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FCC UPDATE

DIGITAL HANDBOOK

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LATEST NEWS!

The FCC launched the LEARN program Sept. 28 to educate broadcasters about reverse auctions, a key component of its incentive auction strategy.

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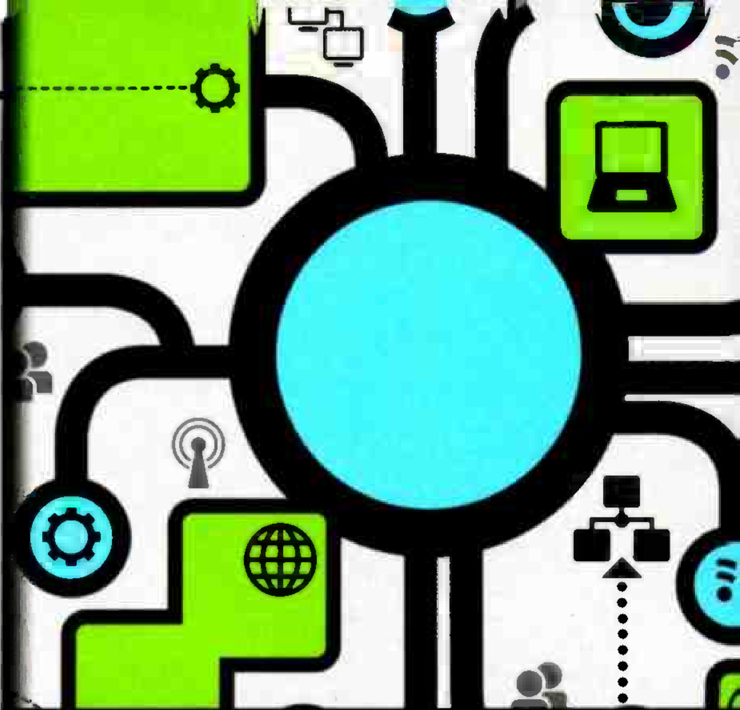

ON THE COVER:

IP has and continues to change the way broadcasters think about many aspects of their operations, including storage and distribution.

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JUST THE FACTS!

Over the past year, U.S. viewers have increasingly watched free and paid streaming content on their connected TVs. A report from The NPD Group showed an increase to 45 percent from 33 percent who say TV is their primary screen for streaming. According to the report, 10 percent of U.S. households own at least one connected TV.

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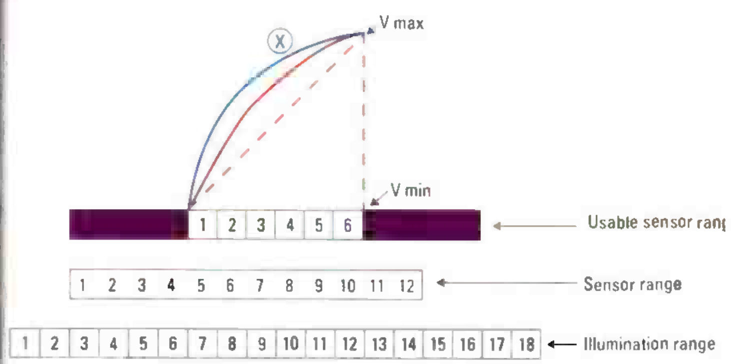

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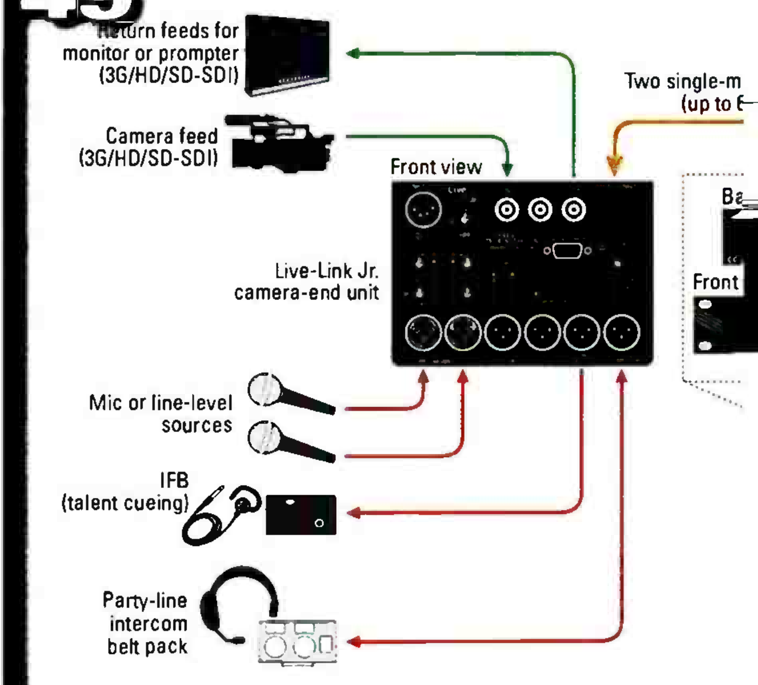

PCAST? Oh, please ...

Ronald Reagan once said, "... government does nothing as well, or as economically, as the private sector in the economy."

Yet, it appears we are about to witness the next example of overreach and mismanagement by government bureaucrats — all under the pretext of solving the so-called spectrum crisis. In this instance, government's solution comes from a blue-ribbon committee's proposed new way to manage spectrum.

The committee, code-named PCAST (which in government-ese stands for the President's Council of Advisors on Science and Technology), has invented a new way to solve what some politicians and the CEA are calling a national spectrum crisis.

While PCAST specifically addressed only federal spectrum, hear me out because, if this weed gets rooted, broadcasters beware. The bottom line is that instead of auctioning federal spectrum to the private sector, PCAST suggests that everyone should just learn to share.

"Clearing and reallocation of Federal spectrum is not a sustainable basis for spectrum policy due to the high cost, lengthy time to implement and disruption to the Federal mission," PCAST says. "Further, although some have proclaimed that clearing and reallocation will result in significant net revenue to the government, we do not anticipate that will be the case ... This study finds that today's apparent shortage of spectrum is in fact an illusion brought about because of the way spectrum is managed."

This consortium of brain cells determined that instead of holding auctions and letting winning private companies manage their spectrum economically, government should just make everyone share those frequencies.

Of course, a key part to any good bureaucracy is the formation of more government, and this committee is no exception. In order for all of this sharing to happen, we need a committee. In fact, we need a whole bunch of new committees and agencies and people to staff them.

PCAST suggests several new White House offices and systems. The plan envisions a Federal Spectrum Access System (SAS), which becomes the spectrum clearing house. In addition to that would be the creation of a Spectrum Sharing Partnership Steering Committee (SSP). Then, as PCAST explains, we need "... increased White House involvement. Specifically, we recommend that the White House Chief Technology Officer (CTO), with equivalent level representatives from the National Security Staff (NSS), the Office of Management and Budget (OMB), and National Economic Council (NEC) formalize a Spectrum Management Team (SMT) to work with the NTIA to carry out the President's directive."

If the logistics of that aren't enough to hurt your head, then consider costs must be covered. Not a problem, says PCAST.

"The existing Spectrum Relocation Fund should be redefined as a revolving (in taxpayer terms, this means a never-ending cost) "Spectrum Efficiency Fund" that recycles private sector payments (that means business fees) for use of Federal spectrum into reimbursements to Federal agencies for investments that facilitate spectrum sharing and enhance spectrum efficiency," PCAST says. "Congress should allow the Fund to reimburse qualifying costs by any Federal service, not just those in revenue-generating bands."

Lest you think this model could not be adapted to broadcast spectrum, see page 93 of the report. There, you'll find a "Spectrum Efficiency" formula. PCAST has resolved the entire spectrum crisis into a single formula that measures "spectrum utilization."

I could go on, but you get the idea. Any problem of any scale can be solved by the creation of sufficient committees staffed by ample numbers of bureaucrats and funded through a never-ending assortment of public and private sector taxes, fees and assessments. The entire proposal can be read at: *http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf.*

Brad Dick

EDITORIAL DIRECTOR

Send comments to: editor@broadcastengineering.com

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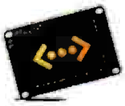

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Distributed routing networks

Moving past a star infrastructure can increase benefits.

BY SVEIN HAAVARD HAUGEN

Today's modular routers with optical extensions are fully capable of switching, bringing with them the benefits of the latest technology. There are, however, inherent issues and challenges with traditional star-routing networks with point-to-point passive links. In addition to cost, a change in network configuration, such as the addition of a location in the network, requires significant infrastructure changes and costs, not to mention extreme risk to live video should network downtime result from patching errors.

A distributed routing network based on a compact router construction with an optical extension delivers a more flexible, scalable and fully redundant optical network. Through the addition of a distributed routing layer, it is possible to create a hybrid electrical/optical routing system capable of sending signals long distances while utilizing electrical connections for most of the local distribution. The result is a price competitive and more efficient system.

Past the star

Classic star architecture is not scalable once it reaches the limits of the main router. Additionally, it represents the "brute force" method of distributing signals to all locations. This method was cost efficient when cabling was done through coax cables. With the increased demand for high resolution content requiring high bit-rates, however, the distances coaxial cable could cover decreased, and optical links were required. In a traditional, point-to-point routing system, generally only 20 percent to 30 percent of the primary router is utilized for switching. This leaves 70 percent to 80 percent for distribution and takes the form of an expensive patch panel. An illustration of this is the amount of crew sitting in different locations during a production, watching the main program feed. This feed alone would normally be distributed to five or more places from the central router. And, with the high bit rates of these signals, distribution will be optical. This inefficiency of the router can be utilized when designing a new network.

An intelligent network management application enables broadcasters to take advantage of smaller, compact routers to move from a classic star network with a large primary main router to a distributed, redundant network comprised of smaller, interconnected nodes. Bringing the right management system to the table also enables an efficient workflow. Tie lines bind the distributed routers together, controlled by a management system that automatically finds the most direct and cost-efficient paths through the network. Redundancy is achieved not only from the router but also its configuration.

If a broadcaster wants to add a fourth studio to its current configuration of studios connected to a master control room, it may find that the primary router lacks the number of necessary ports for that expansion. Reconfiguring the main router entails large amounts of re-cabling and numerous patches to avoid network downtime, while limiting the ability to re-use the existing router.

The new approach and resulting configuration is based on identifying the distributed signal (or signals) that must be universally accessed. Consider a live TV setting with its need for different professionals to access the same feed. Let's say an audio bay, lighting crew and makeup staff are located in different areas. All receive a copy of the

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

Global TV shipments down two quarters in a row

Around the world, shipments continued a decline that started in the last quarter of 2011. The NPD report says the trend indicates worsening economic conditions across the globe and slower erosion of prices.

Technology	Q2'12 units*	Q2'12 unit share	Q/Q growth	Y/Y growth
LCD TV	44,123	85.5%	2%	-2%
PDP TV	3150	6.1%	6%	-26%
OLED TV	0	0.0%	-	-100%
CRT TV	4347	8.4%	-15%	-36%
RPTV	15	0.0%	-40%	-38%
Total	**51,635**	**100%**	**-32%**	**-8%**

Source: NPD DisplaySearch *www.displaysearch.com*

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same unique, main feed. When distribution is based on a central router, this transport is likely done optically due to distances. In a distributed routing setting, the signal is transported optically from the local distribution router close to the studio, and distributed from there electrically to the three sites. This also frees up cross points and ports to the main router.

A mesh or distributed network continually transmits signals and offers the most significant benefit: the ability to scale. A broadcaster can expand rather than alter its network, adding or replacing a node rather than a router.

