- Trinix router

Harris
- Flexicoder encoder
- Videotek monitoring

Ikegami 388 W cameras
MRC TwinStream radio
MultiDyne Fiber products
Panasonic
- DVCPRO camcorders
- P2 camcorders

Sencore IRDs
ViewSonic monitors
Wohler audio monitors
Yamaha surround sound

The walls of the new wing were prefabricated and lifted into position by crane. Finishing was then added to each side, and sound baffling material was added to the roof. The studios also use a separate HVAC system. Some additional customization was done so that the former office space could accommodate the station's radio and IRIS on-air studios.

Redundant master control

Two Grass Valley Maestro digital master control panels with internal branding, DVE, CG, EAS and audio store capabilities handle all of the station's master control operations. This is supported by an Avid Sundance Fastbreak NXT automation system, several Grass Valley K2 servers (for ingest and playout), a Trinix 256 x 256 digital video router — configured for HD and SD signal distribution to support all the digital channels (20.1, 20.2 20.3) — and a 256 x 256 Concerto series router for AES audio. The entire system includes full redundancy to keep the station on-air at all times.

To monitor all incoming (microwaves, satellite and fiber) signals, Pass designed and built a custom monitor wall that spans a three-sided wall. It includes 12 22in ViewSonic LCD screens on the left wall (for ingest), six 50in plasma screens on the center wall (for RF return, outgoing program preview

The master control suite houses two Grass Valley Maestro panels with internal branding, DVE, CG, EAS and audio store capabilities; all are controlled by an Avid Sundance Fastbreak NXT automation system and several Grass Valley K2 servers.

and automation), and 12 LCD screens on the right wall playout with near- and far-field monitoring.

HD production starts with Infinity

The station had been passing through HD programming for the past five years, but was not doing any local origination until it acquired a Grass Valley Infinity digital media camcorder earlier this year. The camera supports WFYI's file-based production and post-production environments.

The Infinity is used primarily in the field capturing both SD and HD images to produce one of the station's most popular shows, "Across Indiana," which highlights various towns in the state. Footage for "Across Indiana" is stored on Grass Valley REV PRO media and then ingested into the company's EDIUS system to perform HD editing. Most of the station's other programs are shot with Panasonic DVCPRO and P2 camcorders and then ingested into one of four Avid Media Composer Adrenaline systems and edited in SD.

There are also new post-production facilities located adjacent to the new production studios. Although some tape backup is still used, most images now shot in the field are ingested into 5TB Avid storage area network, and then edited using one Avid Nitris DS and four Adrenaline systems, one EDIUS, and two Apple Final Cut Pro workstations. The station also rents out the post facilities to outside clients.

Do it yourself

Perhaps the most impressive outcome is that all of the systems integration work was performed in-house by the station's engineering staff and a dedicated group of local freelancers. Pass and his team supervised all of the work and completed the build-out in a little more than a year. This included integrating all of its radio studios, TV post production, TV production, TV master control, RF and transmission centers within the same building.

At the end of the day, WFYI succeeded in making the transition with few setbacks. The station now has a winning combination of ample space and technical complexity. It's on-air signal looks better than other commercial stations in town. In fact, WFYI uses the more bandwidth (13.5Mb/s) for its HD channel than any other station. It also transmits EPG data (100kb/s) transmission for "TV Guide" listings in the same 19.6Mb/s bandwidth. BE

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

SYSTEM DESIGN SHOWCASE

The Dallas Cowboys Stadium

Delivering an exclusive game-day experience to 80,000 spectators is no easy task.

BY DON ROONEY

With 16 HD cameras and thousands of HD displays, spectators at the new Dallas Cowboys Stadium can enjoy a live, up-close and exclusive look at game-day activities such as tailgating and behind-the-scenes views of players and cheerleaders, as well as a sense of the overall festivities that permeate the largest domed stadium in the world. What spectators can't see, however, are the three sleek HD production control rooms and the central equipment room that drive the system and feed video signals to the HD screens and more than 3000 HD displays that make the authentic game day experience possible.

Burst, a Denver-based systems integrator, provided the detailed design, systems integration and project management for the production control rooms at this $1.1 billion stadium, which launched in June 2009.

Bigger is better in Texas

Everything is bigger in Texas, and the new 3,000,000sq-ft Dallas Cowboys stadium, which seats up to 100,000 spectators, is no exception. The stadium embraces cutting-edge technology with a state-of-the-art production system that supports live broadcasts, production and post production in HDTV, and an in-house multichannel HD IPTV cable system for targeted advertising throughout the venue. In addition to the main control room, the facility has two auxiliary control rooms, a rack room with 35 8ft equipment racks and an owner's perch with eight dedicated replay devices.

Burst worked with Dwin Towell, director of broadcast engineering services for the Dallas Cowboys, and Chris Williams, principal at WJHW consulting, to design a 1080i facility flexible enough to support a wide variety of events — from taping a simple conference in one of the stadium's meeting rooms to broadcasting the Super Bowl. In other words, they needed a complex broadcast facility that would also meet the ever-changing needs of the stadium.

Challenges and innovations

Building a television production control room and supporting

The Cowboys' new control room facility relies on Evertz for the core systems such as sync generation, routing, distribution, conversion and multi-image displays. Shown here is the main control room.

infrastructure in a massive facility that is under construction presents a variety of challenges and requires significant coordination and cooperation between interrelated trades and the general contractor. When multiple subcontractors are sharing a common overhead cable tray, a high level of cooperation and respect for each other's work is required. Fortunately, there was a great spirit of cooperation throughout this project.

Due to the large video displays hanging from the center of the stadium, a secondary, reverse-angle show is produced so that the viewers across from the main production can see the action on the big screen in the same direction as that on the field. This was accomplished by placing additional cameras on the reverse side and the addition of Fast Forward Video's Omega HD devices, resulting in six more video replay channels. The additional cameras, replay devices and graphics are controlled in one of the two secondary control rooms. A Sony MKS-9011A control panel uses the third M/E bus in the Sony MVS-8000G switcher. This allows control of this M/E from either control panel.

The size of the center hung screens can support the use of quad-split replays to show four different camera angles of a single play. This quad image may get lost on smaller screens. During each game, there are up to four unique quad-split images available to the production crew.

During a football game, numerous router destinations must be controlled and switched simultaneously. Typically, this includes eight Daktronics video displays in the outdoor plaza areas, as well as two unique feeds to the in-house IPTV distribution system. This was accomplished with a single-button push that controls SALVOS, which was created via the versatile Evertz EQX server system.

Equipment selection

The Cowboys' new control room facility relies on Evertz for the core systems such as sync generation, routing, distribution, conversion and multi-image displays. The routing fabric consists of an Evertz EQX 288 x 288 HD-SDI frame currently

Design team

Burst
- Don Rooney, VP engineering
- Barry Samuels, sales engineer
- Grant Knox, design engineer
- Andy Morris, design engineer
- Nand Ganesh, test/commissioning
- Tom Norman, test/commissioning
- Dave Stengel, project manager
- Danny Rowland, lead installer
- Christian Freeman, lead installer
- Letha Koepp, administrative project manager

Dallas Cowboys
- Dwin Towell, dir. broadcast engineering

WJHW
- Chris Williams, principal

Technology at work

AJA FS1 conversion/frame syncs
Apple Final Cut Pro
Avocent KVM switch
Barco displays
Canon BU-45H robo cameras
Chyron HyperX3 CGs
Click Effects CrossFire HD server
Crestron PRO2 control system
Daktronics video displays
DNF Industries
Drawmer D-CLOCK word clock distributor
EVS XT2 server
Evertz
- EQX router, with XLINK
- Quartz port router
- VIPX multiviewers
- Xenon audio router with MADI/TDM

Fast Forward Video
- Elite HD DDR
- Omega HD DVRs

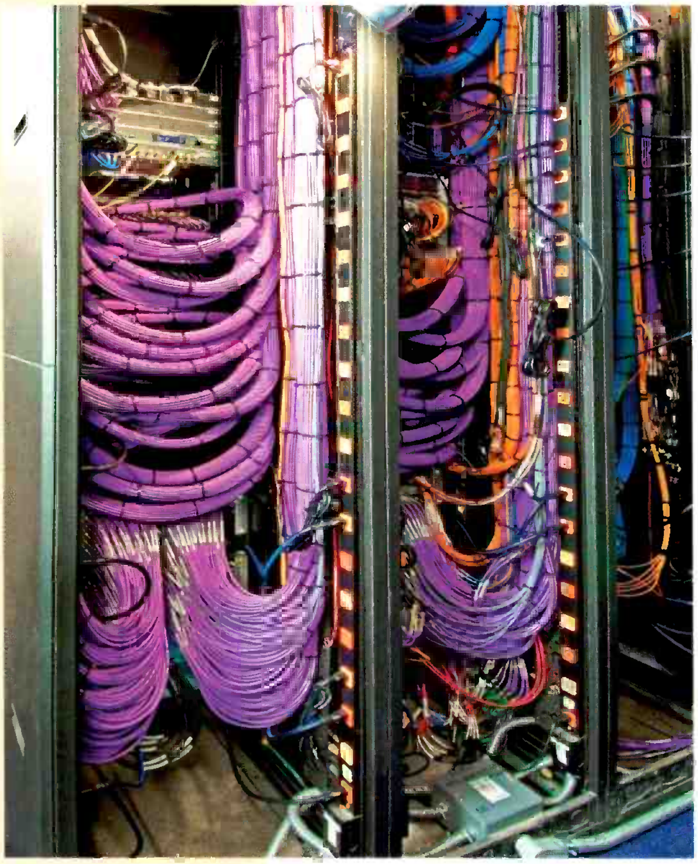
Harris NEXIO servers
Image Video tally interface
Riedel Artist 128 intercom
Sony
- HDC-1450, HDC-X310 cameras
- HDCAM, XDCAM camcorders
- LCD displays
- MKS-9011A control panel
- MVS-8000G switcher

TBC Consoles
Tektronix WFM7120 scopes
Wohler monitors
Yamaha CobraNet audio equipment

populated as 144 x 144, as well as two Evertz Xenon frames with a capacity for 256 x 256 currently populated with 32 x 32 analog audio and 160 x 160 AES audio. These two audio frames are integrated with a MADI/TDM interface that allows seamless A/D and D/A audio conversion within the router. With a mix of analog and AES signals in the stadium, this is a critical part of the system's flexibility.

There is also a 64-port data router for managing RS422 control between the various VTRs, servers, switchers and control panels. This routing system is managed by the EQX server that provides an easy-to-use, intuitive user interface.

From the outset of the project, it was decided to create a 1080i facility along with discreet analog and AES audio. This meant that every signal



Shown here is the rear view of the patch panel racks and audio router. Two Evertz Xenon audio frames are integrated with a MADI/TDM interface that allows seamless A/D and D/A audio conversion within the router.

This control room employs dual camera shading positions for 16 stadium cameras, a Riedel Artist intercom and triax patch panels.

entering the rack room must be native 1080i or be converted as soon as it enters the room. Utility devices such as IRDs, DVCAM, VHS and DVD players are converted to 1080i SDI video and discreet AES audio as the signals leave the device. This conversion is handled by AJA FS1 frame-sync/upconverters. Other signals entering the room, such as the fiber feeds from the truck dock, pass through Evertz 7812UDX upconverter/frame sync cards before they hit the routing switcher. There are an additional five FS1 units used as utility up/downconverters and frame synchronizers.

The main control room is centered on a Sony MVS-8000G HD switcher with 68 inputs and 48 outputs, and two DME frames. The Sony control panel can directly control 13 router destinations through the use of an Evertz 7700R-BRC-SC protocol translator. This interface also allows for the router mnemonics to flow into the Sony control panel. The three control room switchers, the routers and VIP multi-image displays are tied together via Image Video's tally interface for both tally control and UMD data.

A total of 16 HD cameras are available to the Cowboys' production crew. These include eight Sony HDC-1450 cameras with Canon lenses, one Sony PDW-700 with a MRC/LINK RF system, three Sony HDC-X310 POV cameras and four Canon BU-45H robo cameras with a Crestron PRO2 control system.

Content recording and playback is via a variety of devices that include a six-channel EVS slo-mo system with IP Director, two-record/four-playback channels of NEXIO server, a two-channel Click Effects CrossFire, a Sony HDCAM, two Sony XDCAMS and three Chyron HyperX3 CGs.

Although the main in-house audio mix is handled by the PA system, which ProMedia installed, the control rooms required two different audio controls. One is a way to create a basic audio mix that may be recorded or sent to the in-house distribution. This was accomplished by designing a CobraNet system that feeds three Yamaha mixing surfaces (one in each control room). The second requirement was a small mixer that could provide a "room mix" so the control room crew can hear sources such as the PA mix and referee mic to help guide their productions.

During an event, the control room crew has to communicate with camera operators, network production trucks and numerous personnel for coordination of player introductions, cheerleader performances, PA announcer, PA mixing control and a variety of other events that may require audio and/or video support. To accomplish this, a Riedel Artist 128-matrix frame was selected for its ease of setup, configuration and user interface. This system ties together all internal Riedel functions, as well as ties to outside devices such as two-way radios, wireless intercoms and wireless IFBs. It also can be linked with other systems via a four-wire to two-wire conversion and a source assignment panel.

Outcome

The state-of-the-art control rooms at the new Dallas Cowboys Stadium are a perfect complement to support this technologically advanced facility. These systems seamlessly integrate with the rest of the facility including the four large center hung screens, eight outdoor Daktronics displays, two Barco displays at one of the end zones, four channels of the in-house IPTV system, thousands of LCD displays as well as the PA system.

The control rooms have the flexibility to integrate with network production trucks and other outside systems and will help set the tone for future stadium control room design. In short, it does everything Towell requested and more. BE

Don Rooney is VP engineering at Burst.

Building IT networks

Knowing how to build an IT network is becoming the responsibility of the engineer.

BY RUSSELL BROWN

Today's engineer performs many tasks that used to be done by a specialist. Designing IT networks, either for the office or studio, is one of these tasks. The office network is normally straightforward, with workstations, printers and a server. Most nodes (equipment attached to the network) are dynamically assigned IP addresses, while the server and printers have static IP addresses. The use of subnets is important to keep sensitive information separate and off the main network. Subnets also help to organize a network and keep it running at top speed.

Subnets

Subnets (subnetworks) are used to divide up a LAN into functional sections, each with a common goal, such as accounting, engineering or traffic. Computers on a particular subnet can only see the other computers and printers on that subnet, while computers on other subnets can't. This separation reduces traffic by increasing the speed of the subnet and secures it by making it harder to access. To bridge between these subnets, routers are used, which allow information to travel between subnets — only data that is specifically addressed to a node on that subnet, not all the data traffic. Routers can have rules programmed into them to ensure only authorized data passes through it.