This network design also allows distribution of commonly routed signals within the sites, local-to-local connectivity, and improved or maintained redundancy levels. Adding another location to the system does not compromise the network or require complex infrastructure changes. With a hybrid optical fiber network of this type, the broadcaster achieves a redundant system that offers security and scalability at an attractive price.

Redundant networks

Creating a redundant network that cost-effectively maximizes the benefits of optical routing technology and configuration can look something like Figure 1.

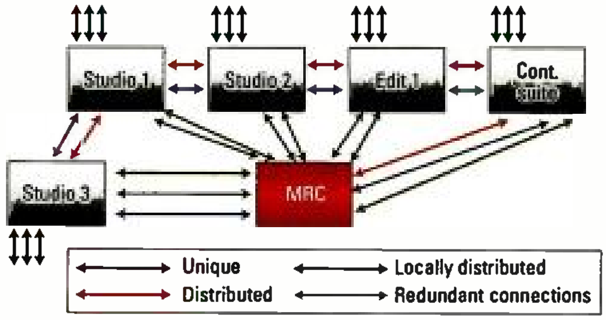

Figure 1. A broadcast facility configuration can alter the star configuration to keep both unique and locally distributed signals local, as well as commonly routed signals distributed between sites.

In addition to redundancy benefits, a distributed network such as this is easy to scale. Expanding locations is as easy as adding a node. A new level of service capacity is also a welcome byproduct. Capabilities are encased within each node. If you take down or add a node, the system automatically resets to maintain operation and redundancy. Or, you may simply route around a node. Redundancy is achieved through the network, not the router itself. The only potential drawback is the number of components. This potential pain point of numerous components can easily be overcome with a management system that helps automate and run the system.

An example of a redundant architecture can be seen in Figure 2. Nodes 2, 3, 5 and 6 are made by 32 x 32 routers with 32 optical extensions (16 in/16 out), and nodes 1 and 4 are constructed by 64 x 64 routers with 64 optical extensions (32 in/32 out). Fibers can be broken and nodes can still be reached, as can routers, without dismantling the network. The architecture provides either a 96 x 96 non-blocking or blocking router scheme. Remembering that approximately 70 percent to 80 percent of a traditional star router is used for distribution, this solution may replace a 96 x 96 scheme. Also, it follows that several of the nodes are close enough together for electrical connectivity. This model could be a start to further system optimizations.

To add studios, sites or nodes, one would connect or alter a limited number of nodes affecting only part of the network. Most upgrade work would have moved from the hardware network to the software control system.

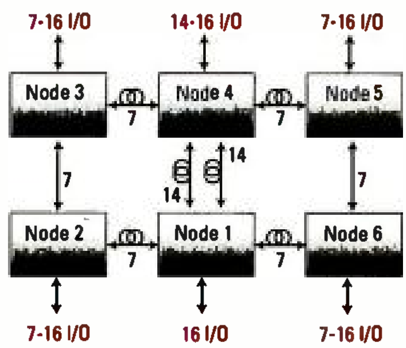

Figure 2. This shows a fully redundant 56 x 56 non-blocking network with the capabilities of a 96 x 96 blocking router with distribution. Knowing the classic star router's limited amount of switching, this is an efficient replacement.

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Effective management

A management system that sits on top of this system is critical to providing redundancy and managing system components. The best ones use built-in algorithms to make decisions for the user and hide network operations complexity. For example, an "intelligent" management system will optimize a network's resources by providing critical path finding. Techniques like shortest-path-first algorithms allow provisioning of the least-costly path from a source to one or more destinations, as well as diverse path routing to support redundancy and provide safest-possible routing. A network must predict all possible moves and the effect a move will have overall. Once a path is allocated, others are blocked.

The best choice is one that has the least-negative (less costly) impact, and intelligence is required to assess effects. Therefore, a cost system is built into the algorithm and enables the system to determine that.

While this is a clear factor in long-haul systems, it's also significant for in-studio use. Network resources are precious, and efficiencies scale over time. State-of-the-art connection management can also enable dynamic connection on an as-needed basis. This helps achieve key flexibility in today's pervasive live video setting.

A comprehensive management system should control and manage optical network nodes, while allowing the end user to view the system as a simple, point-to-point configuration that hides complexities of path finding and maintains workflow. All control should be provided by a simple interface that allows easy network configuration, maintenance, troubleshooting and problem resolution.

Getting full value

Distributed routing networks let the broadcaster take advantage of network topology by using low-cost electrical links for distribution, minimizing the number of optical links for >150ft/450ft transport, and creating redundancy for switching on separate routers. This ability readily exists.

Optical routing in a hybrid environment facilitates the ability to stay connected over a large range of ports and remain fully managed across all optical links. This is often not the case with more traditional configurations. Bringing all capabilities into a fully-managed environment enables users to take proactive action and positively impacts the whole value chain. Well-chosen routers, along with smart engineering, can create long-term efficiencies and cost benefits. BE

Svein Haavard Haugen is director of engineering, Nevion.

Warning, emergency!

The FCC requires stations' emergency warnings to reach the hearing- and visually impaired.

HARRY C. MARTIN

The FCC has issued its annual public notice reminding video distributors — television stations, cable systems and satellite providers, to name a few — of their obligation to make all emergency information accessible to people with vision and hearing disabilities. No excuses for less than full compliance will be accepted.

Section 79.2 of the FCC's rules defines emergency information as "information that is about a current emergency and is intended to further the protection of life, health, safety, and property, by providing details regarding the emergency and how to respond to it." Emergencies covered by the rule include such natural disasters as tornados, earthquakes, hurricanes, floods and wildfires, as well as man-made disasters such as discharges of toxic substances and industrial explosions. The commission has emphasized that this rule allows for no exceptions, even in cases of quickly breaking news about emergency conditions.

Importantly, the rule reaches not only scripted presentations, but ad-lib statements made in the course of live news coverage. In 2005, several TV stations received large fines because the stations' on-the-spot coverage of natural disasters failed to make the programming accessible to vision- and hearing-impaired persons. For example, one station was fined $20,000 for airing, without captioning, an interview with a representative of the American Lung Association who told viewers they should stay indoors, run their air conditioners and avoid exercise.

Visually impaired

What is required for the visually impaired? For the visually impaired, emergency information provided in the video portion of a regularly scheduled newscast or a newscast that interrupts regular programming must be accompanied by an aural description of the video presentation. For example, on-screen images or graphics (e.g., a list of available emergency shelters) must be accompanied by a voiceover describing the video action or reading the text of the on-screen material.

Emergency-related screen crawls that are not part of a regular or unscheduled newscast must be accompanied by an aural tone to alert visually impaired people to tune to another information source, such as the radio. The commission recommends frequent repetition of that tone, at least as often as the information in the crawl is repeated.

Hearing-impaired

To reach people who are deaf or hard of hearing, Section 79.2 requires either closed captioning or other methods of providing the audio portion of the emergency information visually. Any such presentation may not, however, block the closed captioning. Conversely, any closed captioning is not allowed to block another form of visual presentation, such as a crawl.

Network-affiliated TV stations in the top-25 markets have a significantly greater burden in this area. Those stations are required to arrange for closed-captioning services. The commission affords these stations time for the captioning personnel to travel to the station, but in the meantime any emergency information being broadcast must be made accessible to the hearing-impaired in some manner, such as by showing a whiteboard with appropriate text.

In its public notice, the FCC also gives advice about how to file a complaint against video providers who do not follow the rules. Since 2010, all video distributors have been required to file their contact information with the FCC so that any audience member experiencing a problem with closed captioning can reach out to the station directly. BE

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

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

Dateline

- On Dec. 1, 2012, TV and Class A TV stations in Arkansas, Louisiana and Mississippi must begin their pre-filing renewal announcements in anticipation of filing their renewal applications on Feb. 1, 2013.
- On or before Dec. 1, 2012, noncommercial TV stations in Alabama, Connecticut, Georgia, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont must file their biennial ownership reports.
- On or before Dec. 1, 2012, television stations, Class A TV, LPTV stations and TV translators in Alabama and Georgia must file their license renewal applications.
- On Dec. 1, 2012, television and Class A TV stations in the following locations must post their 2012 EEO reports on the FCC's new public file web page and on their own websites: Alabama, Colorado, Connecticut, Georgia, Maine, Massachusetts, Minnesota, Montana, New Hampshire, North Dakota, Rhode Island, South Dakota and Vermont.

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Automation & Media Management

Digital video, audio interfaces

Broadcasters have many choices for audio/video transfer.

BY ALDO CUGNINI

Professional video interfaces are undergoing a change, in part due to the age of the initial digital systems, and also because of the emergence of high-performance interconnects for consumer use. First, let's summarize the existing solutions for high-bandwidth audio/video transfer.

Existing interfaces

Standard-definition Serial Digital Interface (SD-SDI) is a serial link that can transmit uncompressed digital video or audio (usually up to eight channels) over 75Ω coaxial cable. Without repeaters, rates of up to 270Mb/s over 1000ft are customarily used. Digital Video Broadcasting, Asynchronous Serial Interface (DVB-ASI) was defined for the transmission of MPEG transport streams, and is electrically similar to SDI, with a data rate of 270Mb/s.

HD-SDI is the second-generation version of SDI and allows the transmission of HD (1080i and 720p) signals over the same 75Ω cables as SD-SDI. It can handle rates up to 1.485Gb/s. A dual-link HD-SDI provides up to 2.97Gb/s and supports 1080p resolution, but it is being replaced by the single-link 3G-SDI, the third-generation version of SDI that can reach a maximum bit rate of 2.97Gb/s over a 75Ω coax cable.

Consumer electronics are catching up with pro interfaces. Although driven from the non-professional side, evolving consumer electronics interfaces are affecting pro equipment, especially displays. The legacy analog VGA and hybrid analog/digital DVI interfaces used to interconnect PCs with displays could be obsolete by 2015, as chipset manufacturers have announced their intent to withdraw support by that year, and that means PC motherboard manufacturers will likely pull the functions from their new designs. Replacing them on PCs, DVDs and other consumer video devices are HDMI and DisplayPort.

HDMI 1.4a has a throughput of 8.2Gb/s, allowing it to carry up to 4096p24 video (or 1920p60) at 24 bits per pixel, as well as various 3-D formats, eight channels of audio, consumer electronics control (CEC) and High-bandwidth Digital Content Protection (HDCP). DisplayPort 1.2 supports up to 8.6Gb/s, and thus can carry payloads similar to that of HDMI. Functionally, the interfaces differ in the way they handle video and audio, with HDMI using a raster-based protocol, and DisplayPort transporting content in packets. From a market standpoint, the main difference between HDMI and DisplayPort is that the first was designed primarily as a digital TV interface, while the second was intended as a PC-centric interface. The two interfaces also have license and royalty differences.

Consumer electronics are catching up with pro interfaces.

The USB 3.0 (also called Super Speed USB) specification is used almost exclusively as a PC (or tablet) interface to support peripherals. It supports transfer rates up to 5Gb/s, over a maximum distance of about 16ft. As a data-transfer protocol, USB is payload-agnostic, so the transfer of audio and video is essentially limited to the latency characteristics of the interface. IEEE 1394 was originally designed to support bit rates of up to 400Mb/s, but newer versions of the standard support speeds as high as 3.2Gb/s.

Thunderbolt is a newer 10Gb/s bidirectional serial interface. Developed by Apple/Intel, it provides full-bandwidth data and video transfer between a PC and peripheral and display devices, up to a distance of 10ft. Serving as the hardware layer below the PCI (bus used inside PCs) and DisplayPort stacks, the product utilizes a time-synchronization protocol that allows up to seven daisy-chained Thunderbolt products to synchronize their time within 8ns of each other. Like USB, Thunderbolt's key differentiator from other display-interface technologies is its capability to supply power to the peripheral, at up to 10W, superseding USB 3.0's 4.5W capacity.

HDBaseT is a recent standard that uses CAT-5e Ethernet cable to transmit 10Mb/s video and two-way control signals and power, with enough capacity for additional simultaneous 100BaseT Ethernet uses. The great attraction to this interface is that it can be deployed over existing Ethernet infrastructures, greatly reducing implementation cost. As with other data-based interfaces, the video can be conventional uncompressed HD, 3-D, 4K or high frame rate. The maximum specified distance for HDBaseT is 328ft, which can be extended through 8 hops, and the standard supports carrying up to 100W of power.

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Wireless video products

There are several wireless standards that are vying for use driving displays. Wireless Home Digital Interface (WHDI) is an interface that uses the same 5GHz band as Wi-Fi, and is designed to transmit uncompressed HD video at data rates of up to 3Gb/s in a 40MHz channel. The range is said to be greater than 100ft, with a latency of less than 1ms.

WiGig (by the Wireless Gigabit Alliance) is a specification based on 802.11 that supports generic data transmission rates up to 7Gb/s. A different approach is being taken by WirelessHD, a specification that defines a wireless protocol that enables consumer devices to create a wireless video area network (WVAN) that can stream uncompressed audio and video up to Quad Full HD (QFHD, or4K) resolution, at 48-bit color and 240Hz refresh rates, with support for 3-D video formats. The specification, which is based on 802.15, supports data transmission rates at 10Gb/s to 28Gb/s.

The Wi-Fi Alliance has also announced a certification program, called Miracast, through which certified devices can make use of an existing Wi-Fi connection to deliver audio and video content from one device to another, without cables or a connection to an existing Wi-Fi network.

In another industry development, MHL is being used to connect tablets and smartphones to displays. MHL defines an HD video and digital audio interface optimized for connecting mobile phones and portable devices to HDTVs, displays and other home entertainment products. MHL features a single cable with a five-pin interface that is able to support up to 1080p60 HD video and 192kHz digital 7.1 channel audio, as well as simultaneously providing control and power (2.5W) to the mobile device.

Because MHL does not specify a unique connector, various mechanical interfaces have emerged, including five-pin and 11-pin MHL-USB connectors. MHL fully supports the HDCP specification (used elsewhere on DVI and HDMI interfaces) for the safeguarding of digital motion pictures, television programs and audio against unauthorized access and copying.

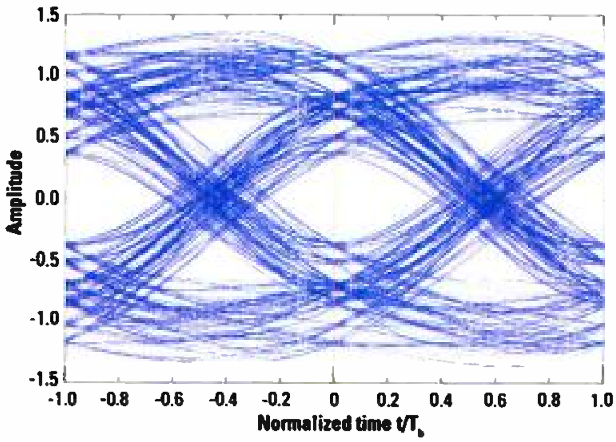

Figure 1. Binary digital signal with interference

Maintaining high-speed networks

High-speed networks are challenging to maintain. When any of these high-speed interfaces are combined with long runs of cable, performance will degrade, primarily from inter-symbol interference caused by cable-based dispersion of different signal frequencies, as well as jitter caused by processing equipment, as shown in Figure 1. The result will be an increase in error rate at the receiving end.

To minimize this, video plants should be designed and maintained with equipment having low jitter and cable runs having the lowest length necessary, with repeaters used for lengths nearing maximum specifications. Adhering to these precautions will result in reliable operations. BE

Aldo Cugnini is a consultant in the digital television industry.

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Router fundamentals

Every engineer should know these concepts.

BY BRAD GILMER

Routers are core to broadcast networks. So, I want to introduce some fundamental concepts regarding networking that may help you understand how routers work.

Ethernet

Ethernet is both a protocol and a hardware specification. The Ethernet specification details electrical signals and voltages on the wire (or the RF transmission scheme in the case of wireless), and it lays out how Ethernet packets are built and what information Ethernet headers contain. Headers contain source and destination addresses. This helps routers direct packets to destination. Ethernet addresses differ from IP addresses.

Ethernet addresses (sometimes called MAC addresses) appear as: nn:nn:nn:nn:nn:nn (six groups of two hex digits). These are hardcoded into network interface chips on a specific computer and typically cannot be changed. Think of MAC addresses as Vehicle Identification Numbers stamped into engine blocks of cars. Ethernet is defined by the IEEE in its 802-x family of standards.

IP

IP is a core protocol. Its job is to move datagrams from one device to another. (A datagram is defined as a self-contained, independent entity of data. It carries sufficient information to be routed from a source to the destination computer without reliance on earlier exchanges between the source and destination computer and transporting network.) The IP layer prepares data sent to it by applications or other higher protocols for transmission across a specific network (an IP network), taking into account things such as packet length, hardware addressing structure and how data should split across multiple packets.

IP packets are the payload carried in Ethernet packets in an "IP over Ethernet" network (about 95 percent of all network installations). MAC addresses may be hardcoded, but IP addresses can be changed in the network configuration menu of almost all modern operating systems. IP is defined by the Internet Engineering Task Force (IETF) as Internet Standard 5.

Once a physical network is in place (wires, connectors, switches, etc.), equipment can be connected to it. With Ethernet and IP, the capability exists to identify specific equipment as packet sources and destinations. And, the means are available to logically group equipment into networks and pass messages from one network to another. But, another protocol is critical to the network functioning.

ARP

Here is a question: What mechanism associates the MAC address and, therefore, a specific physical piece of hardware, with an IP address?

Address Resolution Protocol, or ARP, provides the solution. Figure 1 shows an actual ARP transaction captured using Wireshark — a free packet capture and inspection tool. Assume a router with an IP address of 192.168.1.1 needs to send a packet to 192.168.1.43. The router will send an ARP request asking, "Who has 192.168.1.43? Tell 19.2168.1.1." The computer with that IP address responds, "192.168.1.43 at 00:15:53:7C:22:5C." The router then knows where the packet should go. In most cases, once the router has this information, it stores it in its ARP table for memory. ARP is defined in IETF Internet Standard 37.

Now that the IP address to MAC address question has been resolved, the network is almost ready to go. Packets can be sent from one computer to another on the same network, but what about from one network to another?

Route

Now, we will talk about routes and route tables and how they relate to IP networks. To do this, we need to understand what a network is in terms of IP. For example, let's say you are responsible for designing a network in your station. This network will connect to the news and production departments. Both news and production have their own servers and printers, and you do not want traffic from the production department slowing down news and vice versa.

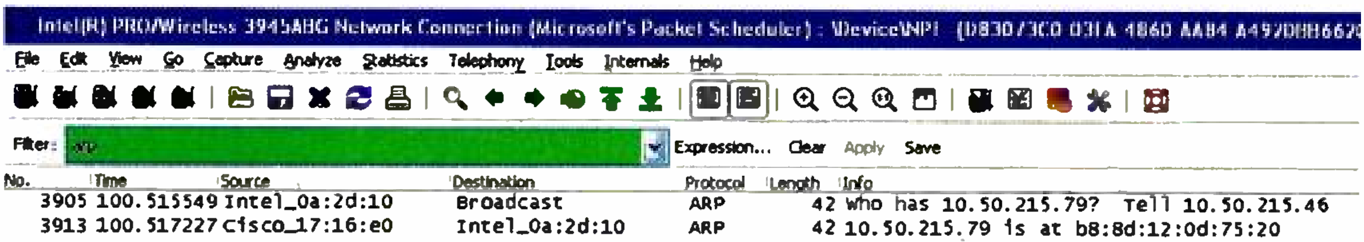

Figure 1. A Wireshark capture shows ARP at work resolving a MAC address to an IP address.

This is a perfect situation for a network. You assign production computer addresses in the form 192.168.0.n, and news 192.168.1.n. Now, you have two networks on one wire. But, if these are two networks, and computers ignore traffic not on the assigned network, how do they communicate?

A router needs to send packets from one network to another. The router keeps a route table that tells it where to send different types of traffic. Every IP device has one. In this simple example, if on a news computer you open a terminal window and type "route print" (or a similar command, depending on the system), you will get output like that shown in Table 1.

This table says if this news computer has traffic for 192.168.1.n (the news network), then keep it local and do not send it elsewhere. This is shown by the asterisk (*) in the Gateway entry for 192.168.1. But, if traffic exists for any other network, send it to the router at 192.168.0.1, and that router will forward traffic where it needs to go. The router also contains a route table, which will be more complicated than this one, that tells it what to do with various packets depending on the destination address. Understanding route tables is important in troubleshooting networks.

DNS

So far, everything we have covered is centered on packets and addresses. But, humans are using computer systems, and humans do not like long numbers. We would much rather use memorable names. For example, if we are looking for *Broadcast Engineering*'s website, it is easy for us to remember http://www.broadcastengineering.com rather than http://67.208.46.146. The Domain Name System, or DNS, resolves names into IP address.

In a nutshell, DNS is a distributed database. When you enter http://www.broadcastengineering.com, the browser asks a DNS server what IP address to go to. The server replies with 67.208.46.146.

This is important because DNS problems are reported frequently as network outages. Before looking for network problems, try checking the network by typing an IP address into a browser rather than a name. If the page loads, you may have a DNS server issue rather than a connectivity concern. They can look the same.

UDP

User Datagram Protocol (UDP) is a straight-forward protocol that allows for mapping of video onto IP. UDP is included here because routers frequently are configured to block UDP traffic. This is because hackers can use it to crash networks.

There are good reasons for UDP in professional media applications, however. So, each user must balance security policies and user requirements. With a UDP problem, be sure network routers and switches are not blocking UDP. **BE**

Destination	Gateway	Genmask	Interface
192.168.1.0	*	255.255.255.0	eth0
default	192.168.0.1	0.0.0.0	eth0

Table 1. A routing table charts commands for a network router to follow. Here, this table shows the connection between news and production department networks.

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

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Object-based storage

The system has advantages for media applications.

BY CHRISTOPHER WALKER

The criteria for data storage are scalability, security, permanence and availability. Making an acronym, we get PASS:

- Permanence means that no data is ever lost;
- Availability means that the user/application requirements for access/performance are met;
- Scalability defines the ease of meeting changing requirements;
- Security defines the granularity and durability of access privileges.

Traditionally, storage has been block-based direct attached storage (DAS)/SAN or file-based via NAS or SAN file sharing (SFS) with some kind of metadata controller. Applications can be designed to work with or without a file system. Simply put, block-based applications are faster; file-based are more flexible.

In the past, certain functions (multitrack audio, grading, etc.) required dedicated block storage. Increasing disk, controller and interconnect speeds have decreased the overhead that the file system adds to the aggregate access speeds; thus, block-based storage is no longer required to meet the needs of production.

The evolution of media storage has gone from achieving the required speed, to making it available to multiple users, to ensuring permanence. First we had block-based storage incorporated into applications. Then we had SAN with direct attached client shared access. V arious parity systems were incorporated for redundancy, and different backup schemes were implemented.

Today, these methods have reached a limit. A major cause for this is that the current architecture requires rebuild times greater than the MTBF. In other words, if you lose a disc on a petabyte storage system, the rebuild may not be completed before you lose another disc. Current methods for avoiding this require compromises in PASS. Object-based storage reduces rebuild time dramatically and negates the performance hit. (See Figure 1.)