Computer networks follow the OSI model that consists of seven layers: Layer 1 is the physical layer, the electrical signals sent over network cables; Layer 2 focuses on moving data frames over Ethernet using MAC addresses, which network switches use to direct the data frames to the correct node; and Layer 3 is where IP addresses are used to route IP packets between LANs or subnets.

One way to design subnets is with virtual LANs (VLANs), which are created using a Layer 3 switch that can cordon off and communicate between subnets that are all connected to it. These Layer 3 switches have all nodes attached to it, no matter which subnet they are part of. Programming of the Layer 3 switch tells it what ports of the nodes are part of which subnet. It acts as both a network switch and a fast router. This one device will perform all the functions you need to set up and run a small to midsize network with several subnets. Because VLANs are programmable (within the Layer 3 switch), the subnets they form can have nodes easily added or removed without rewiring. (See Figure 1.)

Wiring

As we move to networks for technical areas, the requirements can change. The nonlinear editors require GigE or Fibre Channel to connect to a SAN or NAS, which may be mounted in racks back in the equipment room. Soon we will be using 10GigE networks that are capable of handling several streams of HD 3G video. These networks will be limited in size, with just a few nodes, but the wiring will be critical and must be thought out. GigE will run up to 300ft, but 10GigE requires fiber-optic cables for even moderate runs.

Wiring then becomes the defining element in any network, and changing

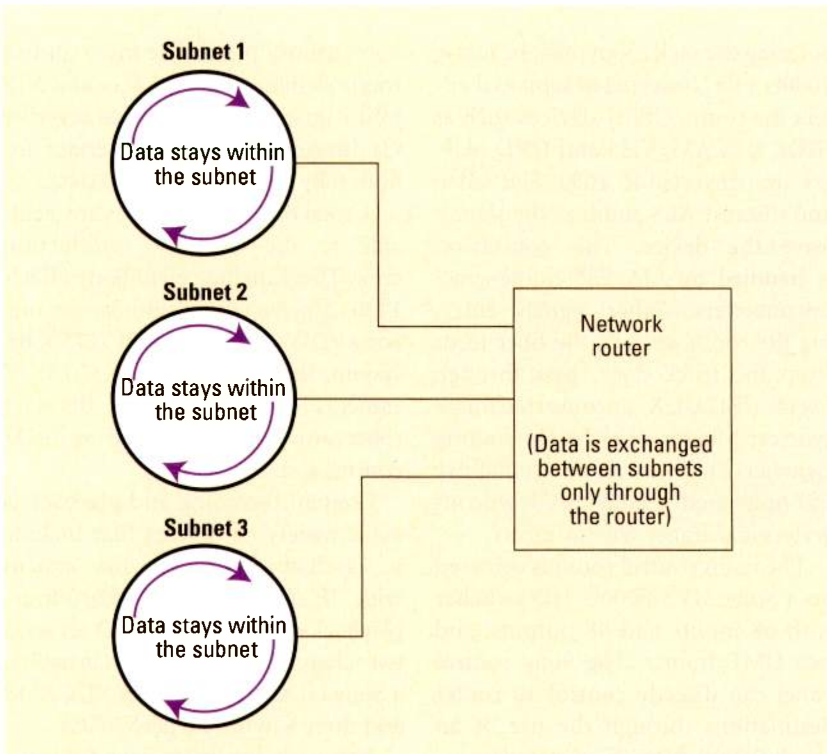


Figure 1. Subnets exchange data through a network router. The use of subnets can enable faster, more secure networks.

out a network switch or computer is very simple compared with changing out the wiring of the plant. You want to future-proof your facility when selecting the wiring that's going to make up the network; just putting in Cat 5 is not enough today. Will you ever put edit bays on the second floor or run out of rack space and need an auxiliary equipment room in the back? If you have installed the correct wiring, then expansion is simple. Installing conduit is another option to future-proof your facility. This will allow you to run fiber-optic cables when needed without having to tear the ceiling down.

Security and access

Don't forget about security — in terms of physical, software and personnel. When thinking about the Internet, a firewall is always a good idea, but sometimes just pulling the patch cord to the Internet is the most secure way to protect your network from intrusion. Many companies now use the Internet to access clients' computers for maintenance and upgrades. Providing outside access to critical on-air systems does carry some risk, but the benefits of allowing both the manufacturers and employees 24/7 access to these systems can be crucial to getting a needed system back online quickly.

There are now several companies that provide access to computers located on the other side of firewalls by installing their own software on those computers. The advantage here is that your computers can be accessed by you on any computer on the Internet, and no software is required on the computer accessing the guarded computer. You can be in an Internet café in Paris and check up on systems back at the station.

All worthwhile endeavors start with a plan, and IT networks are no different.

Be careful when using wireless networks, however. Place them on their own subnet to isolate wireless users from the rest of the network. The MAC address of the wireless device can be used to authenticate it to the network, making it even harder for someone else to break into your network. Passwords are an important part of any security setup, and enforcing policies on password length and makeup are also imperative.

Planning

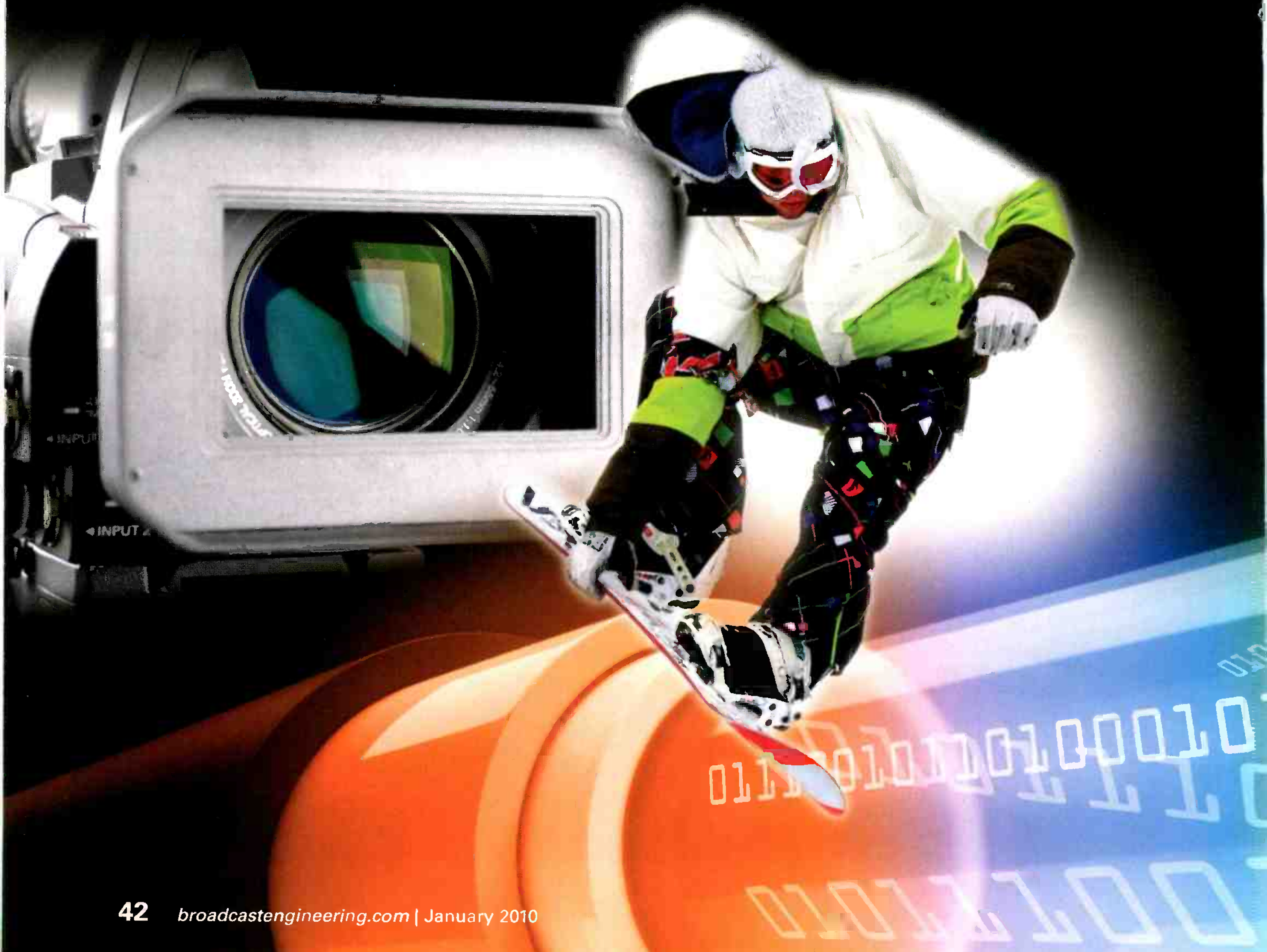
All worthwhile endeavors start with a plan, and IT networks are no different. Begin with a list of requirements. What does the network have to do? Does it connect an automation system together, a video server or edit bays? What data speed is needed, and what level of security and interconnectivity? As you organize the users and equipment by function, the arrangement of the subnets will become clear. Devise a plan of IP addresses for each subnet; think of how many addresses are going to be needed now and into the future. Remember, a subnet mask defines the actual range of IP addresses in each subnet, so making a plan with all the IP data is important. Where will the equipment be housed, will it be secure, and who has access? What backup equipment is necessary, and how will it be put into action if needed? Is Internet access required, and, if so, how will access be controlled?

Just like backing up all your data on your personal computer, all of this may sound like overkill — until the day your hard disk crashes. BE

Russell Brown is chief engineer at KMTP-TV in San Francisco and writer of Broadcast Engineering's "Transition to Digital" e-newsletter.

Sports production technology

BY MICHAEL GROTTICELLI

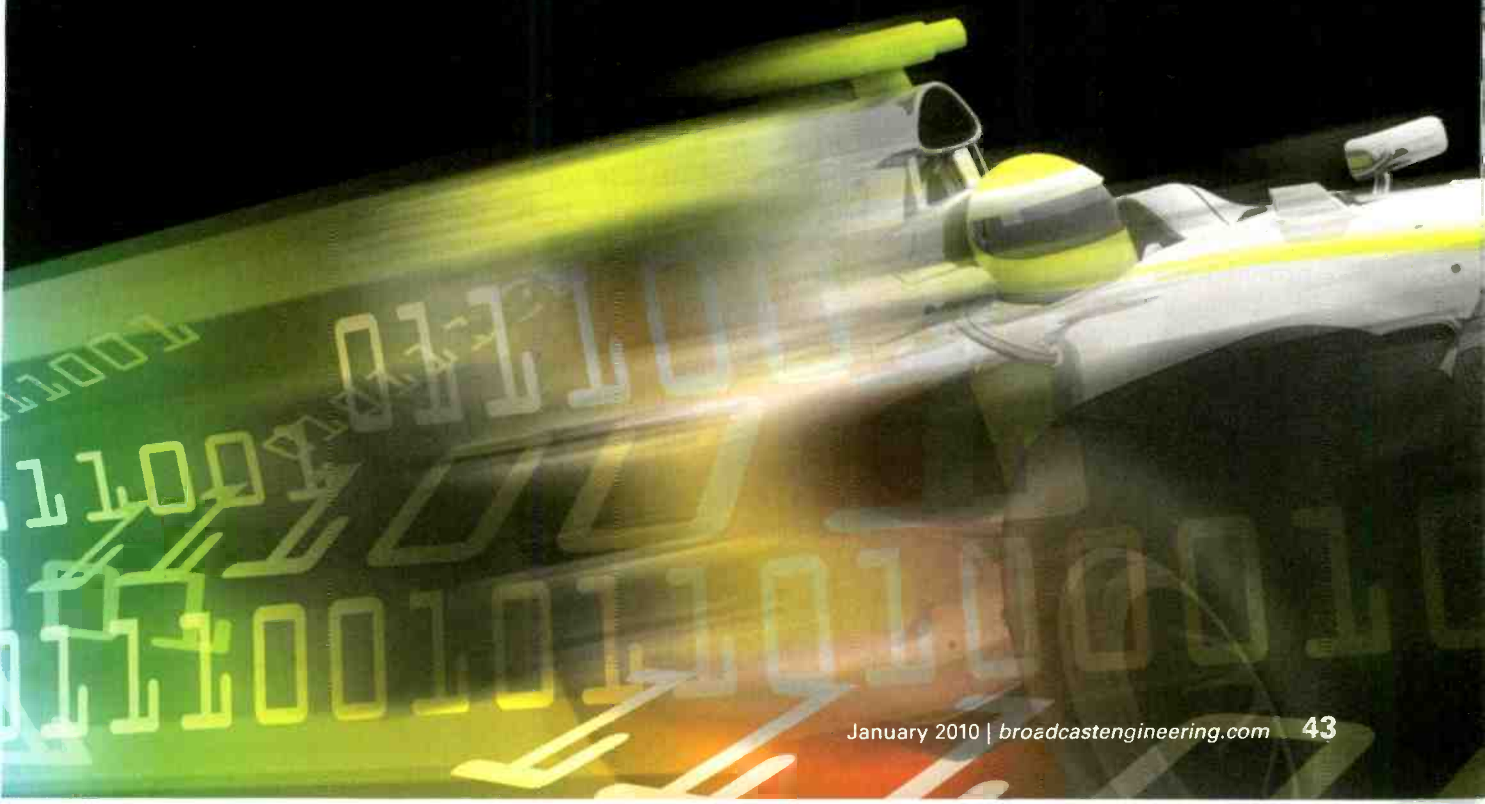


File-based digital productivity is the name of the game.

The concept of handling video clips as digital files — that speed up the production process to get content to air quickly, can be easily shared, and sent and received via IP networks — is no longer a far off dream. In today's highly competitive sports production environment, it is now a necessity.

Indeed, the advent of file-based infrastructures has made a wide variety of traditionally labor-intensive processes more efficient and allows sports production organizations to be in several places at the same time. In a time of budget tightening and staff reductions, IP connectivity has changed the way fast-paced production gets done.

Take, for example, the Big Ten Network, with its production headquarters in Chicago. In order to acquire content for its 24/7 cable channel, it has installed Panasonic P2 equipment (including Panasonic HVX200 cameras and P2 Readers) and Avid NewsCutter editing software at all 11 Big Ten Conference university campuses.



The video production unit for the University of Nebraska Athletic Department recently upgraded to Panasonic HD studio cameras and P2 HD camcorders with wireless transmitters to support a file-based workflow.