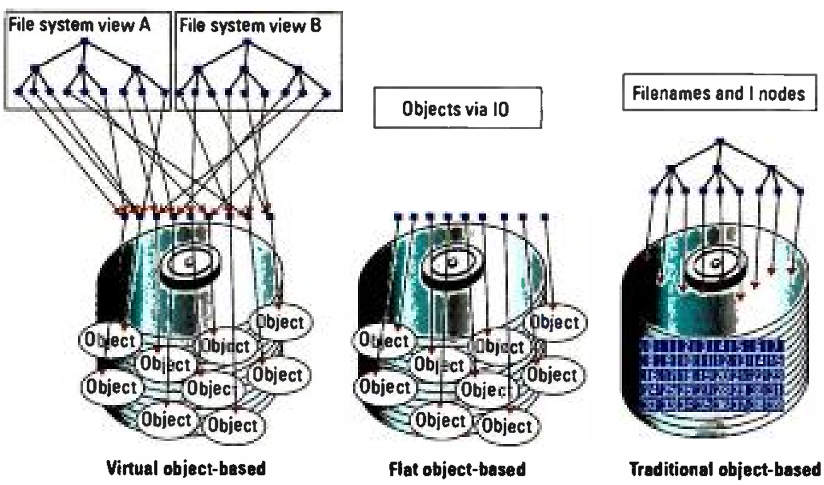

Figure 1. A collection of objects within an object storage device form a flat file space. File structures are abstracted and access the objects via pointers.

Object storage device

Replication is performed by the object storage device (OSD). Clients submit a single write operation to the first primary OSD, which is responsible for consistently and safely updating all replicas. This shifts the replication-related bandwidth to the storage cluster's internal network. There is a lot of discussion about the net results of this architecture change. One point is that no matter how many copies of the data are distributed across how many discs, there is always a rest risk. Object-based storage can reduce that risk to less than 2 percent of the data on the failed disk instead of the 100 percent in traditional parity systems. This is because replicas are stored at the object level, allowing for two copies with the same net loss of capacity as a single parity drive.

Systems using object storage provide the following benefits: data-aware prefetching and caching; intelligent space management in the storage layer; shared access by multiple clients; scalable performance using an offloaded data path; and reliable security.

Usage

Let's look at some media use cases and see why an OSD is preferred.

Archiving is easy as there is substantial agreement within the industry that the two main requirements, scalability and permanence, can best be met by object-based storage systems.

Acquisition can take advantage of object-based storage because the nature of the object is stored in the object metadata. This will ensure that the object is always stored in a manner suited to the application. An essence requiring a continuous data rate of 150Mb/s will automatically be stored where this data rate can be provided. Yes, there are other ways to do this, but they are all add-ons inducing administrative as well as performance overhead.

Post production requires real-time shared access of the assets. In the OSD model, the protocol is system-agnostic


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TV

and therefore system-heterogeneous by nature. Since the OSD is the storage device, and the underlying protocol is supported on either a SAN (SCSI) or a LAN (iSCSI), device sharing is simple. (See Figure 2.) Data sharing is accomplished the same way. The objects on an OSD are available to any system that has permission to access them.

Performance

The OSD model is designed to allow performance characteristics of objects to be attributes of the object itself and independent of the OSD where it resides. An HD video file on an OSD may have an attribute that specifies an 80MB/s delivery rate as well as a certain quality of service (i.e. a consistent 80MB/s). Similarly, there could be different attributes for the same object that describe delivery performance for editing rather than playback. In editing mode, the OSD may skip around to many different frames, thus changing the way the OSD does caching and read-ahead. Similarly, for latency and transaction rates, an OSD can manage these more effectively than DAS and SAN because it has implicit and explicit knowledge of the objects it is managing.

Just to put the performance question to bed, one of the cool things about OSD is how it handles zone bit recording. Because discs spin at a constant rate, the transfer rate more than doubles from short inner tracks to long outer tracks. OSD provides a simple method of offering the fastest part of the disc to the data that needs it most while still making the rest of the disk available for other data. In addition, the inherent drawback/advantage that an object cannot be overwritten makes versioning automatic and provides a consistent data state.

Transcoding and confectioneering are both compute-bound, highly automated processes. The ease with which OSD provides access to distributed objects can only improve these workflows.

Playout can certainly profit from the abstraction of the storage from the application, allowing for automated staging of items in the playout list with a minimum of overhead. As the location of all assets is automatically tracked, a misapplied file pointer will become a thing of the past.

One of the major hurdles to monetizing existing content is the tremendous amount of storage required to keep that content online. Estimates show that the cost of managing storage resources is at least seven times the cost of the actual hardware over the operational life of the storage subsystems. This is independent of the type of storage (i.e. DAS/SAN/NAS). The illusion that falling disc prices will actually reduce costs in mission-critical applications does not account for the costs of keeping the data available for on-demand applications.

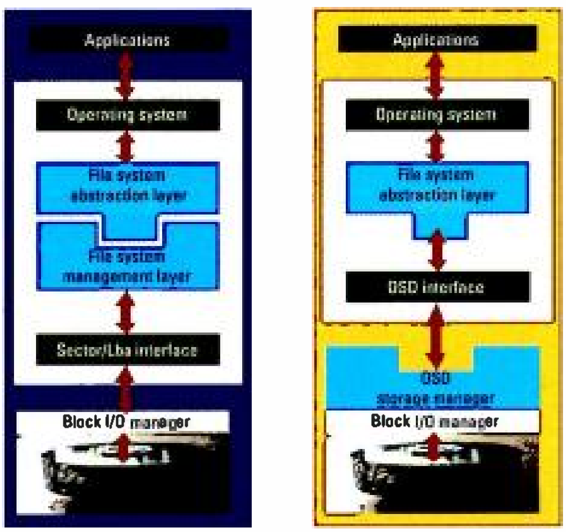

Figure 2. Separating the file system abstraction layer from the storage management component makes many of the problems related to device sharing go away.

Management

Storage resource management has

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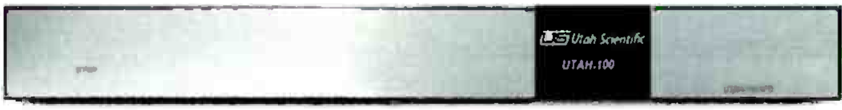

The **UTAH-100/XFD** Fiber Distribution Frame packs up to 16 channels of coax-to-fiber and fiber-to-coax conversion into a compact 1RU frame.

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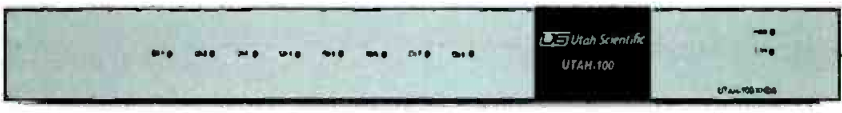
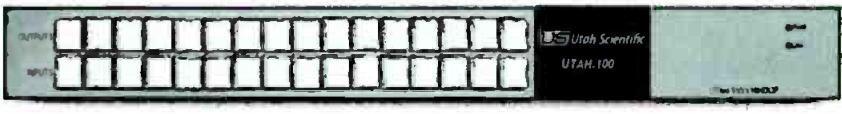


The **UTAH-100/XHDA** is a 3G-capable High Definition Distribution Amplifier with a big difference. It has 8 amplifier blocks, each of which can be programmed by the internal web interface to serve 2, 4, 6 or 8 outputs.

This unmatched flexibility makes it perfect for mobile systems, allowing a single unit to replace racks of DAs.



The UTAH-100 family offers a wide selection of routers in all signal formats in sizes from 8x8 to 32x32 with standard built-in web control and options for built-in or remote control panels, third-party control interfaces, redundant power supplies.

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been identified as the most important problem to address in the coming decade. The DAS and SAN architectures rely on external storage resource management that is not always entirely effective and has never been standardized. The NAS model has some management built in, but it too lacks standards. The OSD management model relies on self-managed, policy-driven storage devices that can be centrally managed and locally administered. The execution of the management functions (i.e. backup, restore, mirror, etc.) can be carried out locally by each of the OSDs without having to move data through an external managing device.

DAS was designed for direct attachment to a single system. All the management functions are done from the single system to which these devices are attached. The difficulty arises when more systems attempt to address the same storage. Because the management is distributed among all the systems that the storage devices are attached to, complicated coordination is required, and there is no central management instance.

A SAN system has access to all of the storage devices and thus management can be centralized on any one of the hosts. However, implementing self-management in a heterogeneous environment has proved difficult. NAS devices have more "intelligence" built into them by their very nature (i.e. there is an OS with a file system, a communications stack, etc.). This extra intelligence lends itself to the idea of self-managed storage, making the overall task of managing storage resources somewhat easier. This architecture implies increased complexity when more granular performance requirements are to be met or increased performance achieved.

To achieve the requirements for PASS while at the same time reducing TOC, the OSD architecture is designed to be self-managed using the OSD intelligence built into each OSD. Devices know how to manage each of several resources individually or through an aggregation of OSDs. These resources include availability of capacity, requested bandwidth, latency requirements per session, IOPs and user-definable PASS requirements.

Finally, OSD defines the concept of "object aggregation" whereby a hierarchy of OSDs can be made to appear as a single larger OSD. The resource management of this large aggregated OSD is done either through a single or multiple redundant OSDs at the top of the aggregation or can be assigned to each of the individual OSD devices to achieve maximum resource management flexibility.

Don't object; get objective. BE

Christopher Walker is a consulting engineer for Sony DADC Austria.

Codec evolution

Panasonic's AVC-Ultra is the latest iteration of AVC.

BY STEVE MULLEN

There is no doubt that we are in the midst of a rapid evolution of codec design. Traditional codecs, some might call them legacy codecs, are gaining evolutionary improvements. These codecs include HDCAM, AVC-Intra 50 and 100 as well as AVCHD 1.0. This article will, after a brief overview of AVC-Intra and ProRes 422 as well as the new sensors that drive codec evolution, focus on AVC-Ultra. There are five flavors of ProRes 422 in comparison to uncompressed video. (See Table 1.)

Although ProRes 422 codecs are 10-bit codecs, they may carry 12-bit data values. However, they vary in terms of color space and compression ratios. ProRes 4444, however, has additional functionality. The first three 4's indicate that the codec is capable of carrying either RGB values or luminance plus two chroma components, with all three values present for each pixel. The fourth 4 indicates that an alpha value can be carried along with each pixel. When cameras record ProRes 4444, the fourth value is not present, making the data stream simply 4:4:4.

The advantage of the ProRes proxy codec is best experienced in Final Cut X. When you import any type of data, you have the option of automatically, in the background, creating a ProRes 422 or proxy version of the original file. You then edit the 4:2:2 10-/12-bit proxy video, which allows real-time editing of most any format on almost any Mac. During export, the original file is used as a source of all image data.

AVCHD has evolved to version 2, which has two new features: the ability to record at frame rates of 50fps or 60fps, and to record at 28Mb/s at these higher frame rates. To date, the AVCHD specification has not been enhanced to support Quad HD or 4K2K images. For this reason, cameras, such as the JVC HMQ10, record Quad HD in generic AVC/H.264. Using Level 5.1 or Level 5.2, 24fps or 60fps respectively can be recorded.

Panasonic's AVC-Intra is available in two formats: a 50Mb/s codec and a 100Mb/s codec. AVC-Intra records a complete range of frame rates. At 1920 x 1080: 23.98p, 25p, 29.97p, 50i and 59.94i. At 1280 x 720: 23.98p, 25p, 29.97p, 50p and 59.94p. The characteristics of each of these two flavors differ. (See Table 2.)