The HD control room at the New York Giants' Meadowlands Sports Complex employs Sony HDC-1400 studio cameras and XDCAM HD optical camcorders, an MFS-2000 production switcher, HDCAM decks, and LUMA LCD monitors.

Each school also has a P2 server that sends and receives 100Mb/s HD files via a 1Gb/s link back to Chicago headquarters via FTP.

Student crews capture local footage and ingest it into the on-site server. Back at the Big Ten Network studios, a server automatically receives the finished files and places them into separate folders for each school.

Chicago-based producers view clips and select those for inclusion into the network's nightly highlight shows. Other shows, like "Friday Night Tailgate," also make extensive use of the footage.

These many efficiencies result from using a file-based production system. Benefits include the ability for producers to see clips quickly, no tape costs and faster production.

Looking to further expand its reach, the network is now building flypacks of HD equipment that was previously used for the Olympic sports of volleyball and women's basketball. The flypack includes Panasonic HVX170 cameras, a Sony AnyCast switcher and T-VIPS IP encapsulators to encode the video. The systems are relatively inexpensive to put together and enable student crews to acquire high-quality footage.

Comcast SportsNet Bay Area, located in Northern California, has moved to a new HD production facility, where a team of more than 90 journalists produce several hours of programming daily using Avid iNEWS. The facility also features an Avid NewsCutter, Media Composer systems, and an ISIS and several AirSpeed servers for play to air.

Each of Comcast's nine edit rooms has access to 96TB of storage on the ISIS system. Up-to-the-minute management of almost 700 online hours of HD media is handled by Interplay, Avid's nonlinear workflow engine. The Interplay system ties all of the disparate pieces together, allowing unlimited collaboration among the production staff.

As HD files are being transferred from Sony XDCAM HD field acquisition media, incoming satellite feeds are being captured into AirSpeed servers using the Avid DNxHD codec. Newsroom personnel log content at their desktops using the Interplay Assist application. As program, rundowns and scripts take shape in the iNEWS system, HD stories, promos and graphics are transferred to playback under the control of Avid Command.

In-stadium entertainment and team training

Sports teams' in-house production departments are embracing file-based workflows for the creation of HD video content for team training and fan entertainment. The digital technology's fast turnaround times and cost-effectiveness facilitate the use of video in a variety of creative ways.

The New York Giants football team, for example, is using Sony XDCAM HD camcorders (with Canon HD lenses) and XDCAM HD source decks at its new training facility in New Jersey. The facility is located within the Giants' home stadium, the Meadowlands Sports Complex. It houses a full HD control room, including Sony HDC-1400 studio cameras and XDCAM HD optical camcorders, an MFS-2000 production switcher, HDCAM decks, and LUMA LCD monitors. The HD control room also handles stadium video production, including developing content for playback on stadium screens during games.

Don Sperling, vice president/executive producer for the Giants, said the file-based Blu-ray optical disc workflow, with its pristine image quality and "proxy" files on the disc, were the main reasons for choosing the


CHANGE YOUR VIEW
HARRIS
22:43:08
09:32:27
02:08:56
Source One
Source Two
Source Three
Source Four
Source Five
Source Six
Source Seven
Source Eight

XDCAM HD recording system. The original disc is also used as the archive media, which makes the handling of footage easy and much closer to traditional tape-based workflows.

At Boston's Fenway Park, the large video display board and monitors around the ballpark are fed by a 360 Systems three-channel MAXX video server. Channel 1 feeds the in-house

At Boston's Fenway Park, the large video display board and monitors are fed by a 360 Systems three-channel MAXX video server.

cable channel, Sox on Six, which serves up programs like "The Red Sox Report" and "Red Sox Stories" to video monitors throughout the stadium. A second channel provides a backup "in-game" feed to the stadium video display. During rain delays, stored material keeps the crowd entertained with "evergreen" features. The remaining channel is used for ingest.

Chief engineer Eric Hancock said that because they are working with files, they could roll out a playlist, edit it and quickly change the file order as necessary. Staff members use the Image Server's built-in editing features to trim the heads and tails of programs. Eight edit bays and editors work on Apple Final Cut Pro (FCP) and transfer files over a GigE network feeding a Ross Video router and an Echolab switcher.

Likewise, the Cincinnati Reds' Great American Ball Park has a large scoreboard display and hundreds of digital signage displays located throughout the stadium. A new control and production facility was built to support the production of HD content.

With a 40TB centralized storage solution from EditShare integrated with software from Dixon Sports Computing and EVS servers, Reds' production manager Dave Storm and his team create a variety of packages while quickly managing and repurposing audio and video clips through the use of metadata. The Reds' EditShare system is connected via 10GigE to an HP ProCurve network switch to ensure simultaneous access to clips for its five editors working on Apple FCP workstations.

File-based production on a grand scale

The World Wrestling Entertainment (WWE) provides fans with a variety of live and post-produced shows from its HD broadcast and production facility in Stamford, CT. The network produces more than 50 hours of programming per week on a SAN-based facility using Grass Valley K2 servers and the Aurora HD editors. The file-based infrastructure permits editors to quickly turn around packages, sometimes in less than an hour. For the show "Wrestlemania," the backhaul starts airing before the final tail is finished.

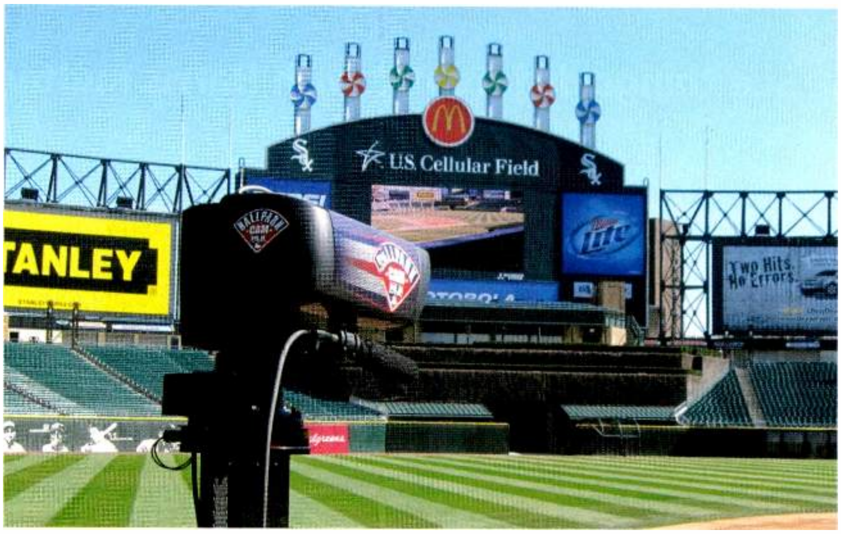
In January 2008, the facility was converted to HD with multiple Aurora HD systems, and a file-based infrastructure is handled as I-Frame MPEG-2 at 70Mb/s, which maintains a high-quality level and makes it easy to store and retrieve from a dozen four-channel Grass Valley K2 servers. This also allows editors to avoid working with mixed formats.

WWE's HD digital production system now includes 16 HD ingest channels. There's a maximum capacity of 3800 usable hours of HD with 15,000 hours of online disk base proxy storage. At full capacity, the system will enable 50 simultaneous users, 20 full-resolution viewing seats and 36 full-featured multistream nonlinear editors.

The Aurora platform works alongside an Apple XSan supporting FCP editors, which are not tied into the K2 SAN. A Telestream FlipFactory moves content between the XSan and the K2 SAN. WWE archives its digital files to an SGL robotic library system.

IP networks expand reach

Another file-based workflow proponent is Major League Baseball, which launched its MLB Network channel a year ago from the former MSNBC facility in Secaucus, NJ. The MLB Network has a large 140,000sq-ft space that is tied into all 30 MLB



The MLB Network employs a system called BallParkCam. Three signals from up to 15 live games as well as 48 channels of discreet audio are sent live via MPEG-4 4:2:2 AVC encoded streams to the highlights factory, and a clean version is recorded on a local server.

ballparks around the country via two-way links.

Systems integrator The Systems Group installed most of equipment under the guidance of broadcast design firm CBT Systems, which drew up the plans and supervised the massive rebuild. Mark Haden, vice president of engineering and IT for the MLB Network, supervised the engineering group.

The new facility features 25 edit rooms, employing 10 Apple FCP workstations, 15 Grass Valley Aurora LT NLEs, multiple Grass Valley K2 HD servers and two large studios — one of which contains a full-sized baseball infield complete with mound, dugouts and scoreboards. A new production space includes 15 Apple FCP edit suites and two Fairlight-based audio sweetening rooms.

The adoption of IT-centric infrastructures has helped improve coverage of sporting events.

Employing a system called BallParkCam, three signals from up to 15 live games as well as 48 channels of discreet audio (effect, TV audio, radio calls and foreign-language commentary) are sent live via MPEG-4 4:2:2 AVC encoded streams to the highlights factory, and a clean version is recorded on a local server. In addition, HD content with multitrack audio is sent from Secaucus back to the ballpark for use in the local scoreboard or the on-site production truck.

Once complete (more than half of the MLB ballparks have been finished), each ballpark will have from two to five robotic cameras, supplied by Canon, providing unique POV shots of the dugout, centerfield, the pressroom and both bull pens. The MLB Network uses a Riedel intercom system that allows the crew, talent and guest players to communicate over an IP network between Secaucus and the various ballparks.

Integrated production systems

At a time when virtually everyone is looking to limit production costs while providing more content for their fans, the use of integrated production systems has become popular with both professional sports organizations as well as colleges and high schools. The systems have become increasingly popular because they require only a single operator to manage an entire production.

Turner Studios is using a Slate 3000 integrated production system from Broadcast Pix to produce an innovative "second screen" experience for sports fans. Accessible via Web or mobile devices, these live webcasts complement Turner Sports' NBA and NASCAR coverage. Viewers can see additional HD camera views of the live action, as well as timely scores, stats, and exclusive interviews.

To complement its NBA and NASCAR coverage, Turner Studios uses a Slate 3000 production system from Broadcast Pix to produce live webcasts accessible via Web or mobile devices.

No matter what level of competition, the adoption of IT-centric infrastructures has helped improve coverage of sporting events and allowed productions to do more than was ever possible before. Today, that's the name of the game. BE

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

BY DENNIS CIAPURA

Turn down the volume

Uncle Sam plans to control digital TV audio.

With all of the complexities of digital TV broadcasting, who would ever have thought that audio level control would become a national issue? It's become an issue so much so that the Commercial Advertisement Loudness Mitigation Act (the CALM Act, H.R. 1084) is inexorably inching its way through Congress and is expected to gain broad consumer support.

It's not as though this is a new issue. The FCC issued a Notice of Inquiry on the subject in 1962, a second notice in 1979 and an Opinion and

Order in 1984. The perfect storm that has finally forced the situation to a head is the intersection of digital television's far greater audio dynamic range and the proliferation of high-quality 5.1 TV audio systems in the home as companions to the large-screen HDTVs that have been flying off the shelves.

Why digital audio is an issue

Dialnorm, the audio metadata protocol, was supposed to provide absolute level assignments to all sources, and in a perfect world, DTV audio level control would not be a problem. Commercials would be assigned appropriate levels compatible with surrounding program levels, and the Dolby decoders in the home would dutifully reproduce the desired level scaling. Unfortunately, as Gilbert Besnard pointed out in his article "Getting loudness under control" (in *Broadcast Engineering* December 2008), it is virtually impossible to preserve the original audio metadata through the complexities of production, storage, distribution and transmission in a modern TV plant.

Therefore, viewers with digital receiver outputs feeding 5.1 Dolby decoders are essentially getting raw audio, and most commercials are processed to produce consistently high average levels. They are intentionally loud. This is further exacerbated by the fact that many viewers are enjoying their 5.1 program audio at high levels, and when loud commercials hit, they really hit! Even before digital, and with significant analog program audio compression at the station, the inherent commercial loudness differential was prompting a regular stream of viewer complaints. And even with cable or satellite set-top boxes with additional audio compression enabled, many commercials still sound louder than the programming.

Government steps in

There are three major components to the commercial loudness problem. It's certainly a broadcast technical problem, but there's also a consumer electronics component as well as a growing political problem. Of these, the political aspect may be the most vexing. Broadcasters and advertisers loathe the idea of government intervention. The advertiser and ad agency perspective is revealingly reflected in a June 29, 2009, "Adweek" column by Robert Thompson, wherein he points out that "noisy and strident are part of the very foundation of advertising aesthetics." Broadcasters obviously strive to super serve advertisers and the agencies, particularly in today's difficult economic environment with ever increasing shares of ad dollars going to alternative media.

TV broadcasters can no longer ignore the reality of the pressure for a legislative remedy after 40 years of complaints.

But TV broadcasters can no longer ignore the reality of the pressure for a legislative remedy after 40 years of complaints. As Joel Kelsey of the Consumers Union stated in his June 11, 2009, testimony before the House Subcommittee on Communications, Technology and the Internet, 21 of the 25 FCC reports on consumer complaints since 2002 have listed loud commercials as a top grievance. Jim Starzynski of NBCU and David Donavan of MSTV provided effective testimony at the same session. They described the ongoing industry efforts to resolve the commercial loudness problem and requested that legislation not be moved forward pending the introduction of the new Recommended Practice for implementing the ATSC audio standard.

In late October, Starzynski presented a demonstration of how the Recommended Practice would work to subcommittee representatives, and although the demo was well received, it looks like H.R. 1084 is moving forward anyway. It has been amended to reference the Recommended Practice, but calls for the FCC to mandate its implementation. The original bill was clumsily based on "modulation" levels and maximum program loudness without reference to program length time integration, so at least the amended version would be based on meaningful industry-developed standards.

The ATSC Recommended Practice was introduced at an ATSC seminar on Nov. 4, 2009, and will be summarized in an article by Jim Starzynski in the March 2010 issue of *Broadcast Engineering*. This recommendation is the culmination of years of work by many of the brightest minds in the business and is intended to provide a path to effective commercial loudness control while maintaining the exciting program dynamic range that consumers have come to expect.

The reality is that in H.R. 1084, Rep. Anna Eshoo, D-CA, has a bill that almost nobody other than advertisers, TV broadcasters, cable and satellite operators would oppose. After all, how many representatives would like to explain to their constituents back home why they opposed a bill to stop loud TV commercials? And with consumer-oriented FCC chairman Julius Genachowski at the helm, it is expected that there will be effective enforcement.

The amended bill, which would be effective a year after passage, gives operators that can demonstrate hardship a one-year waiver with a possible one-year renewal, and this is a big loophole that many operators will jump through. This in turn will likely create an awkward mix of conforming and nonconforming outlets for some time, which may lead consumers to conclude that nothing much has changed, resulting in a continued flow of complaints to the FCC for years.

Audio equipment in the home varies, making the control of commercial loudness an even larger challenge.

Understanding the technology

The least controllable element in the commercial loudness control challenge is consumer equipment in the field, and there can be some unexpected interactions with broadcast 5.1. For example, some commercials are not produced with 5.1 audio, but are transmitted as digital 5.1 with stereo audio "enhancement." The receiver decoder senses the 5.1 digital input and applies whatever sonic processing the user has selected for normal 5.1 audio. This often results in phase-shifted mono or stereo audio that has an echo, which makes it louder than the surrounding program audio, even if the level is the same. In a mix with other commercials that have been properly encoded, this also creates a spot-to-spot differential.

And there are other anomalies. While most produced long-form programming these days comes with excellent 5.1 audio, local- and even some network-generated programs may lack true 5.1 capability. A convenient solution is to feed the available stereo audio to the left and right 5.1 channels. The problem with this is that home video/audio systems typically include a crossover to the subwoofer channel at 100Hz-200Hz. With no subwoofer input, the viewers get thin-sounding audio with the low end band limited by the crossover frequency. The subwoofer is essentially out of the picture — until a nice punchy compressed commercial comes along! In this age of sophisticated home video/audio, program producers and broadcasters must understand the technology that consumers are using.

Viewers are enjoying their 5.1 program audio at high levels, and when loud commericals hit, they really hit!

Conclusion

The key to the successful implementation of the Recommended Practice, and heading off further government intervention, is in universal adoption. While the major networks and most major market affiliates can be expected to conform, the cable and satellite systems may lag. Local spot inserts in cable systems are a particularly weak point. These are usually local direct retail spots sold by local salespeople who are desperate to get their client's spots noticed. Hopefully, advertisers and their agencies at all levels will come to realize that the ATSC Recommended Practice is a far better solution than the viewer's mute button. BE

Dennis Ciapura is president of Performance Broadcasting, a broadcast management consulting company.

How to make your loudness comply

With or without additional government regulations, ATSC standards published back in the mid-1990s and adopted as the law by the FCC mandate that loudness be correct. If you didn't know that, you are not alone. There is no practical guidance as to how to make this happen. However, a new ATSC recommended practice attempts to distill a lot of information into one reference.

ATSC A/85 "Techniques for establishing and maintaining audio loudness for DTV" lays out a comprehensive plan for managing loudness from production to transmission. Essentially, it boils down to measuring content using an ITU-R BS.1770-compliant loudness meter to ensure that all audio either matches a loudness reference (-24 LKFS +/-2) or that the audio and corresponding metadata match. In either case, content that does not match can be rejected or adjusted, or metadata can be reauthored.

Guidance on both permanent and reversible dynamic range control is presented to help broadcasters understand the choices, and practical advice is given for setting monitor levels properly in production and post production so that an appropriate dynamic range will result during mixing and not be relegated to arbitrary adjustment later. A useful quick start guide is included to point readers directly to areas of interest.

What does a broadcaster need from the station side? At a minimum, you need a copy of A/85 and at least one real-time ITU-R BS.1770-compliant loudness meter to act as the station's DTV audio "mod monitor." It may be wise to invest in more than one to allow monitoring of incoming content and to keep live productions in check. There's no need for mixers to worry; loudness meters work alongside the existing devices they are comfortable with.

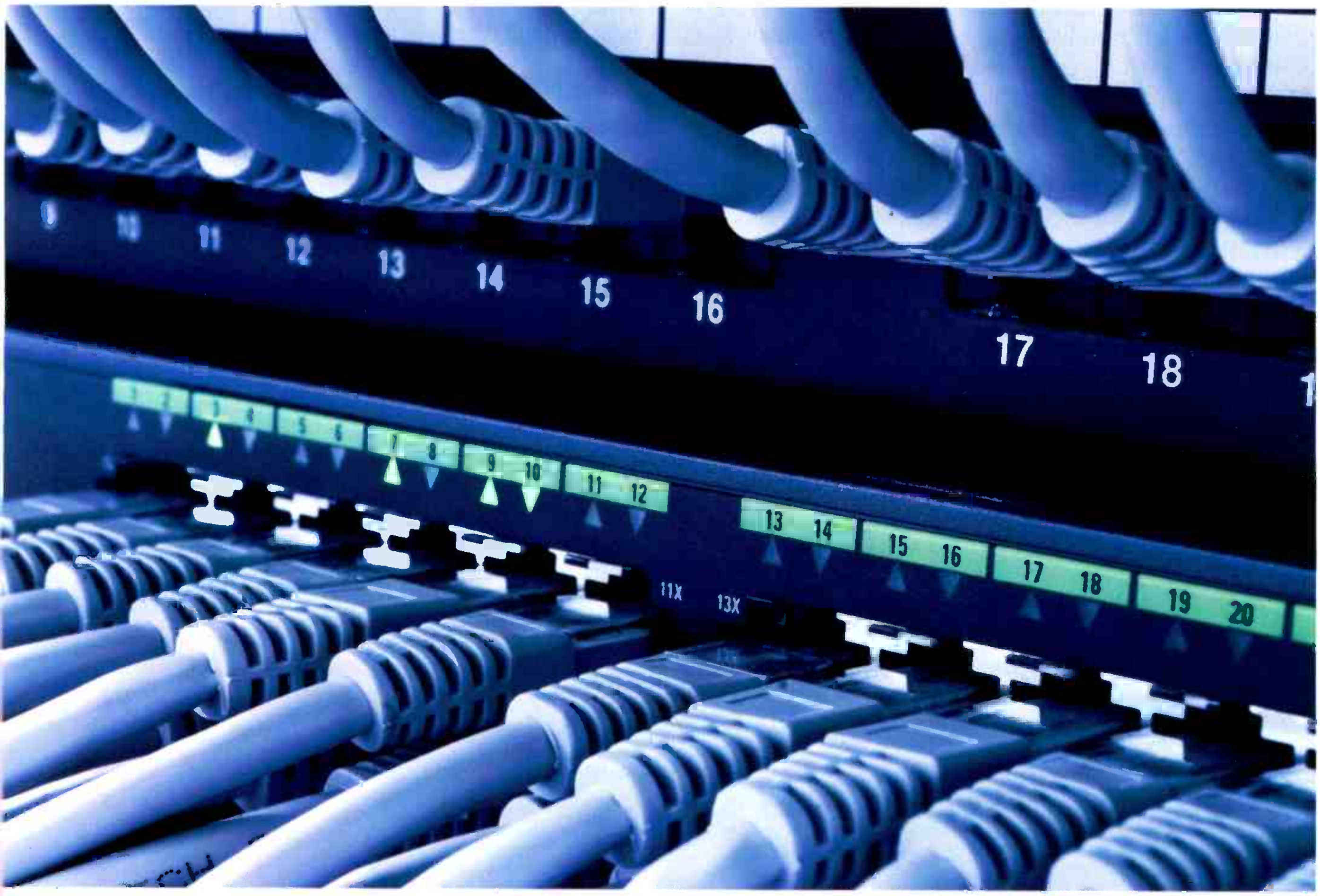
Since the overwhelming passage of A/85 in November, broadcasters now have a reference to point to in their own delivery specifications and can send a clear and united message to program and commercial providers that they require loudness consistency in order to preserve audio quality, maintain legal compliance and most importantly satisfy viewers.

ATSC A/85 can be downloaded online at *www.atsc.org/standards/practices.php.* BE

Tim Carroll is the president and founder of Linear Acoustic.

Employing Data Center Ethernet in media networks

BY LUC ANDRIES



As more broadcasters transition to file-based media production systems, Internet Protocol (IP) has become the transport technology of choice. Applying an IT-based infrastructure to media introduces benefits to media workflow systems, but also creates new requirements that must be addressed. One area that demands particular attention is storage, as media applications pose unique storage requirements that differ from classical IT solutions.

An IP-based media storage architecture must provide robust parallel throughput and high capacity, scalability, redundancy and availability. The nature of a file-based media workflow means it must operate in a multiuser environment and provide simultaneous access to files (leading, by definition, to a random access pattern on the underlying file system and storage architecture). Because of the continuous nature of media applications, the throughput of each I/O operation on media storage must also be guaranteed under all circumstances. While a slow e-mail is still an e-mail, a slow video is no longer video.

To meet these requirements, each technology layer of a media storage environment must perform optimally and provide guaranteed throughput, including the storage network. Today, many file-based media storage environments use InfiniBand (IB) storage network interfaces due to its high link bandwidth (16Gb/s throughput for double data rate IB) and low cost per port. Now, a new technology, Data Center Ethernet, has emerged that can offer performance advantages over IB. Our lab tested DCE against IB in a typical media network and found that DCE provides a compelling media storage solution.

Creating a lossless network

A stringent requirement for any

storage network technology is to provide a lossless environment. IB and DCE accomplish this in different ways. IB uses a buffer-to-buffer credit mechanism to avoid frame loss. Credits of available buffers are continuously exchanged between ports on the same link. When no buffer credits are available, no packets are transmitted until the network processes its congestion and buffers become available again. Hence, the receiver never needs to drop frames.

DCE provides a lossless network through the use of a pause frame mechanism defined in the IEEE 802.3x standard. Conventional Ethernet does not keep track of the buffer availability on the receiving end of a link and assumes by default that buffers are available, creating a risk of buffer overflow on the receiver. With the pause mechanism, a receiver that notices that its buffers are being filled above a certain threshold can send a pause frame back to the source, telling it to hold all transmissions for a certain amount of time. (See Figure 1.) Once the buffers have returned below the threshold, the source can resume transmissions.

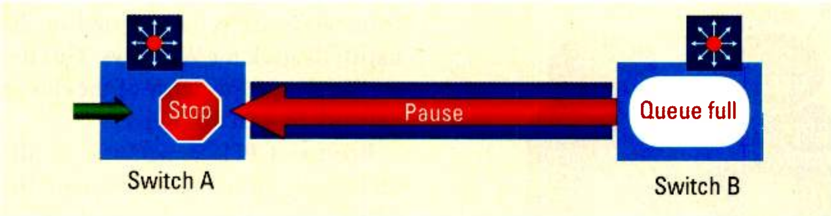


Figure 1. IEEE 802.3x pause frame mechanism

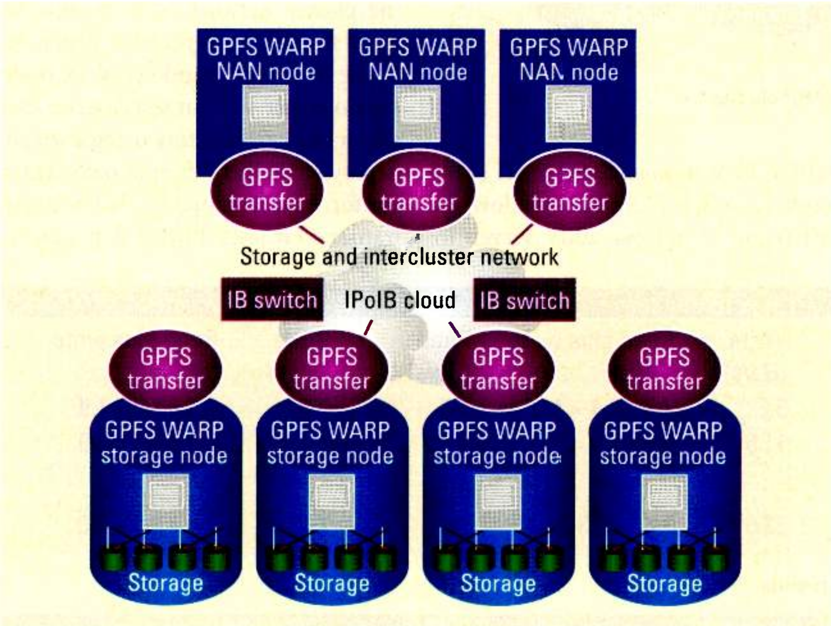


Figure 2. GPFS media storage WARP cluster

In a media cluster environment, with its simple well-defined topology, the 802.3 pause mechanism should demonstrate an observable behavior close to the lossless buffer-to-buffer credit mechanism of IB.

Running the test

We based the test architecture on the General Parallel File System (GPFS) media storage cluster from IBM, one of the most powerful media file systems available. A GPFS cluster based on the network-attached node (NAN) model consists of storage cluster nodes and network-attached cluster nodes. The storage servers are directly connected to the storage, whether locally attached or via a storage-area network (SAN) architecture. NAN nodes are via a cluster network connected to all storage nodes, but are not directly attached to the underlying storage. In this architecture, each storage node is the access point or primary server for part of the total storage. The NAN node stripes its data requests over all storage nodes, thereby aggregating the available bandwidth of each individual storage node and connected storage subsystems.

IB-based WARP cluster

The IB cluster architecture, named Workhorse Application Raw Power (WARP) media storage cluster, displays a many-to-one traffic pattern. When a NAN node reads from the storage nodes, all the storage nodes respond at the same time back to the NAN node with large bursts of traffic. If, on the other hand, multiple NAN nodes write data to the storage, the receiving storage nodes are simultaneously addressed by the bursts of all the writing NAN nodes. Both cases result in heavy oversubscription of the cluster network.

The InfiniBand stack is extremely efficient for Linux-based servers, reaching the full physical limits of the underlying bus technology. The processing of the protocol stack is fully offloaded in the IB host channel adapter network cards. Even remote direct memory access is fully supported and exploited. This leads to a powerful cluster architecture, extremely well adapted for file-based media production environments. (See Figure 2.)

DCE-based WARP cluster

One potential issue of media environments that places constraints on IB-based architectures is that many media client applications require a Microsoft Windows operating system. This is the case for both Windows applications that have to run on the NAN cluster nodes and

Figure 3. DCE-based GPFS media storage WARP cluster

applications that require a mount of the central file system via the CIFS protocol. Recently, IBM added a GPFS-on-Windows client to its NAN node configuration. This allows a Microsoft Windows 2003 server to participate as a NAN node in the GPFS cluster. The state-of-the-art IB stack for Windows machines is, however, much lower-performing than the Linux version. The cluster protocol stack has to fall back to using IP-over-Infiniband (IPoIB) without any offloading, because not all GPFS commands are yet supported in the native IB stack for Windows. This decreases the performance of the cluster network by a factor of five.