Codec parameters

All codecs have a similar set of parameters. These include image resolution, image composition (single frame versus two fields), de-Bayered

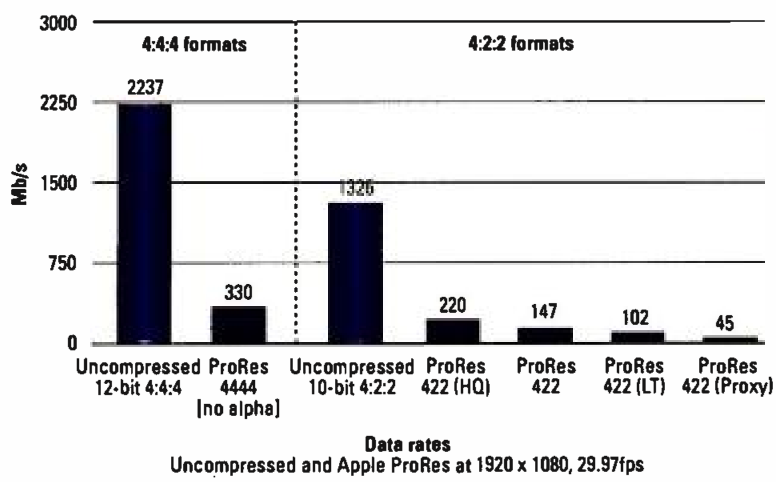


Table 1: ProRes 422 formats

AVC-Intra 50
Nominally 50Mb/s, size of each frame is fixed
CABAC entropy coding only
1920 x 1080 formats are High-10 Intra Profile, Level 4
1280 x 720 formats are High-10 Intra Profile, Level 3.2
4:2:0 chrominance sampling
60Hz video: frames are horizontally downscaled scaled by ¾: (1920 x 1080 is scaled to 1440 x 1080, while 1280 x 720 is scaled to 960 x 720). 50Hz video is not downscaled.
10-bit luma and chroma

AVC-Intra 100
Nominally 100Mb/s, size of each frame is fixed
CAVLC entropy coding only
1920 x 1080 formats are High 4:2:2 Intra Profile, Level 4.1
1280 x 720 formats are High 4:2:2 Intra Profile, Level 4.1
4:2:2 chrominance sampling
Frames are not downscaled
10-bit luma and chroma

Table 2: AVC-Intra formats

versus raw (progressive-only), image frame rate or field rate, color sampling (4:4:4, 4:2:2, 4:1:1 or 4:2:0), RGB versus YCrCb, compression ratio, and bit depth.

Traditional codecs employ bit depths of either 8 or 10 bits. The number of bits used for recording is independent of the number of bits output by the sensor's analog-to-digital converter.

Nevertheless, a camera's dynamic range is a function of sensor performance (low noise is critical), number of A/D bits and the number of codec recording bits. Each stop requires a doubling of sensor output voltage, and each bit represents a doubling of voltage. Therefore, a 12-bit A/D has the potential to capture a 12-stop dynamic range.

As a camera's bit depth increases, the smoothness of the camera's gray scale increases. (See Figure 1.)

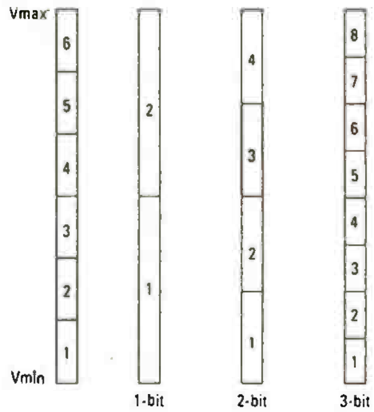


Figure 1. Grayscale smoothness as a function of bit depth

(Banding is reduced.) Therefore, the A/D and post A/D processing traditionally has more bits than necessary to capture the sensor's dynamic range — thereby realizing the sensor's potential.

Both ProRes 4444 and AVC-Ultra can provide 12-bit sample depth. Alternately, data can be converted to log values. In this case, 16 bits can be represented by only 10 bits. Thus, when looking at bit depth specifications, it's important to know whether it's log data.

Consider an illumination range of 18 stops. Assuming older sensor technology, at best only 12 stops can be captured by the sensor. However, these 12 stops are not all usable. Low

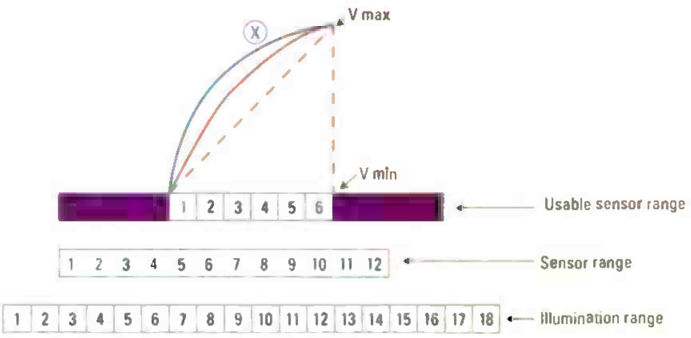


Figure 2. Legacy video sensor and processing

illumination causes several stops to be lost because of high levels of noise. Likewise, at high illumination, several stops are lost due to clipping under extreme light levels. The effective dynamic range is only about six stops. (See Figure 2.)

In Figure 2, the brown diagonal line shows a perfectly linear gamma. In order for a video signal to be displayed correctly on a monitor, a nonlinear gamma must be applied to the signal from the A/D. In the HD world, it's called Rec. 709. (Red curve.) This curve provides the video image that we are used to looking at. When video will be transferred to film, a lower contrast video image is required. (Blue curve.) The "X" marks the point where the filmic curve yields a brighter mid-tone image that reduces apparent contrast.

Consider a contemporary sensor. (See Figure 3.) The illumination range remains the same at 18 stops. The potential sensor range, however, has increased to 15 stops. Because of improved technology, fewer stops are lost to noise and bright light clipping. Thus, the sensor is able to capture a usable 12-stop dynamic range.

Once again, the brown diagonal shows a linear gamma curve, and the red curve shows Rec. 709 gamma. To record a 12-stop signal, a 12-bit codec can be employed. Alternately, some cinema cameras utilize a logarithmic gamma (green curve) that is applied to sensor data. At point "Y," the logarithmic curve yields a brighter picture that reduces apparent contrast. Likewise, at point "Z," the logarithmic curve yields a darker picture that also reduces apparent contrast.

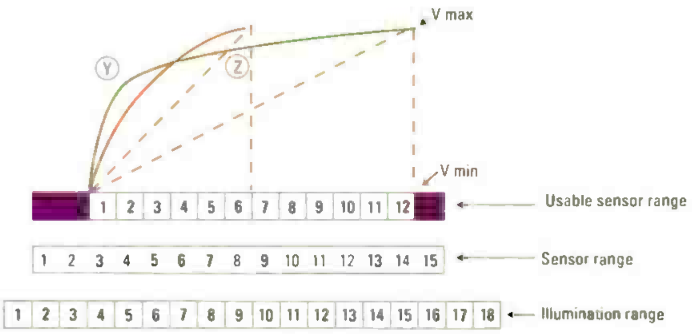


Figure 3. Contemporary cinema sensor and processing

This explains why a logarithmic image looks so much "flatter" than a Rec. 709 image. After log conversion, only 10 bits are required to carry the 12-stop signal range.

AVC-Ultra

Today's sophisticated sensors demand a recording system that is capable of carrying a much higher-level quality image. For this reason, Panasonic has announced AVC-Ultra. AVC-Ultra is backward compatible with AVC-Intra. That means that an AVC-Ultra decoder can decompress all of Panasonic's P2 codecs. AVC-Ultra offers several quality levels. (See Table 3.)

The Panasonic AVC-Ultra family defines three new encoding parameters from the MPEG-4 Part 10 standard. Unlike the Intra codecs, Ultra codecs can utilize the AVC/H.264 4:4:4 Predictive Profile.

AVC-Intra Class 50 and 100 are extended to Class 200 and Class 4:4:4. The Class 200 mode extends the bit rate to 226Mb/s for 1080/23.97p, while Class 4:4:4 extends the possible resolution from 720p to 4K with value depths of 10 and 12 bits. It's possible Class 4:4:4 at 10 or 12 bits with a 4K frame size will be employed in the 4K camera Panasonic showcased at NAB2012. The Class 4:4:4 bit rate varies between 200Mb/s and 440Mb/s depending on resolution, frame rate and bit depth.

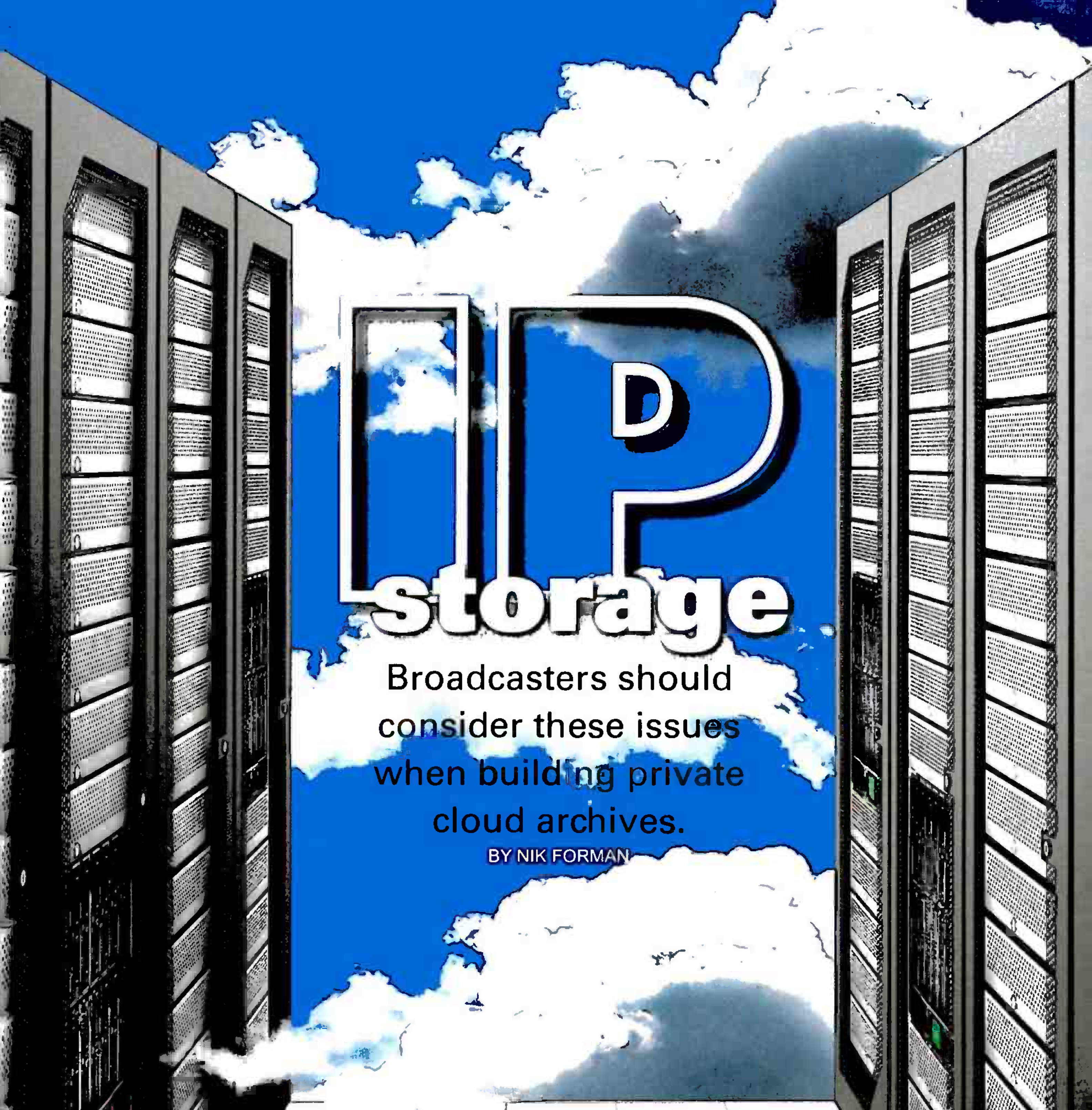
There is also a new 8-bit AVC-Proxy mode that enables offline edits of 720p and 1080p video at bit rates varying between 800kb/s and 3.5Mb/s.