Because GPFS is agnostic to the underlying network technology, the GPFS WARP cluster can be designed with DCE technology replacing IB as the cluster network. (See Figure 3.) This should be especially beneficial in the Microsoft Windows NAN node environment. For our test case, we created a DCE architecture using a widely deployed 10Gb/s Ethernet data center platform that supports 802.3 pause frames. Our tests showed that a DCE-

		Linux IB cluster			Windows IB cluster		
		Read (Gb/s)	Write (Gb/s)	Read plus write (Gb/s)	Read (Gb/s)	Write (Gb/s)	Read plus write (Gb/s)
Single NAN	One stream (dd)	7.7	5.3	7.2 + 4.4 = 11.6	1.7	2.4	0.9 + 1.0 = 1.9
	Nine streams (dd)	1 .3	11.5	4.7 + 9.1 = 13.8	1.7	2.4	0.9 + 1.1 = 2.0
Three NAN	Nine streams (dd)	25.7	23.0	3.6 + 20.3 = 23.9	5.0		2.4 + 3.5 = 5.9

Table 1. IB-based WARP cluster throughput results

		Linux 802.3x DCE-based cluster			Windows 802.3x DCE-based cluster		
	Single connected	Read (Gb/s)	Write (Gb/s)	Read plus write (Gb/s)	Read (G/s)	Write (Gb/s)	Read plus write (Gb/s)
Single NAN	One stream (dd)	9.8	9.7	5.4 + 9.1 = 14.5	9.9	9.6	6.1 + 6.5 = 12.6
	Nine streams (dd)	9.9	9.8	5.7 + 8.9 = 14.6	9.9	9.9	4.5 + 8.1 = 12.6
Three NAN	Nine streams (dd)	22.6	20.0	4.2 + 17.4 = 21.6	23.6	22.9	3.6 + 18.6 = 22.2

Table 2. Single-connected DCE-based WARP cluster throughput results

		Linux 802.3x DCE-based cluster			Windows 802.3x DCE-based cluster		
	Double connected	Read (Gb/s)	Write (Gb/s)	Read plus write (Gb/s)	Read (Gb/s)	Write (Gb/s)	Read plus write (Gb/s)
Single NAN	One stream (dd)	17.7	15.7	5.3 + 12.0 = 17.3	11.5	10.4	6.0 + 6.6 = 12.6
	Nine streams (dd)	1 7	16.3	5.3 + 12.4 = 17.7	1.0	14.8	4.3 + 8.9 = 13.2
Three NAN	Nine streams (dd)	26.1	22.8	3.8 + 17.8 = 21.6	25.3	23.1	3.1 + 19.7 = 22.8

Table 3. Double-connected DCE-based WARP cluster throughput results

based GPFS WARP cluster is capable of making use of the full bandwidth provided by the 10Gb/s DCE platform.

The results

We configured the IB-based system to use the "dd" application as stream generator and used DDR IB in an active/active setup using verbs. The storage throughput limitation for the system was ~800MB/s per storage system, and the cluster consisted of three NAN nodes and four storage nodes. As a baseline reference, we performed throughput benchmark tests on the IB-based clusters with both Linux and Windows NAN nodes. The tests included:

- single stream throughput from one NAN node;
- multiple streams from one NAN node (for a more even saturation of the link bandwidth); and
- multiple streams simultaneously from all NAN nodes.

Table 1 shows the results.

For the next phase, we replaced IB with 10Gb/s DCE in the storage cluster network. The IEEE 802.3x pause mechanism was activated, both on the switch and on the converged network adapters to create a lossless Ethernet. The DCE-based WARP cluster tests were executed with Nehalem-based servers as NAN nodes, as they were able to fully saturate the 10Gb/s link.

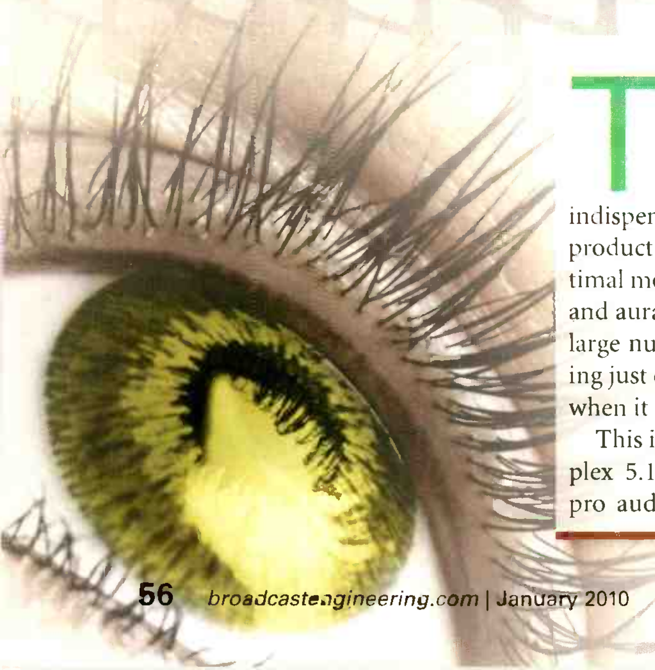
In the first DCE setup, all servers were connected with a single 10Gb/s link to the switch, compared with the double active/active setup of IB. In a second test, dual links were used. The traffic between different server pairs was routed over different interfaces. We performed the same benchmark tests as were used for the IB-based system. The results for the single-connected and double-connected systems are shown in Tables 2 and 3.

These results show that the DCE system outperforms the IB cluster on these benchmarks. A single NAN DCE-based cluster outperforms the IB-based cluster by 663 percent, and three NAN DCE-based clusters outperform the IB-based cluster by 384 percent. The performance gain for the Windows setup is remarkable.

Ultimately, DCE is an effective solution in real-world media environments. The Windows performance of a DCE-based GPFS media storage WARP cluster opens up opportunities to connect many Windows-based editing stations to a generic media storage cluster. With this architecture, it is easy to envision a high-resolution HD post-production editing platform that scales well beyond the state-of-the-art solutions presently offered by media vendors. BE

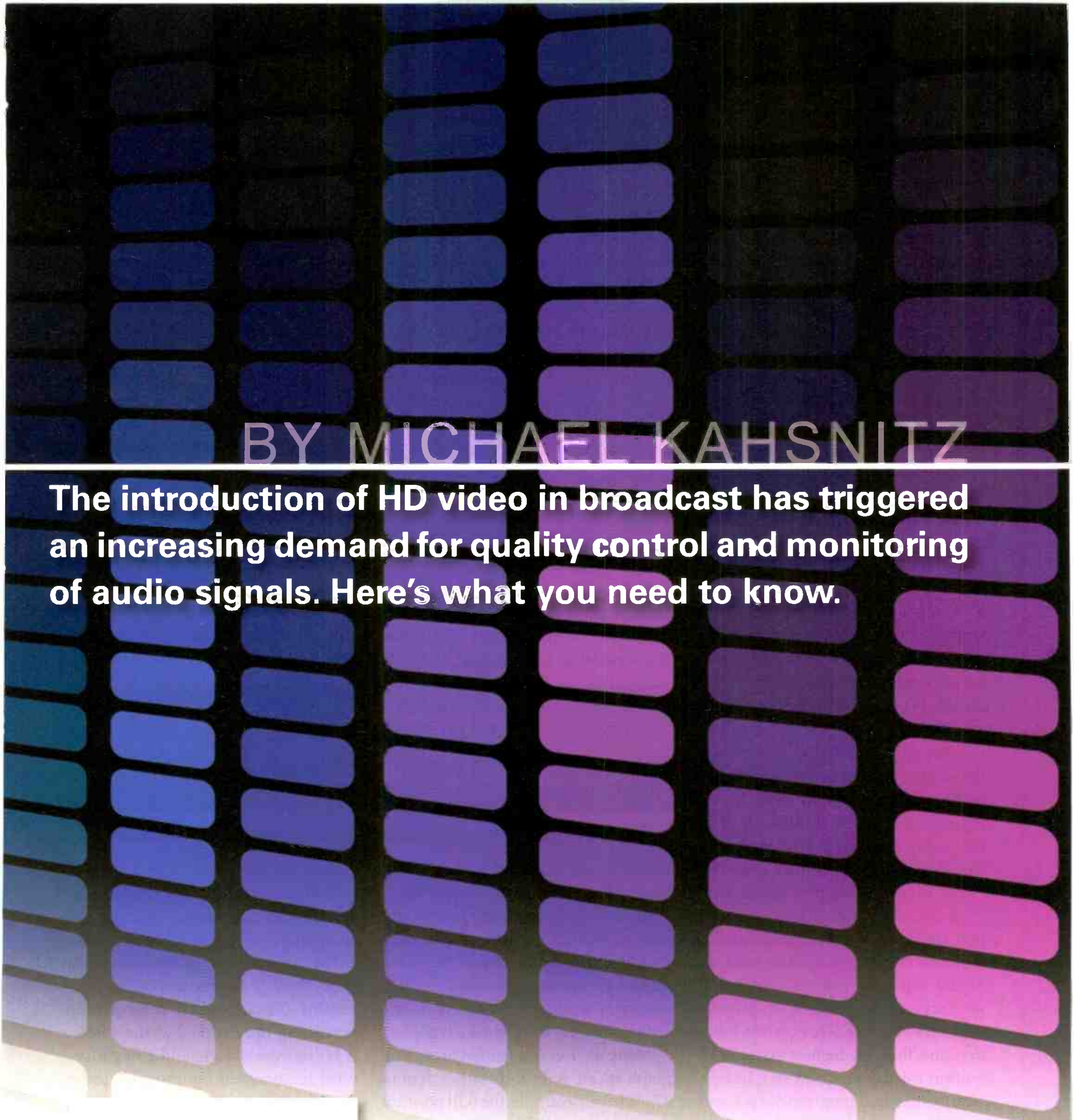
Luc Andries is ICT-architect at VRT-medialab.

Visual AUDIO-SIGNAL monitoring



Today, fast perception and accurate assessment of audio, using visual representation methods, are indispensable in production, post production and broadcast. Suboptimal monitoring conditions, stress and aural fatigue are just a few of a large number of reasons why relying just on one's ears is not enough when it comes to quality control.

This is particularly true for complex 5.1 surround mixing. In the pro audio market, there is an extensive range of specialized tools for any type of audio-signal monitoring — from simple peak meters to highly sophisticated surround analyzers. Ideally, those units allow for quick and intuitive interpretation of what is being viewed and fast reaction as necessary; however, this requires an understanding of at least the most critical technical interrelations and the basics, as well as a reasonable configuration of the available instruments.



BY MICHAEL KAHSNITZ

The introduction of HD video in broadcast has triggered an increasing demand for quality control and monitoring of audio signals. Here's what you need to know.

Level

In professional audio, the type of visual display required most often is the level meter used for examining signal levels; today, this component is found on every mixing console and countless peripherals and recording devices. A level meter is needed, for example, for visualizing clipping on recorders or transmission lines, or in signal processing. At the same time, level meters reveal too-low levels, which make optimum use of the dynamic range between the noise floor and the clipping threshold difficult. The signal level does not only need to be adapted to the technical conditions of the transmission network; at the latest, when exchanging programs with other studios or broadcasters over links or recording media, adhering to agreed standard levels as well having internationally different standards becomes critical. Here, too, level meters are crucial. In this context, it can be assumed that we mostly deal with digital audio today. The first stumbling block, in particular, for a professional user who might not exclusively — and not even mainly — have to handle audio is the actual recording to a tape, hard-disk or solid-state medium: All audio devices used in practice have some kind of meter — be it a pointer or bar graph instrument or a GUI element on a PC. Unfortunately, only a few of these meters meet professional demands and standards, and are therefore capable of delivering comparable and reliable results. The same is true for digital audio, although there is a clearly and uniquely defined unit: dBFS (decibels relative to full scale). In fact, the task at hand is quite simple: A standardized digital dBFS-scaled peak meter (PPM) is needed to meet professional requirements.

Now, it would be reasonable from a technical viewpoint to define the scaling of such a PPM instrument for digital audio in a way that the zero corresponds to the maximum level of 0dBFS. (For reasons of simplicity, we assume here that levels above 0dBFS do not exist.) On the other hand, there are a number of reasons for including headroom instead of using a fixed zero (i.e. 0dBFS = 0dB on the scale). In practice, this approach would make things simpler and safer.

For example, when examining the level of any commercially available pop-music CD on the digital domain, it almost constantly remains near the digital full-scale level. Modern CDs are purposefully mastered in this way to achieve the highest possible loudness and thus the highest possible attention for the program in question. Unfortunately, many producers seek to achieve a similar level near the full-scale threshold already during the recording phase. Let's consider a sample scenario: An audio engineer prepares for an interview. Right before the recording starts, he quickly checks the recording level and adjusts it with that goal in mind. It is obvious what will happen: The first loud clearing of the throat will result in considerable clipping. This is a serious problem. Unlike analog recording media, digital systems do not have a smooth transition to clipping. Even an upstream limiter will normally not prevent excessive levels that usually result in extremely unpleasant distortion. Recorded digital clipping can be fixed afterward only using disproportionate post-processing efforts — if at all. Therefore, appropriate headroom is a must, in particular, with digital systems. Moreover, this approach presents virtually no drawbacks because modern devices usually have an extensive dynamic range. Even recordings made at a level far below the allowable maximum are not at risk of getting too close to the noise floor. Using modern digital systems, raising low recording levels at the post-processing stage is child's play.

Each production facility or standardization body independently defines a level range as headroom below full-scale level. For example, the EBU recommends 9dBFS; this means that when using a digital scale with 0dBFS at the top, the headroom range would start at -9dBFS. In order to visualize that, the maximum level of the signal should be set at or around -9dBFS, specifying a color or brightness change above that level would make sense.

Many devices implement an analog graph scaled in decibels rather than in dBFS. In our example, the 0dB position would be at -9dBFS, while the maximum scale interval would be +9dB. Of course, this would still correspond to 0dBFS; after all, only the scaling has changed. This approach visualizes the desired maximum recording level even better. (See Figure 1.)

Many users from the fields of professional audio have become accustomed to the integration time of peak meters, which is typically 10ms. Therefore, sticking to that integration time when metering digital signals has become common practice. This is to ensure that the familiar viewing characteristics can be retained, although there are actually different principles applicable on the digital domain. To make sure, however, that no digital peaks are missed by the instrument, the display should also include a marker showing the level at sample precision without integration time.

Comparing the display values with and without integration time for different types of programs such as speech, music or test tones reveals partly considerable differences. For example, with speech recordings with proximity effect, the deviation can be more than 6dB. In practice, this means that peaks can actually reach levels at or above -3dBFS even if the recording level has been set with 9dBFS headroom at an integration time of 10ms. Consequently, setting headroom on such a scale is realistic rather than exaggerated.