Both the Class 200 and the Class 4:4:4 are intra-frame codecs. Although Panasonic has always promoted intra-frame encoding, its new AVC-LongG is an inter-frame codec. AVC-LongG enables compression of video resolutions up to 1920 x 1080 at 23.97p, 25p and 29.97p. Amazingly, 4:2:2 color sampling with 10-bit pixel depth can be recorded at data rates as low as 25Mb/s. BE

Steve Mullen is the owner of DVC. He can be reached via his website at http://home.mindspring.com/~d-v-c.

	Class 4:4:4	Class 200	AVC-LongG	AVC-Proxy
Bit rate	200Mb/s to 400Mb/s	226Mb/s @ 1080/23.98p	As low as 25Mb/s	800kb/s to 3.5Mb/s
Frame size	720p 1080p 2K 4K	720p 1080p 1080i	720p 1080p 1080i	720p 1080p
Bit depth	10- to 12-bit pixel depth at 4:4:4	10-bit pixel depth at 4:2:2	10-bit pixel depth at 4:2:2	8-bit pixel depth at 4:2:0
Codec	Intra	Intra	Inter	Inter

Table 3: AVC-Ultra formats



IP storage

Broadcasters should consider these issues when building private cloud archives.

BY NIK FORMAN

Clouds, and the services hosted therein, including archiving, come in three flavors: private, public and hybrid. In archiving terms specifically, public, cloud-based archiving involves the use of a third-party storage service, for example. These companies will store and manage assets in remote storage centers, and provide all of the security, failover and disaster-recovery facilities as part of the service. Data transfer can be arranged in a number of ways, depending on bandwidth availability. However, although these services can be customized per user, they tend to lend themselves more to enterprise-level data storage, and broadcast-specific issues such as larger file sizes (and associated transfer times) or content security may make these services less

Figure 1. A private cloud archive provides standard archive functionality, as well as disaster-recovery facilities for multiple remote sites.

attractive. A private cloud archive, such as the one shown in Figure 1, is created and maintained within the organization that uses it, and can range from a simple, single-server, disk-only archive servicing a single department to a network of globally linked archive centers with a central database, all sharing and managing assets within what remains essentially a single closed system.

A hybrid archive is generally offered by a service provider (often as part of a public cloud archive service), but with a selection of storage locations; rapid-access content might be stored locally on the customer's own servers, while material that will be rarely used but still requires retention might be stored in the third-party's storage farms.

Using these definitions, private cloud archives are currently the most common form of broadcast archive, as this covers all company-internal archives. There is no set rule on the size, schema or architecture of a private cloud archive. As with any broadcast system, the archive will be designed to facilitate the needs of each individual organization, and is likely to grow as the requirements placed upon it change. The provision of service agreement around which an archive is designed will be different for each organization, which can produce radically different designs and interpretations. However, there are a number of considerations common to all private cloud-based archives, and some of these are set out here.

Physical architecture

When building an archive within an existing operation containing standard broadcast systems (e.g. automation, asset management), the archive can generally operate across the same communications infrastructure as the rest of the organization, as long as this contains sufficient bandwidth to accommodate archive transfers.

A recent archive installed by a national broadcaster in Europe across four geographically separated sites used the existing WAN to replicate and centralize archive data.

A combination of 4.5Gb and 1.5Gb connections are able to stream a mixture of HD and SD live feeds and other content, along with an average of around 200TB per month of archived/restored data between the sites. The archive system is also able to schedule transfers, if required, so as not to impinge on live content at busy times.

One item to note on transfer speeds across WANs is that when archiving directly to tape, data transfer speeds have to be kept above a minimum in order not to cause undue stress on tape-drive write heads. Data speeds slower than the optimum for a given tape drive mean that the tape drive has to constantly stop and re-start during the write process, causing a condition known as shoe-shining as the tape slips over the heads; this can impact drive and tape quality and life span. This minimum speed varies with drives, but generally it is recommended to "feed" a drive at no less than 40MB/s.

Size — physical storage

The hardware required for the archive will depend on the agreed-upon levels of provision. Typically, both disk and tape storage will be used, and the total amount will, naturally, depend on the amount of data that is to be processed. However, the size of the archive will be defined not only by standard archive operation considerations (i.e., how much content is moved in a single operation from source to tape or disk), but also on supplemental services (e.g. disaster recovery, content migration), and retention policies.

At our multi-site European broadcaster, the archive cloud handles the 200TB per month of archive/restore data transfers across total disk storage of 600TB, with a DR/deep archive tape library containing 3000+ LTO-5 tapes.

Size — storage control

The next consideration is the controlling application. In our private cloud archive, the content management application sits between the production/management application layer and the storage itself, as shown in Figure 2, and requires its own hardware. The amount of hardware used by the controlling application is directly related to the amount of data throughput that has already been calculated: Depending on the software used, high-end servers may be capable of driving two to five tape drives each, with a data throughput of up to 140MB/s per drive. This is not an exact science, however; concurrent disk and tape transfers, disk cache sizes per server, and, of course, the ever-present spectre of bandwidth are all contributory factors that must be considered.

Content management software compatibility

When considering the archive management software, perhaps the prime consideration is its interoperability with the rest of the systems and hardware. Compatibility with the immediately superior control application layer is, of course, essential, in particular with reference to the management of metadata across multiple management systems and transfer media, but other implications may also need to be considered. For example, it may be advantageous to an organization to choose an archive management application that is built to support new overlying or supporting technologies as they appear. Generally, any new hardware is supported by most main archive management vendors as a matter of course, but as IT comes to play an ever-increasing role in the broadcast

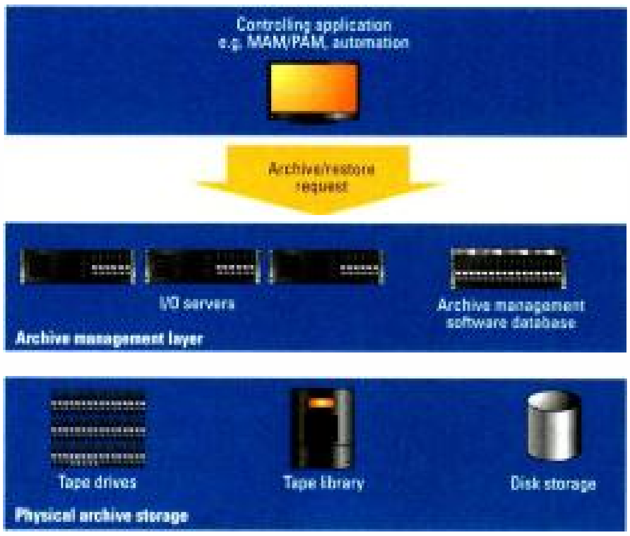


Figure 2. The greater the number of archive disk and tape storage devices need to be driven, the more storage control servers are required for the data I/O.

environment, newly introduced technologies may need to be supported by systems already in place.

In a real-world example, a facility provides audio-visual services to other broadcast organizations nearby. It offers archive-as-a-service (in this sense, it is offering a broadcast-centric, semi-public cloud archiving service), and in order to achieve this, it uses archive management software that is compatible with several different breeds of control systems that instigate the archive and restore operations directly from the (remote) client sites. In addition, the software also has to be suitably designed so that the main facility can plug in its own billing software (in this instance, using a simple XML-based API), which automatically calculates monthly service fees based on usage data extracted directly from the archive. Open communication interfaces such as this also allow facilities to construct their own LOB-specific applications, enabling them to completely customize their archive and restore operations to create unique workflows.

Archiving-as-a-service, as discussed above, begins to approach the definition of public cloud archive services, and although our example is still broadcast-centric, by taking the archive out of the private cloud, wider frameworks may have to be considered. Public cloud storage in general is becoming increasingly standards-driven, and some customers may request compliance in their cloud storage applications. Some mainstream storage bodies such as Storage Networking Industry Association (SNIA) are defining cloud storage-specific standards (e.g. Representational State Transfer [REST] and Cloud Data Management Interface [CDMI]) that seek to define common interfaces and transfer/management protocols for all cloud storage applications. Although these standards are data-generic (rather than broadcast-centric), as they become the norm in general IT, it is possible that broadcast customers will also seek to implement solutions that apply the same levels of standardization to broadcast data and storage processes.

In addition, when providing disaster recovery as a wider archive service, absolute definitions such as recovery time objectives (RTO) and recovery point objectives (RPO) must also form part of the service-level agreement, and the ability to provide these depends on the capability of the archive hardware and software. BE

Nik Forman is marketing and branding manager for SGL.

Live streaming from multiple locations

A technology conference moves to the Internet

BY BEN CLEARY

Streaming an event live has become common in recent years. Codecs, equipment and the Internet have adapted well to the needs of the corporate community. But when the team responsible for putting together this year's Wolters Kluwer Technology Conference decided to have a virtual conference and stream content back and forth between 10 cities simultaneously, more than a few eyebrows were raised. Wolters Kluwer, a worldwide publishing and software company, wanted to cut expenses as much as possible yet still provide a quality event for its employees. The steering committee realized that just cutting travel expenses alone would save the individual business units hundreds of thousands of dollars.

Concept

Ten cities around the world were "host" cities for the conference. All of the keynote sessions would originate from the Hilton Hotel in New York City, where quality had to be excellent. In addition to New York, the other cities would be origination points for the afternoon breakout sessions. Each city would have four "conference" or meeting rooms set up to receive the afternoon breakout sessions from other cities. The biggest challenge was to find a low-cost way for each of the remote locations to transmit their sessions. The system had to be simple enough for an amateur to operate successfully.

Traditional teleconferencing systems were eliminated early because of cost. We found an economical system in New York-based Livestream. In addition to the company's live streaming and storage capability, its streaming software had the ability to push a live camera shot of the presenter and a PowerPoint presentation simultaneously. The company also provided a separate webpage/channel for each encoding location.

Setup and testing in New York

Rather than rent video equipment in New York and produce the keynote sessions ourselves, we decided to farm out the encoding and live video production to the company's live production crew. They were able to interface with PSAV, the hotel's preferred AV company. PSAV operated the house audio and presentation switcher. They also rolled prepared videos for sessions in the main ballroom and provided a video feed of the screen content to the company. Livestream's crew combined the PSAV feed with live shots from two HD cameras in their video switcher. The feed from the streaming company's video switcher fed their encoding computers. The New York Hilton's telcom people provided a 10MB/s private VLAN for the New York live feed. (See Figure 1 on page 44.)

Setup in host cities

After determining which of our business unit locations could handle the 1500kb/s encoding bandwidth requirements, we pared the number of transmitting sites down to nine sites in eight locations. Two were in Europe and seven in the U.S. To handle the rest of the breakouts, we added a second encoding room at the Hilton Hotel in downtown Manhattan for a total of nine streaming sites. Three other cites, one in Canada and two in the U.S., didn't have the bandwidth to encode, so they were designated as receive-only sites.