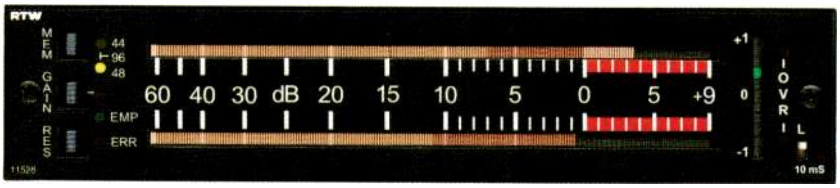


Figure 1. This digital PPM instrument has an analog scale and 9dB headroom.

As already mentioned, while getting an appropriate signal with no clipping is the top priority at the recording stage, there is no risk of causing irreversible clipping when subsequently processing the material at the studio. It is relatively simple and straightforward to compress the program using an appropriate dynamics processor and then to raise the overall level statically or dynamically until the loudest passages are set to a level near 0dBFS. There are a huge number of appropriate hardware and software tools on the market, many of which include functions for loudness maximization.

When producing a live broadcast, post-processing is not an option; a "ready-to-use" signal must be delivered in real time. Engineers experienced in live recording know that setting up large headroom during the

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rehearsals is critical. When the band or orchestra starts its performance in front of the audience, levels are normally higher by at least 3dB than during the sound check. Considering modern 24-bit digital recording and broadcast systems, there is definitely no need anymore to approach the digital full-scale level when doing live broadcasts or recording. I want to point out that even today there are many A/D and D/A converters that produce artifacts even before reaching the full-scale level; at -3dB, this is no longer a problem.

Loudness

A reliable and standardized method of examining program loudness has become a critical element of modern radio and TV production and broadcast. Information obtained using that method allows for adapting program dynamics to different target groups and for effectively preventing abrupt loudness changes between different program formats. While the technically achievable audio quality in radio and TV broadcast is better than ever before, listeners rightly complain that they need to manually compensate annoying loudness changes using their remote controls more often than ever before — for example, when the program changes from a commercial break to a movie broadcast in 5.1 surround sound. In addition, accomplishing program dynamics that please both the motorist in his car and the demanding film enthusiast in his home-cinema environment seems hardly possible. Metadata and dynamic range control (DRC) may be helpful in dealing with this problem, but they are not extensively used at the moment. What is more, the necessary configuration steps on consumer-level surround receivers are often more complicated than setting up professional units.

Regardless of the preferred solution and the type of program, loudness measurement at various points of production and distribution paths is obviously inevitable. The same applies to binding loudness-measurement standards. For some time, the ITU has been working on such standards (BS.1770/1771); however, at the time being, these are recommendations. In addition, the parameters used in loudness metering are not yet defined as uniquely as users and manufacturers would require. Thus, measurement results can be compared only if additional measurement conditions such as the reference level, time constants, thresholds and the applied weighting filter are known in addition to the actually measured value. Moreover, the fact that the terminology has been changed several times during the development of BS.1770/1771 leads to confusion. For example, the weighting filter, which was initially referred to as "RLB," was renamed to "R2LB" when a pre-emphasis was added; later on, the original term "RLB" was restored though the pre-emphasis was not omitted. Meanwhile, the term "K" is used for that filter — which must not be confused with the K-metering designed by Bob Katz.

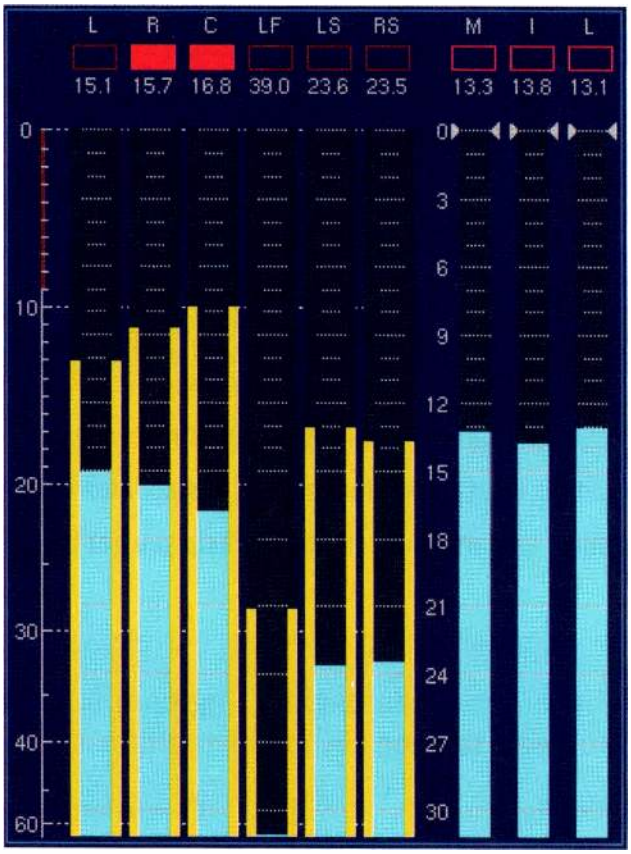


Figure 2. Seen here in combination with a PPM bar graph, loudness metering uses an LKFS scale.

The loudness-measuring unit has changed, too. While loudness was initially scaled in dBLU (Loudness Units) from -21 to +9, the Advanced Television Systems Committee (ATSC) has now introduced "LKFS" (Loudness, K-Weighting, and Full Scale), an alternative unit shown in Figure 2.

As long as there is no common loudness-metering standard, the manufacturers of such tools keep the relevant parameters variable on their systems; as soon as a standard has been agreed upon, they will adjust those parameters accordingly by means of a firmware upgrade.

A loudness-measurement system covering all conceivable applications from recording and live production to post-processing to distribution and subsequent program analysis needs to include multiple different measuring tools. These tools must primarily differ in the time windows the measurements are based upon. A loudness meter for live broadcast needs to meet entirely different requirements than a solution for long-term loudness analysis of the different stations run by a broadcasting organization. With live productions, current loudness information is needed at any time, so measurements need to be made with a relatively short integration time. This results in a current "loudness image" over all channels of a mono, stereo or

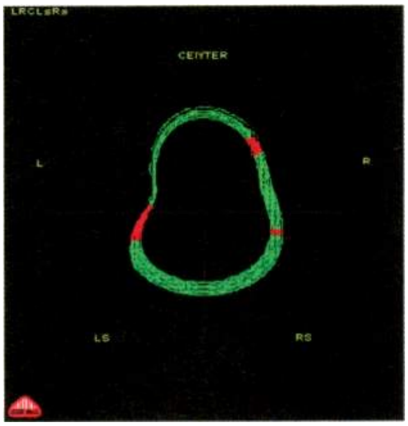


Figure 3. DK-Technologies features a surround-signal visualization method called Jelly-Fish.

surround program that can be displayed, for example, as a bar graph.

Another useful piece of loudness information is delivered by a tendency indicator. By means of an integrating averaging, it allows the operator to identify the loudness tendency of a program during the last 20 or 30 seconds. This again allows for visualizing loudness uptrends or downtrends that the engineer can then compensate manually. During this process, an ongoing (dynamic) time window is critical to ensure that averaging always occurs over an identical time range. In addition, excluding modulation pauses using an adjustable threshold would also be desirable to make sure that measurement is not spoiled; otherwise, a very loud program followed by a pause would result in an entirely normal average.

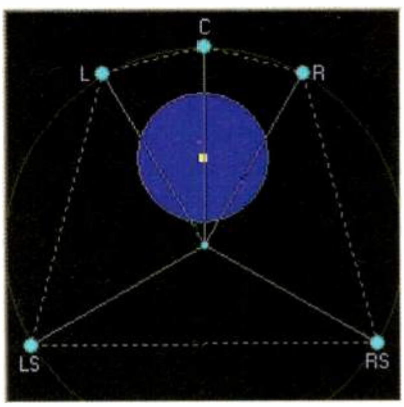


Figure 4. The Pinguin Surround Meter shows another method for surround-signal visualization.

In addition, long-term measurements and recording of measured loudness values may be interesting for broadcast control, QC and subsequent program analysis. Such a tool may be used for examining the loudness history of the program over several hours or days and for either graphically representing the results over time or summarizing them as a numerical loudness average. It is questionable, however, whether measurements over a long time are reasonable at all.

Surround

When dealing with surround programs in production, post production, broadcast or mastering, intuitive audiovisualization is critical. Due to the larger number of separate channels, the risk of errors would otherwise increase significantly — up to the complete failure of channels. In addition, the phase relationships of the channels, which are elementary for a high-quality surround signal, need to be constantly monitored.

Several different surround-signal visualization methods are available on the market today. These include, for example, the Jelly-Fish and Star-Fish by DK-Technologies (See Figure 3) and the Pinguin Surround Meter (See Figure 4).

The RTW Surround Sound Analyzer with the typical "house display" developed by graduate engineer Thomas Lischker visualizes phase and loudness relations between channels at a glance. (See Figure 5.) The base is a calibrated vector representation of the sound-pressure levels (SPL) of the individual channels where the end points are interlinked by lines. The area enclosed by the lines becomes a measure of the overall volume, and the distribution of the area over the four quadrants defines the sonic-image balance.

When the house display shows a square, the four L, R, LS and RS channels share the same sonic-pressure level. If the side faces are straight, without any bends, the individual

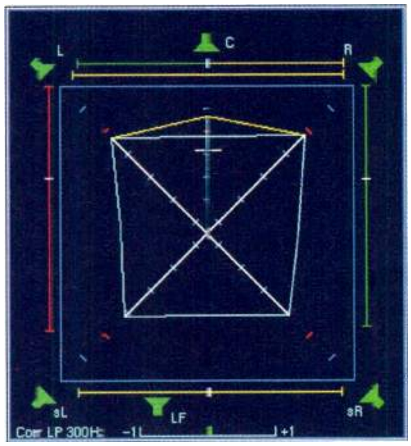


Figure 5. The RTW Surround Sound Analyzer visualizes phase and loudness relations between channels at a glance with its typical house display.

channels do not correlate — for example, when a cheering audience is on the recording. Boundary lines bent outward indicate a positive correlation of the two channels in question, while lines bent inward show a negative correlation. (See Figure 6.) This way, an inverted phase on one channel can be clearly identified. One of the vectors being shorter than the others implies a missing channel or a too-low level. The yellow vector of the center channel is interlinked with the L and R front channels by separate yellow lines. This allows for quickly realizing the relation between the phantom source formed by L and R and the center channel. This means that if the yellow triangle considerably stands out from the overall image in the upper part of the SSA view,

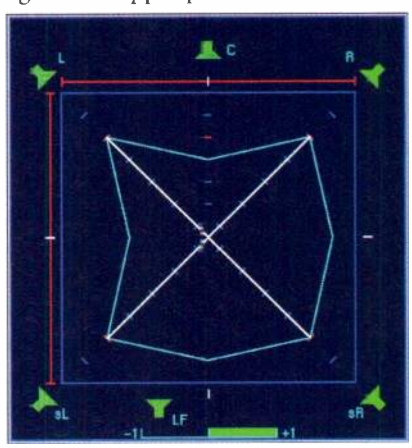


Figure 6: This SSA view shows a polarity error on the left front channel.

the center channel is predominant compared with the others. Depending on the program material, such predominance might or might not be desirable. The positions of phantom sources existing between the other channel pairs are easily grasped, too. The dominance vector, which shows the aural focus of the overall sound source, is marked by a white X.

The weighting algorithms used for accurate surround representation are actually not uncritical. On the one hand, the display must visualize the phase relations between the individual channels at appropriately high speed; on the other hand, integration times should be long enough to precisely display the SPL of each channel and its aural effect. For that purpose, the RTW unit employs a weighted RMS detector. Too long integration times would make the display sluggish. When the monitoring and display systems are calibrated to a specific SPL value (for example, 78dBA SPL), red markers on the SSA screen indicate for each channel when that predefined SPL is reached.

AES3 status data and interface parameters

Status data within the AES3 signal includes information on the sample rate used, the signal status (professional or consumer) and various user data. A critical aspect about status data is that the nominal data does not necessarily match the actual physical conditions. Typically, the data is generated either automatically or from relevant user settings by the sending device; that is, it is not the result, for example, of an actual sample-rate measurement performed by the analyzer. Therefore, discrepancies between the actual sample rate of a digital signal and the information provided by the status data are among the most frequent error sources on the digital domain and might even prevent successful transmission. For example, according to the supplied status data, a sending device outputs a 48kHz signal; however, the received signal has a sample rate of 44.1kHz. This inconsistency may result in the receiver not processing the incoming signal. Therefore, convenient error-checking capabilities are critical. In addition to reading the AES3 status data, an analyzer must be able to identify the actual physical characteristics of the signal.

Those characteristics include not only the sample rate and the carrier voltage but also check of the clock synchronicity of multiple data streams. In professional audio, the fact that all available digital signals are in sync regarding their phases and clocks is taken for granted; however, often enough this is not true — for example when the digital signal of a freely running unsynchronized player (DVD player, satellite receiver) is used. This results in sporadic clicks. Latencies are another issue. For instance, when transmitting a surround as well as a stereo signal from sporting events to the broadcasting center, the two signals are often separately encoded and transferred over different links. The use of a professional analyzer that also monitors the incoming digital signal allows for easily identifying latencies or asynchronicity. When troubleshooting an audio setup with numerous external sources, checking these parameters should be on top of the list.

The status data also includes information about whether the two received channels carry a single stereo signal or two separate mono signals and whether linear PCM audio or other data types (e.g. encoded surround signals in Dolby AC-3 or Dolby E formats) are transmitted. Data of those types must be run through an appropriate decoder before further processing and/or D/A conversion. Already today, several routers are capable of transparently forwarding not only linear PCM audio but also encoded streams of those types over AES3 interfaces. Routing such a data stream directly to a D/A converter without passing it through an upstream decoder would result in high-level noise, which is extremely unpleasant to the human ear. This is effectively prevented by evaluating the information about the type and contents of the transmitted information included in the status data. In this case, a properly configured D/A converter will just mute the channel. Specific surround-enabled audio-analyzer systems could be enhanced with an integrated Dolby decoder allowing for signal analysis and post-processing of the individual channels without requiring an external decoder.

ID signals

When dealing with surround signals, experience shows that channels are often swapped by mistake. This is particularly true when a signal uses multiple separate transmission channels. A number of broadcasters and organizations have developed methods for uniquely identifying channels. Black and Lane's Ident Tones for Surround is probably the best known; other variants include EBU 3304 for surround, as well as GLITS and EBU 3304 for stereo signals. In addition to the actual identification, detection of level and latency mismatch between channels by the receiver is critical for troubleshooting. Latencies can occur, in particular, with surround-signal transmission.

Correlation meter

Phase relations between the two channels of a stereo signal — and thus its mono compatibility — are still key parameters for assessing audio signals: The kitchen radio plays mono, and the same is true for a number of TV programs. Correlation meters are often used for quick and continuous monitoring of phase shifts between channels. Those units are useful for discovering reversed polarity or run-time errors, as well as for optimizing microphone placement.