Once we finalized locations, we then began to recruit people interested in learning to use the streaming system and who would be responsible for all of the encoding at their locations. Most of the volunteers came from the local IT departments. Because our goal was to eliminate travel costs, I found myself on the phone, e-mailing pictures and diagrams back and forth, to try to determine how to help the local person set up and test everything.

We knew we would have to adapt much of what was already on-site at each local office to interface with the encoding computer. While varying in size, most of the conference rooms had a projector and some type of audio system. In every location, the projectors had standard VGA inputs and the audio systems had 3.5mm mini input plugs, designed for playing computer audio over the room speakers. This made playback simple.

To get the presenter's mic into both the room sound system and the encoding computer, we used an external mic mixer. The presenter's mic was input into a small mixer. One channel of the output fed into the room's audio system for the local attendees, and the other channel fed the line-level audio input of the computer's sound card.

A video camera was set up on a tripod and locked on the presenter, who was standing at a podium. The composite video output of the camera was input into the computer using a simple composite-video-to-USB converter. A few of the conference rooms were small and had a small number of attendees planned, so in those cases, the easier solution was a webcam with built-in microphone plugged into the computer's USB port.

At a couple of locations, we had professional HD-SDI cameras and quad-core desktop workstations instead of laptops for the encoding. There, we opted for an HD-SDI capture card.

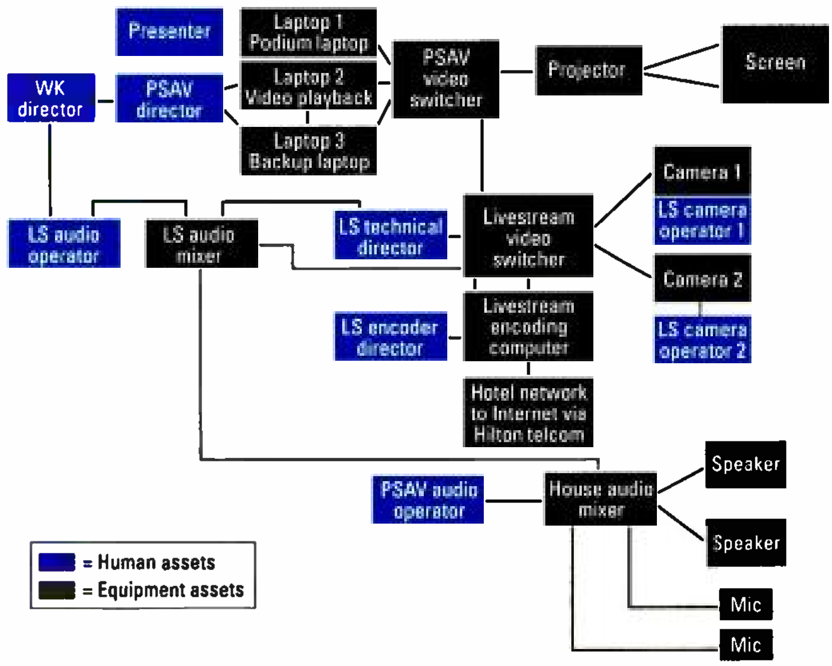


Figure 1. System layout for keynote presentation at Hilton Hotel in New York City

AS HEARD ON TV

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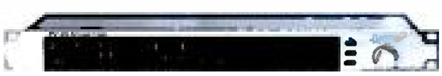

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To keep it simple and eliminate an audio mixer, we ran the presenter's mic into the XLR input on the professional camera. This sent the audio and video signal into the computer via the camera's HD-SDI signal. We also ran an audio output of the camera into the local room's sound system.

In every case, video was fed from the encoding computer to the room's projector via a dual-VGA output card. That way the tech person running the encoding computer could see what was being encoded, and the presenter and attendees in the room could see the projected image.

A second computer was set up next to the encoding computer to allow instant messaging communication between the tech leads and me during the sessions. The communications operator also handled questions submitted by attendees over Twitter.

Testing

About two months before the event, we scheduled several live testing days when everyone would have all of their equipment up and running at the same time. Since we couldn't get access to the Hilton in New York, I provided an HD feed from my WK Business Unit's TV studio in Kennesaw, GA. After much testing and the handling of the inevitable glitches, the tech leads became more comfortable with their equipment and Livestream.

The event

While there were a couple of stumbles in the beginning, issues were quickly rectified, and the conference material was delivered on schedule. At any given time in the afternoon, there were eight simultaneous sessions being transmitted across the Internet to cities and viewers across the globe.

With more than 560 people from all over the world registered, the conference began at 9 a.m. Wednesday, June 27, and closed successfully at 5 p.m. Friday, June 29. By that time, participants had seen four major keynote sessions and close to 60 breakout sessions from around the world thanks to the hard work and dedication of dozens of Wolters Kluwer employees. Streaming of live events is nothing new, but conducting a live event with content originating from different cites at the same time was both successful and fascinating. **BE**

Ben Cleary is the Manager of Audio Visual production for CCH Small Firm Services, a Wolters Kluwer business in Atlanta, and Tech Lead for the WK Technology Conference.

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TSL's PAM2 monitor

The audio monitoring unit helps the CatholicTV Network maintain high QC.

BY MARK QUELLA

At the CatholicTV Network (CTV), a non-profit educational organization that utilizes communication technology to offer 24-hour programming supporting the Catholic tradition, quality assurance monitoring of audio content has become an essential part of the production process.

The network's programming is distributed through cable companies across the United States, other English-speaking countries and territories, and via the Internet and Apple mobile devices through iTunes. Ensuring compliance with loudness regulations and verifying audio formats for stereo and surround, all while taking multiple audio sources and delivery methods into account, can be difficult. Access to these audio streams is crucial for making informed production decisions. The challenge for CTV, then, was bringing this capability to the wider production and operation teams.

Assuring quality assurance

The CTV production complex has three studios, one of which is a chapel, while the other two are used for talk shows, panel discussions, presentation segments and music programs. The facility offers two control rooms that can be used to produce shows from any of the three studios. With the completion of the HD upgrade, based on the 3G 1920 x 1080 60P standard, the enhancement required a 3G HD-SDI-compatible audio quality assurance monitoring system able to create user-programmable listen scenarios and also track loudness levels over time.

These capabilities came in the PAM2 3G16 audio monitoring units, both Dolby and non-Dolby, from TSL Professional Products. They have performed flawlessly. Configuration and installation of the units for surround sound monitoring was simple and straightforward, so there was no problem from the wiring side of things. Once we had learned the program user presets and understood the relationships of the settings, everything ran smoothly and reliably. The production team now has a full, legitimate tool to help accomplish the rigorous production schedule.

The PAM2 enables users to monitor surround sound and loudness for both incoming and outgoing streams.

High QC

A big part of the HD upgrade was the implementation of surround sound and expanded multilingual capabilities. While this has provided access to a much wider audience, it also meant more audio streams. The audio monitoring units give up to eight pairs of AES/EBU and up to six balanced stereo analog inputs, so there is maximum flexibility in dealing with source audio within the facility. This ensures that all possible audio sources will be addressed efficiently. Simplifying audio monitoring of the expanded multichannel facility has been indispensable. The monitors offer operators an easy way to identify channel assignments and levels via soloing and down-mixes.

The units, both Dolby and non-Dolby, provide instant access to relevant audio streams. This enables users to monitor surround sound and loudness for on-air and satellite distribution, as well as handle different audio streams coming in to support programming. The Dolby-equipped unit is used for master-control room surround sound monitoring and quality control of the on-air programming chain's loudness. The non-Dolby unit is located in the satellite receive center. It helps identify and enable quality control for the many different satellite audio assignments and channels coming in from satellite receivers that are necessary in order to receive global feeds of papal travels and events.

The monitoring units are powerful, yet can be simplified for different operational positions whenever time is of the essence. The units allow A/B monitoring of the multichannel air chain pre- and post-processing. They are also used to time track loudness in order to meet new standards. In regards to level consistency, this has improved overall quality control. Having the ability to preprogram user listening selections has empowered operators and quality control personnel to manage audio levels more quickly and efficiently. The ultimate result is a more consistent on-air presentation.

In summary, having the capability to efficiently monitor multiple audio streams for quality assurance provides better consistency and, therefore, better programming. BE

Mark Quella is chief engineer, CatholicTV.

Studio Technologies' Live-Link Jr.

The remote camera interface eases field deployment.

BY GORDON KAPES

In the fast-paced, diverse world of outside broadcast, time is always a challenge when deploying complex systems to meet production and event schedules in the field. It is in especially short supply for the smaller OB van operations, with their typically compact systems and limited crew size. The variety of required cabling can add additional complexity to this issue. While the large broadcast production trucks can usually pull up close to a venue, and often take advantage of "house" cabling resources, the required video, audio and support cable runs between a camera location and the associated OB/ENG van can be quite long. And for the smaller satellite uplink/production van covering the same sports event or concert, the cable runs might be even longer as the available parking location may be even farther away from the venue.

Cabling needs include supporting a camera feed, return video for monitoring, mic- or line-level audio sources, IFB for talent cueing and party-line intercom belt pack connections. More involved applications may also involve connections for camera control using serial data and on-air tally signals. Clearly, running multiple cables to connect a truck-side unit to the camera location in the field is cumbersome at best, and extremely inefficient and costly in terms of crew hours, hauling weight and truck space. Finding a solution to the cable conundrum is certainly in order for the industry at large and for smaller OB vans in particular.

While the large broadcast production trucks can usually pull up close to a venue, the required video, audio and support cable runs between a camera location and the associated OB van can be quite long.

The cure

Studio Technologies developed the Live-Link Jr. remote camera interface system to solve the cable conundrum for operators needing to quickly and efficiently connect camera and return video, on-air and talent cueing audio, and party-line intercom between

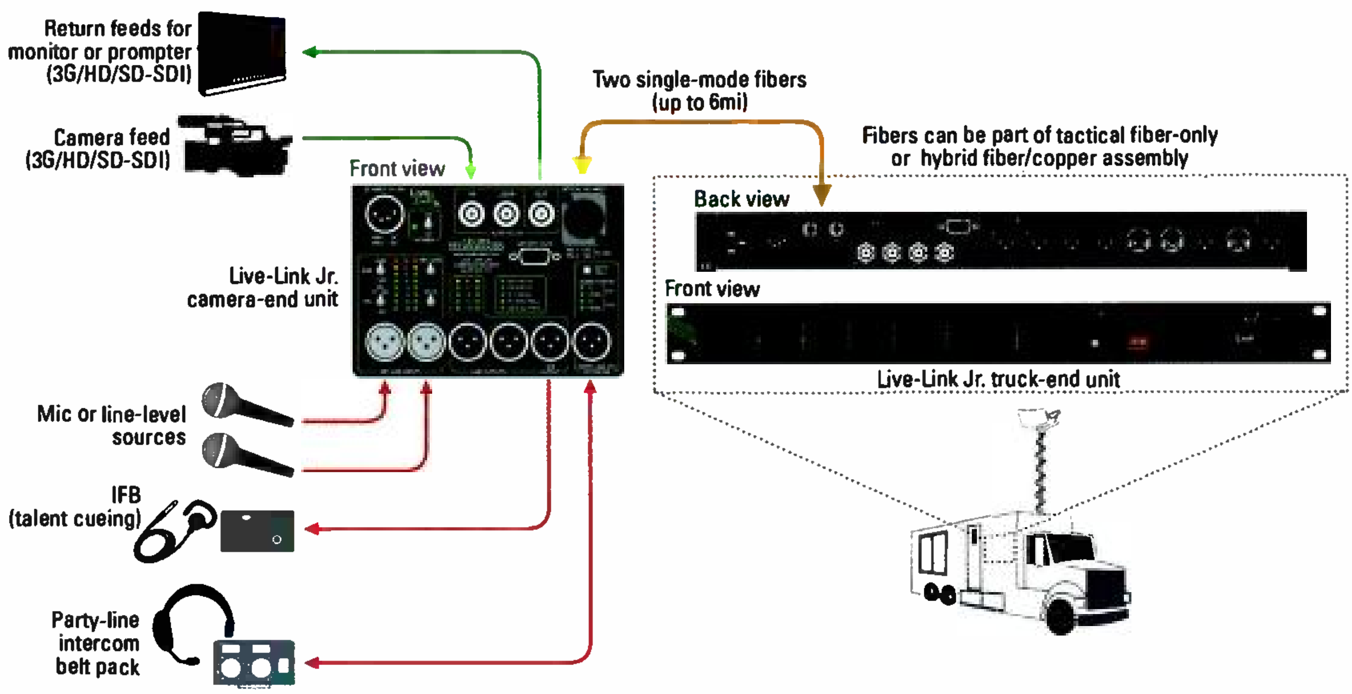

Figure 1. Linked using just two single-mode optical fibers, the system's portable camera-end unit and 1U rack-mounted truck unit deliver video and audio signals at distances of up to 6mi.

a camera location in the field and a small broadcast vehicle. The system offers an extensive set of features highlighted by excellent audio quality and a compact, rugged form factor. Its design was specifically optimized for live event, OB/ENG and uplink vehicle applications. Interconnected with just two single-mode optical fibers, Live-Link Jr. allows for the rapid deployment of all the resources required for a single-camera "live shot."