High-quality correlation meters operate over a wide range independently of the level, i.e. the level does not affect the display values. A commonly accepted design of correlation meters is a horizontal or vertical bar graph where the positive range is often green and the negative range red.

The correlation scale ranges from -1 to +1; the zero point is at the center of the scale. "Correlation" refers to the degree of correspondence of two audio signals. Entirely identical signals (for example, a mono signal on both stereo channels) have a correlation of +1; completely unrelated signals have a correlation of 0. The same value is displayed when a channel fails. The correlation meter also allows for concluding the "width" of a stereo signal. A displayed value of 1 refers to a mono signal located in the stereo center; on the other hand, 0 indicates a signal reproduced on the channel sides only; no sound from the stereo center is heard. Stereo mixes normally have a correlation between 0.3 and 0.7.

A stereo signal with a negative correlation is normally considered as technically defective. When two channels of the stereo signal are identical but their phases are reversed by 180 degrees due to polarity reversal, the correlation meter shows a value of -1. A value between 0 and -1 results from a stereo mix that contains phase-modulated components as generated by effect units, delay units and electronic sound generators. Downmixing such signals to mono causes drastic sonic changes due to phase cancellation.

Stereo-image display

Stereo-image displays (which are also referred to as goniometers or audio vectorscopes) provide comprehensive information about phase relations, intensity, stereo width and directions; however, the user requires specific basic knowledge for correctly interpreting the screen display. This is because these devices are not as intuitive and easy to understand as the simple ±1 bar graph of a correlation meter.

Stereo-image displays originally were modified oscillographs featuring a monochrome display tube. Today, these have been replaced by modern high-quality multicolor flat screens — for example, TFT displays. While those devices cannot replace acoustic checks of a production, they are still very useful for supporting the user in assessing the balance of a stereo mix. Stereo-image displays show the phase relations of signals contained in the mix in real time and allow for discovering errors caused by polarity reversal or clipping. Current devices are even capable of displaying the phase relations and levels of the input signals at the same time, which is quite convenient.

Since the practically utilizable display range of those units is relatively small, a vectorscope must include an automatic gain control (AGC) circuit to keep the signal level within an appropriate range regardless of the actual input level. On the other hand, this means the instruments constantly readjust the processed level. Therefore, this instrument is not suitable for assessing the absolute level or even the loudness of a signal; it deals only with level and phase relations between the left and right channels.

Experienced users immediately notice whether a stereo signal has an appropriate stereo width, is shifted from the center and contains out-of-phase components. In general, a wide presentation hints at many out-of-phase portions, while circular images suggest a large stereo width and an appropriate phase. The position of that "ball" quickly shows tendencies toward a side. A mono signal results in a line; its direction on the display indicates the signal position within the stereo panorama.

Real-time analyzer (RTA)

Another important tool for visual audio QC is a real-time spectral analysis. Typical applications of RTAs are found in the area of sound reinforcement; these not only include examinations of room and speaker-system characteristics but also allow for quickly localizing sudden feedback using a peak-hold function on the analyzer display. An RTA can also serve users in production and mastering of music programs and continuity by allowing them to assess the spectral balance of the program and to adjust it as necessary using an EQ. In addition, an RTA provides for localizing interfering resonant frequencies that occur, for example, when recording sources in small speaker booths. Experience has shown that a real-time analysis based on individual third-octave band filters as used in acoustics measuring matches the characteristics of the human ear particularly well and is therefore capable of providing a meaningful representation of the spectrum. Of course, users working with a sample rate of 96kHz in production are particularly interested in the effective bandwidth enhanced to 48kHz. None of us will aurally perceive 36kHz noise produced by the defective fan of an air-conditioning system; however, such spectral components (and their interference) may subsequently cause undesired artifacts in the mix. Therefore, in addition to the spectral representation of the audio range, a summing display of spectral components above the audible range up to half the sample rate would be desirable.

Conclusion

A main objective of any measuring is the comparability of the results. This is achieved by specific standardized measurement units and methods. Unfortunately, many established measurement standards suffer from lack of uniqueness in practical use; this is true for audio technology, too. Scopes of standards remain subject to interpretation, which makes true comparability rather difficult. In this context, the critical point is that the same measuring standards must be applied everywhere within the immediate working area. All instruments must be calibrated accordingly. Never lose sight of the fact that setting up a meter or another analyzer tool will never change the actually examined audio signal — only the personal "view" of it. BE

Michael Kahsnitz is head of engineering at RTW.

Ross Video's openGear

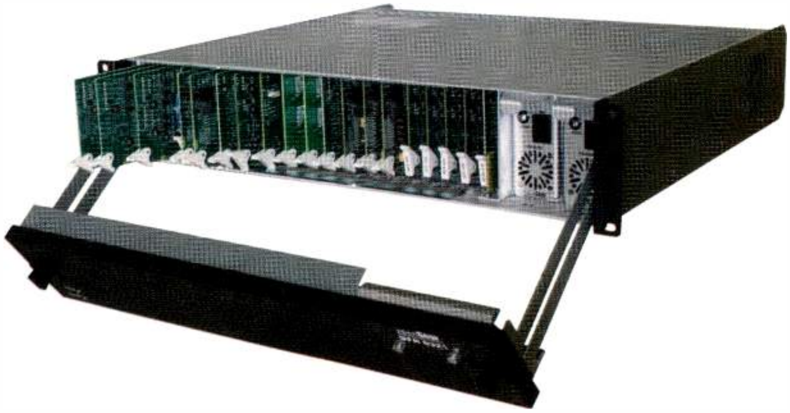
The open architecture platform for signal processing and distribution saves space and reduces complexity.

BY ERIC GOODMURPHY

A common challenge the broadcast industry faces today is finding solutions for signal processing and distribution in one single platform. It's not uncommon to find an installation requiring numerous platforms, many only half-filled, in order to meet the needs of that particular day. Numerous issues arise, including wasted rack space, the need for multiple platform spares, multiple control systems and increased complexity. The ultimate solution is to develop one industry standard, open platform, available to all manufacturers with one standard control system. A standard signal processing and distribution platform saves space, reduces complexity and offers a unified control infrastructure.

An open architecture platform is driven by the desire to achieve standardization in the industry. This pushes manufacturers to excel in their field of expertise, becoming leaders of their respective technology without being penalized for not offering a complete solution. The simplified solution is one platform and control system.

The Ross Video openGear platform, DFR-8321, offers a total of 21 slots with 20 slots reserved for signal processing and a dedicated 21st slot reserved for network control. Power, fault and fan fail indicators on the front door make it easy to quickly identify frame issues. Unique to the frame design is a hot-swappable fan assembly enclosed in the frame door, which is removable without the use of any tools. A modular backplane offers enhanced flexibility with a variety of I/O connections customized to the front module solution to meet the needs of any interface requirements.



Ross Video's openGear signal processing and distribution open architecture platform is driven by the desire to achieve standardization in the industry.

An open platform

The openGear concept was designed as an open architecture platform with well-defined specifications, protocols, flexible rear I/O modules, branding areas, SNMP interfaces and control interfaces localized on the card. All of the design considerations make the openGear platform easy for other manufacturers to adopt and develop solutions to expand the offering within the portfolio.

This allows manufacturers to excel in their field of expertise, becoming leaders of their respective technology.

The core components of the platform consist of two fully redundant hot-swappable power supplies with independent mains input for both power and mains redundancy. Five fans located in the front door, with cooling vents in the rear, offer front-to-back air flow, dual frame-wide genlock inputs, Ethernet connectivity for remote control. The Ethernet frame controller offers DataSafe, a feature where card parameters are stored and then restored when a hot swap is performed. External remote control to the platform is available from DashBoard and SNMP.

The challenge with any design is the ability to process any mix of signal types, analog audio and video, digital audio and video, HD video up to 1080p at 3Gb/s, to state a few. The backplane connections must be flexible to manage numerous interfaces for today and into the future. Signal integrity becomes critical at high speed to guarantee error-free reception and transmission. To further challenge the design, processing cards must be removable from the front without the need to disconnect connections from the back. The openGear solution uses a rear module design that houses a high-speed connector to carry signals on and off the front processing solution. The advantage of this approach, in an open system, is it allows developers and partners freedom to custom design rear modules for specific solutions without impacting the base frame architecture.

In the world of control systems, the manufacturer is faced with the dilemma of acceptable reactive control speed, alarm monitoring and interoperability. The solution is to create a proprietary protocol to offer real-time operation with alarming and then offer the industry standard simple network management protocol (SNMP) for interoperability with other control systems. SNMP was designed as a generic monitoring protocol, which is extremely useful for monitoring, but does not offer any real-time control.

A control and monitoring system must allow the user to configure all parameters on a card and monitor the status from anywhere. The configuration for the parameters should be in real time, so when a parameter is changed in the control system, the card makes the changes immediately without visible lag. Providing a control system that is easy, intuitive and supports multiple vendors presents a few challenges. The manufacturer of the control system does not want to have to write custom software for every vendor. In fact, the manufacturer will not be aware of every vendor's cards and features. The solution is to define a protocol that the cards on startup can communicate with the host application and self-describe themselves. With this type of platform, every card reports to the host how many parameters it has, the data types, constraints on the values and the type of control element needed. The host application can then build the control screens for any card on the fly, with no custom software required in the field.

The challenges of developing a frame and allowing the processing platform to be an open standard to freely share with a variety of manufacturers is unique. openGear now has more than 20 partners, all working toward a common standard, offering the industry an extensive and diversified portfolio, all in one platform, all under one control system. **BE**

Eric Goodmurphy is RossGear marketing product manager for Ross Video.

Litepanels 1x1 Bi-Focus

The LED light fixture is suitable for almost any sized set or application.

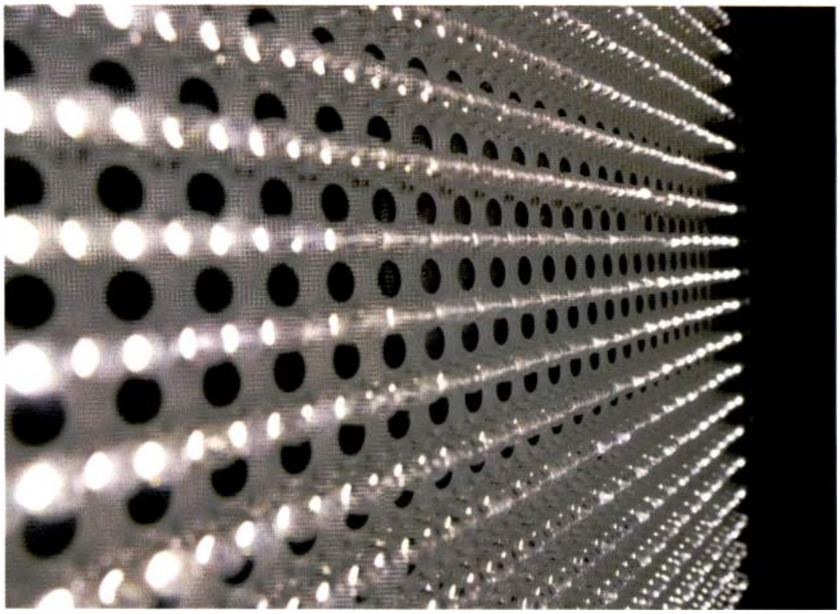
BY BARRY BRAVERMAN

For us road warrior shooters who spend most of our lives on airplanes, the hassle of transporting gear has reached epic proportions. The situation has become so untenable and expensive that we must restrict the size and scope of our equipment to the absolute minimum. No longer can we afford to transport 35 cases of gear to China, Eastern Europe and the east side of Cleveland, as I once did with routine alacrity in the 1980s. Today, we are far more likely to march into battle with a stripped-down package, consisting typically of the camcorder, tripod and a horrifically overstuffed shoulder bag, replete with an on-board monitor, matte box, memory cards, a ton of other stuff and, uh, one or two kitchen sinks.

The Litepanels 1x1 Bi-Focus LED is designed to meet a road warrior's needs. The unit is remarkably controllable; rather than weighty drop-in lenses like a conventional HMI PAR, this system includes cross-fading LEDs to achieve a variable flood-spot pattern.

This begs the question of lighting. No other aspect of our itinerant lives is more challenging than determining our travel lighting package. Of course, we prefer the control enabled by a bevy of C-stands, sandbags, cutters and 12/3 stingers, but this bulky leaden stuff is simply not going to fly these days, not with the airlines and not with the bean counters who would understandably rather forego the sky-high excess baggage charges. For almost 20 years, I've been carrying two K5600 Joker 400W PARs. I've shot features and umpteen high-end documentaries and corporate projects with just these two lights. They're potent and extremely malleable, and they put out a beautiful daylight blast of light that can be bounced or projected through a grid cloth to produce a smooth and flattering soft light.

The flexibility of the Litepanels 1x1 Bi-Focus system is the ability to gang instruments into a single aggregate source; this expandability makes the LED light fixture suitable for almost any sized set or application. The company also manufactures a similar Bi-Color unit but without the beam control. Of these two parameters, beam control is the most critical to shooters; the color balance of a source is relatively easily tweaked in a conventional way using cut gel.



The Litepanels 1x1 system is expandable to accommodate almost any size setup. A single unit may be all a broadcaster needs for most interviews.

For this reason, I recommend that shooters add a Jelly Roll of assorted cut gel to their travel package. It's one of the best and most useful items in your kit.

Hail the performance

The Bi-Focus is highly directional, more characteristic of a Fresnel than a traditional soft light or PAR. At full flood, the LED produces a smooth wash with only a hint of a center hot spot. Designers of professional lighting (and video projectors) tend to favor the approach to concentrate beam intensity

The Bi-Focus unit is ruggedly constructed with beefy focus and dimming controls — a common source of failure in competing lower-cost units. One caveat: The Litepanels system requires 24VDC — not the most convenient input voltage for field operation.

in the middle of the frame where shooters tend to need and want it most. The fall-off to the edges of the field may also reduce the need for a makeshift Black-Wrap fix in some setups.

Note that the bi-focus feature of the unit is somewhat limited compared with a conventional Fresnel. I didn't find a great deal of range from spot to flood, so shooters should consider this limitation when assessing their lighting needs.

The unit's color temperature appears well balanced to the eye, although my Minolta color meter confirmed a slight shift to magenta. In critical applications, a CC05 green gel may be used to help balance skin tones. The color temperature of my test unit measured a consistent 4800°K, ±100°K even when dimmed. This means the unit overall is a bit underpowered, when compared with its nominal 5600° K daylight rating.

Conclusion

Owing to its versatility, high efficiency and output, the Litepanels 1x1 Bi-Focus will certainly find a useful niche in nonfiction, news, documentary and reality applications. The LED light fixture is compact and lightweight, and it can help establish a comfortably cool operating environment for shooting interviews and close-ups. Moreover, its variable beam spread can be critical to achieving a desired texture in the face and eyes of talent.

With respect to air travel, we shooters must constantly re-examine our gear complement. The requirements for camera, tripod and accessories seem rudimentary, but lighting is an animal of a different color and focus. Thus, the clear advantage of the Bi-Focus unit is that it measures a mere 1sq ft, so it may fit into your overstuffed carry-on bag. **BE**

Barry Braverman is a veteran cinematographer. His latest book, "Video Shooter," is available from Focal Press/Elsevier.

Content repurposing

Broadcasters need to provide consumers with content anytime, anywhere, in a multiplicity of formats.

BY JOHN LUFF

We often have to remind ourselves that the purpose of broadcast engineering is to create compelling content that informs and entertains viewers in ways that provide a return on the investment in production and distribution. In this era of technology, there is an incredible array of options in which to invest, and often no clear consensus on which alternate delivery mechanisms will be more than an interesting historical footnote.

Take, for instance, early attempts at interactive cable in the 1980s. Warner Cable deployed CUBE interactive systems in several markets, but never got the kind of viewer response that proved it was something worth sustaining. The company killed it. Then the company tested a "full service network" in Florida. That too closed, at which time the "Orlando Sentinel" said, "the company is shifting its emphasis toward an evolved form of the technology being developed by outside companies under contract with Time Warner Cable."

Other alternative distribution systems have been tried, including various broadband wireless models. In the end, the most successful model to date is Internet delivery of both pay-per-view and free (streaming and downloaded) content. Inexorably, digital delivery via the Internet is making other models of content distribution at once more interesting and in some cases signaling a permanent shift in consumer habits — away from packaged media toward impulse and subscription delivery.

This had pernicious effects on every part of the production and delivery ecosystem. From a technology standpoint, it is relatively easy to adapt bit rates, picture formats, compression choices, aspect ratio and quality to fit delivery to any intended display. The rub is that there are simply so many of them. As I sit at my desk writing this article, I have within arm's length reach no less than 10 choices of aspect ratio and many more choices of resolution available for delivery of digital content for consumption. I routinely watch current content on my Mac Book, iPhone, pocket organizer, laptop, desktop monitor and tablet PC. I watch small windows on news sites, content of every possible level of quality and coding standard on YouTube, and last night's prime-time programming on Hulu. Each presents options for level of quality, aspect ratio and connection speed that directly affect how the content is produced. I have the ability to stream content to any set in the house over the wireless network deployed as part of the IPTV service I subscribe to. This year I will add ATSC Mobile options to my panoply of choices.

A broadcaster's quandary

The quandary a station owner has to face is which of the options are worth doing. A serious issue is how to technologically support many alternative reuses of the content a station has the rights to distribute. Some cases are relatively easy. A public broadcaster I work with sends content to the video on-demand service of a local cable provider by delivering content to the drop box on a transcode engine, which then places it in the cue for delivery to its partner's servers via ftp. The transcode setup is well-defined, and it is a relatively transparent process. But that is essentially an alternative that does not modify the content; it simply changes the coding parameters.

Aldo Necco reformats content at Azteca America's NOC using FlipFactory from Telestream.

The more general problem, and the one worth spending some time on, is how to make content fit new viewing models, both technological and sociological. For instance, some research shows that viewers will use mobile devices more often without full-length content. This replicates the "news on demand" model often seen on Internet news sites. That requires a different version of the content itself, perhaps a 10-minute version of a 30-minute newscast. Technology and workflow collide at the point content needs to be repurposed in a cost-effective manner and delivered in near real time to boot.

Take the actual screen display of news where the screen is perhaps 2in x 3in. Some things don't work well when pushed to small screens, especially supers. A super that is 4in wide on a 17in laptop is only 3/4in on an iPhone and barely 1/2in on many cell phones. This begs the question of whether screen content needs to be rerendered for small screens. One manufacturer has shown a system that can read the supers, zoom the "area of interest" in the picture to better frame the content for a small screen and then reapply the text to the reformatted screen. The demo showed a soccer match with the player moving the ball tracked in a zoomed in display automatically. This provided a much better viewing experience on a small screen.

For the multiplicity of delivery formats, it has become quite common to have a transcoding engine, or farm of transcoders, that renders multiple versions of the same content either live or from a file (as appropriate to delivery). Once a format is successfully set up and proven on the intended receiving device, it becomes a "black box" solution, which acts dispassionately to deliver the content in the right form. The process of fine-tuning the transcode can be lengthy and complicated. Captions, alternative languages and metadata needed to identify and tune to the content must all be optimized. Complex file-based workflow solutions like this are not for the faint of heart, nor for technicians without a deep understanding of wrappers, compression and the intended application.

With the deployment of ATSC-M/H this year, many broadcasters who have done only small content windows on their Web sites for news will get immersed in the multiplicity of issues surrounding content repurposing. It is a good time to bone up on compression, file-based workflow issues and service-oriented architecture, which can help automate processes and can evolve rapidly as the market moves.

It is a good time to bone up on compression, file-based workflow issues and service-oriented architecture, which can help automate processes.

Lastly, the IT industry, which is the basis for all transcoding, has been working on software as a service (SaaS) for some time. This year, a cloud-based service was announced that will transcode content and deliver it back to you without any investment in hardware or software. While not particularly inexpensive for an ongoing service, it may prove to be an efficient model for nonrecurring projects. As the cloud computing industry grows, and presumably prices fall, transcoding as a service in the cloud may prove to be a great way to adapt to a changing reality. **BE**

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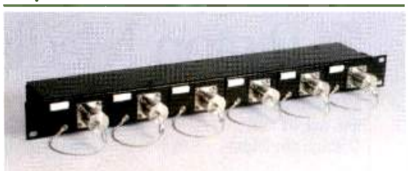

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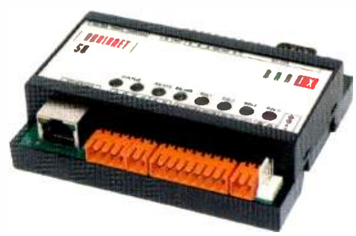
Barix — Barionet 50



IP automation controller, monitoring device and visualization system can operate stand-alone or in concert with other units, Web servers and control systems; uses low power (typically 1.2W with inactive control systems); implements serial protocols, serves as the "intelligent" component in a data collection system or takes actions based on the provided data on the interfaces; offers four logical inputs and four relays for interfacing to contact closures, as well as RS-232 and RS-485 serial ports.

866-815-0866; www.barix.com

ESE — DV-201

SDI (3G, HD and SD) 1 x 4 distribution amplifier distributes 270Mb/s, 1.5Mb/s and 3Gb/s data rates; automatically detects the data rate and reclocks and equalizes the signal; can equalize 400m at 270Mb/s, 200m at 1.5Mb/s and 140m at 3Gb/s with 1694A coax cable; features integrated power supply requiring 117VAC or 220VAC to operate; housed in a black, anodized aluminum enclosure.

310-322-2136; www.ese-web.com

Fast Forward Video — Micron HD

Digital video recorder uses JPEG2000 compression at speeds up to 100Mb/s; offers up to five hours of record time; features removable 2.5in SATA drive that is fully compatible with the Elite HD camera-mounted DVR; enables users to record, play and store multiple SD and HD video files; with a machine controller, users can access a larger set of functions and command multiple units with one keystroke.

800-755-8463; www.ffv.com

Gekko Technology — kelvin TILE

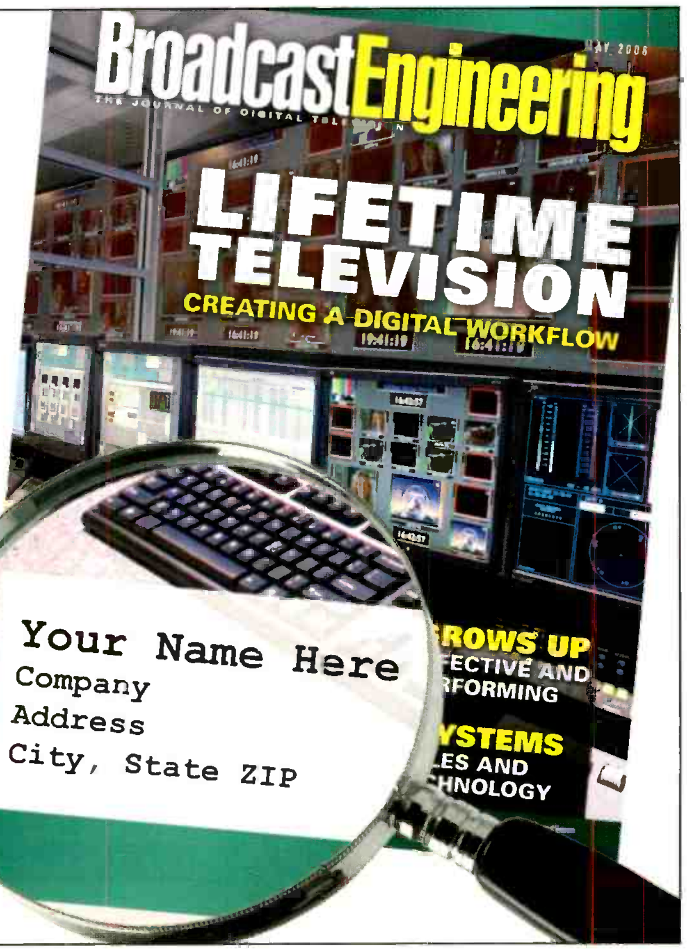
Soft panel employs a combination of three-color LEDs in a 16 x 15 matrix to generate high-quality, broad-spectrum white light; provides total control over color temperature from 2200K to 6500K, with presets at 3000K and 5500K; measures 12in x 12in x 4in; delivers up to 419lx at 5500K or 273lx at 3000K, with a power consumption of 85W; features beam angle of 108 degrees at 50 percent intensity; lighting parameters can be saved, recalled and cloned when using the optional paint box.

**+44 844 8005326
www.gekkotechnology.com**

ComNet — Comworx CNGE2FE24MSPoE

Environmentally hardened managed Ethernet switch provides a high port density in a compact package and power over Ethernet to peripheral devices such as IP cameras and video encoders; makes available 24 10/100TX ports and two 1000Mb/s combo ports that use easily interchangeable, small form-factor pluggable optic devices as optical interfaces; ports support IEEE.802.3af-based PoE; two ports are configurable for copper or fiber media for use with single- or multimode optical fiber, selected by optional modules.

203-796-5300; www.comnet.net



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DTV decade of struggles

Has it already been 10 years since Y2K? Let's take a stroll down DTV memory lane.

BY ANTHONY R. GARGANO

When does a new decade begin? That's now a hotly debated topic, but why? The argument is whether it begins with the year ending in "0" or ending in "1." Put me down in the year ending "0" camp. Think about it. Doesn't it seem more natural to look at, say, the decade of the 1990s as beginning Jan. 1, 1990, as opposed to Jan. 1, 1991? If it didn't start until 1991, then it didn't end until Dec. 31, 2000. Did anyone really consider the year 2000 as the last decade of the '90s? If you are still not convinced, just grant me license, and come along for the ride. You will still have a whole year to think about your own retrospective.

8-VSB trumps COFDM

Although now clearly successful, the DTV transition in the United States endured a decade of struggles. As we entered the decade, the dot-com bubble was still growing. It was that pre-9/11 era of "peace dividends," federal budget surpluses and abounding optimism. In the television marketplace, station penetration and consumer adoption rate forecasts for digital television and HDTV were aggressive, perhaps overly so, initially, in light of large-screen HD receiver prices approaching five figures. On the technical front, the DTV standards war was over, but the battles continued to rage.

The modified ATSC recommendation for DTV, which embraced an 8-VSB modulation scheme, was adopted by the FCC in December 1996. Following the infamous comparative DTV reception tests in Baltimore, where COFDM bested 8-VSB, the FCC's Office of Engineering and Technology took yet another look, and in September 1999, reaffirmed its support for 8-VSB. Even with this initial adoption and subsequent reaffirmation, as the new decade began, the adherents of COFDM continued to battle on. Eventually, the combination of more DTV signals coming on-air and consumers purchasing DTV receivers resulted in 8-VSB achieving a level of infrastructure critical mass such that the proponents of COFDM realized it could not be overturned. Continuing development in ATSC tuner chips yielding marked improvements in signal reception played an important role as well. Yet, even today, from time to time you can read the laments of COFDM diehards on the various technical forums.

DTV sets for everyone

Another seemingly looming problem was set pricing. Early in the decade, HDTV set prices were astronomical compared with inexpensive analog receivers. DTV naysayers argued that the expense of the core receiver and ATSC tuner technology coupled with exorbitant licensing fees doomed affordability for the masses. They believed inexpensive television receivers would be a thing of the past, and portables? Forget it! There simply would be no affordable portable receivers. What a difference a decade makes! Now, at the start of the new decade, a 46in 1080p, 120Hz receiver can be purchased for $799 and a 22in 720p receiver for $229. And what about those inexpensive portables doomed for extinction? A 7in portable DTV receiver can today be purchased for the munificent sum of $89, which by the way is $72 in year 2000 dollars.

The nonevent transition

Originally, by May 1, 2002, all commercial stations were required to be transmitting on their digital channel followed by all public stations by May 1, 2003, and analog was to be gone for good in 2006. For many reasons, it didn't happen. But eventually, after being rescheduled, it did. On June 12, 2009, analog ended, and the great switchover to digital occurred. With 64 million DTV converter coupons issued and despite only 35 million redeemed, DTV arrived as a nonevent. The latest projections indicate that by the end of this year, three-quarters of all households will be equipped with one or more HDTV sets.

Up next: 3-D

As we arrive at the cusp of the new decade, and with DTV and HDTV already taken for granted, the next new technology is preparing to move to center stage. Broadcasters with trepidation, set manufacturers with anticipation and the poor unknowing consumer are about to transition from the DTV era to the 3-D era. Never mind what you've been told; necessity is not the mother of invention. Revenue generation is. Otherwise, we would still be crowded around that tiny 10in black-and-white CRT in the massive wooden cabinet.

When it comes to the concept of decades, the DTV decade was a game changer. It opened the digital door to the new television technologies to come, and as it slowly fades, a new 3-D decade is beginning to take shape. So, get ready for literally an eye-popping ride for the next 10 years. And, who knows? If the good Lord and my editor cooperate, in 10 years time I may be ushering it out, and the new decade (of holographic video?) in. BE

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

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


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