Untangled

Linked using just two single-mode optical fibers, the system's portable camera-end unit and 1U rack-mounted truck unit deliver excellent operational performance for all video and audio signals essentially regardless of the interconnect distance, whether hundreds of feet or miles apart. (See Figure 1 on page 49.) The camera-end unit allows for remote powering from the truck-end by using hybrid fiber/copper cable with distances of well over 1000ft possible. It can also operate locally from a 12VDC source or by a battery connected through an Anton/Bauer or V-Mount battery mount. The truck-end unit offers both AC and DC powering capabilities, with the DC source capable of serving as a hot standby. If a connected AC mains source fails, the unit will automatically continue operation from the DC source.

A major strength of Live-Link Jr. is its integrated 2-channel intercom system, which tames the typical hassles and limitations associated with field intercom system implementation.

Picture-perfect video and audio

On the video side, the system transports one SMPTE-standard SDI signal in each direction. SD-, HD- and 3G-SDI data rates are supported as well as many different video standards. An integrated embed output is associated with each SDI input, providing a signal that follows the audio and auxiliary data embedding process within Live-Link Jr. This "post-embedder" signal can be valuable for confidence monitoring, transport of signals via coax or as an aid during testing/troubleshooting. At the truck-end, the SDI signal associated with the camera is provided as two independent buffered outputs for maximum flexibility.

On the audio side, all audio and related data signals are transported between the camera-end and truck-end units as embedded SDI data. The camera-end unit has two mic/line inputs that are compatible with microphone or line-level signals. Related features include adjustable input sensitivity, 48V phantom power and level metering. Each mic/line input can be independently set for compatibility with line-level (0dB gain) or mic signals (gain of 15dB, 30dB or 45dB). Two balanced line-level outputs are provided on the truck-end unit's back panel and are associated with the camera-end unit's mic/line inputs. Two additional balanced line-level outputs are also located on the truck-end unit's back panel to provide de-embedded analog signals associated with group 1 — channels 1 and 2 of the transported SDI signal. These convenience outputs allow audio embedded, for example, by a camera connected to the camera-end unit to be accessible without the need for an external de-embedder unit at the truck-end.

Commanding comms

A major strength of Live-Link Jr. is its integrated 2-channel intercom system, which tames the typical hassles and limitations associated with field intercom system implementation. A 2-channel party-line intercom interface is provided on both the camera-end and truck-end units, allowing beltpacks to be directly connected and powered. A fully functional camera-end-to-truck-end "comms" system can be up and running in just minutes.

Additionally, two line-level audio signals can be transported from the truck-end to the camera-end. Two balanced line/IFB inputs are located on the back panel of the truck-end unit and allow the connection of a variety of analog audio signals, including those used for talent cueing (IFB). However, unlike traditional IFB systems, the excellent audio quality of the system allows transporting even on-air signals. For flexibility, both line-level and "wet" IFB (power and audio) outputs are provided on the camera-end unit.

Everybody in the spool

With budget stress, green concerns and staff cutbacks in the mix for all levels of the industry, finding ways to deploy a system in the field more efficiently has become a mandate. The Live-Link Jr. Remote Camera Interface System allows video, on-air and IFB audio, comms and support, including RS-422 data and GPI/GPO, to be deployed quickly and easily, extending the resources of an OB vehicle to the camera location. Almost as quickly as a tactical fiber or hybrid fiber/copper assembly can be run, the entire broadcast production system can be in place and operational. With that efficiency and on-air "tool kit" at hand, the miles of copper cables usually transported from venue-to-venue can now be left in storage. Cable conundrum solved. **BE**

Gordon Kapes is president, Studio Technologies.

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Production switchers

Today's switchers come with a dazzling array of capabilities.

BY JOHN LUFF

It's funny how our business reinvents itself on a regular basis. Even funnier still is how commodity IT technology has been in the forefront of switcher developments of late.

For decades, production switchers were rigid in their architecture. Each M/E bank fed into an internal router but cascaded together in a fixed structure. M/E 1 could not have M/E 3 as a source, though the reverse was possible. There is a simple reason for this: Analog switchers could accommodate only a fixed amount of delay, and cascading effects busses together lengthened the latency of the signal.

To accommodate this, fixed delays were inserted where appropriate in a switcher so that when cascaded, things still would work. In analog color composite systems, this was necessary to keep the color subcarrier in phase.

A game changer

In the late 1970s, Grass Valley introduced a switcher (Model 300) that, although still analog, broke that paradigm by using delay lines of various lengths to allow "infinite re-entry." This was a game-changing innovation. It was complex and expensive, but it sustained the 300 as the premier switcher for many years. For years, there were "300 emulation modes" in some switchers to allow TDs who are reticent to change to do things in familiar ways, long after digital switchers killed the market for analog production switchers altogether.

Analog switchers were expensive for many reasons, but it is important to remember that they were truly a system. Replacing a single module might require extensive setup of the entire switcher for (especially) levels and phase. This meant that initial checkout and fine tuning in the factory was labor-intensive and required considerable time while electronics "cooked" together. Digital switchers can be produced one board at a time and don't need to be checked and tuned as a system to anything like the precision necessary in the analog world.

Feature creep in digital switchers is often a matter of writing new code, though in some instances that code must be run in FPGA chips, which have extraordinary capabilities. Enabling features not purchased initially can be as simple as inserting a code to authorize your use, since it is not practical to deliver many versions of software with many combinations of features to users all over the world.

Today's capabilities

"Infinite re-entry" was revolutionary in its day, but today switchers come with a dazzling array of capabilities. A modern 1 M/E system can do most of what a 3 M/E Model 300 would have been capable of, is more stable, contains multiple digital effects channels, and may be capable of both HD and SD.

Take keying, for instance. A 300 had two keyers, but a modern switcher may have four keyers per M/E, or in at least one case five keyers per M/E. In older analog systems, chroma key was an option that often cost considerably more and could be assigned to one M/E at a time. Now digital switchers often have more than one on each M/E.

But nowhere is the difference more striking than when considering digital video effects. When Vital Industries introduced the Squeezoom in 1977, it cost $200,000 and only did 2D manipulations on the X and Y axis without perspective. It was a "wirewrap wonder," a bit flakey to keep working and fundamentally changed our industry. A couple of years later, AMPEX introduced the ADO, and Grass Valley added digital effects in association with NEC that filled an entire rack. Compare that to a switcher today that might have eight channels per M/E.

More horsepower

But good news always creates a shadow. Increases in production capability have required manufacturers to find ever more capable processing hardware solutions to enable the steady advance of features that require significantly more horsepower than their predecessors. This is where commodity IT hardware becomes part of our solution.

Take a look at any computer game today, and you will see incredible rendering capability evidenced. A big part of that is in software, of course, but rendering complex images in real time is done in increasingly sophisticated graphics engines. The compute power behind those card level solutions that every teenager wants to have are not integral to video switchers. Just look at your smartphone and rotate the screen. That real-time image processing is far from trivial, and the availability of hardware and software solutions to do many of the manipulations we do in professional switchers is critical to the ability of manufacturers to build systems at prices we are willing to pay.

The next step

My column has been about technology in transition for more than a decade. I have to admit that I only partly saw the logical extension of the evolution of switchers until recently.

What if there was a simple box with tons of processing capability in a platform best described as a deep layering engine? Think of a conventional M/E as what it really is, a highly structured set of layers with transitions possible in each layer.

Taking this to the logical extension, what if that same layering capability could be described not as nested or infinite re-entry of descrete M/Es, but rather as a set of layers that could even be described completely in human readable text (XML) so that new instructions for switcher "configuration" could be authored in many different applications. Transitions can be made to appear global or affect a single element in a single layer of a deep composite of many elements.

Make that processing stack deep enough, with a boat load of memory, present sufficient inputs to it, and you effectively have a very complex, very powerful switcher that can be redefined any way necessary. Control panels truly become a user interface.

Though this may seem a bit futuristic, it is quite possible with current processing technology that arises in part from video processing developed for the gaming industry. Such a system would be inherently reprogrammable to do many different tasks, including digital effects, titling, compositing and essentially all the processes we are used to seeing in a production or master control switcher.

When musing about this with a colleague, it was suggested to me that a system like this might cost a fraction of a large production switcher and could allow a training facility to be built. TDs who have no experience with the latest model might sit down at perhaps a touch screen control panel, which could be configured to look just like any production switcher, but more importantly could be reprogrammed to act like others at will.

Even more powerful, though, is changing the function of the switcher completely to suit the immediate need. The processing frame could be a master control switcher one minute and a production switcher the next. Integrating graphics and commercials into a sports broadcast might be as simple as giving control of the master control electronics to a production control room with a different user interface running, perhaps at the same time that master control sees its panel just like usual. Lower cost in total, more utility and future extensibility — all in a compact package that harkens to its roots as a computer game console. BE

John Luff is a television technology consultant.

ONLINE For more information on these products, go to www.broadcastengineering.com

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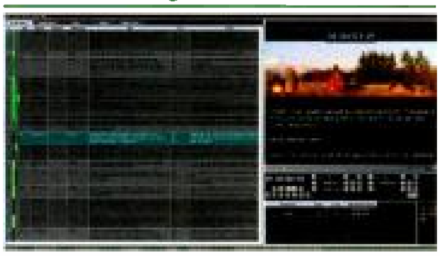

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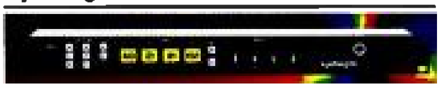

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Employment

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It's all about sports

Savvy broadcasters will take advantage of a consistent revenue source.

BY ANTHONY R. GARGANO

In June of this year, D.I.S. Consulting released a comprehensive market study titled "Sports Video World 2012." The study represents a complete analysis of the market for sports television equipment. Sports have always held a uniquely important position in television, and the growth in sports revenue over the years has been nothing short of phenomenal. Sports today represent a mega-multi-billion-dollar total market that just seems to keep growing exponentially.

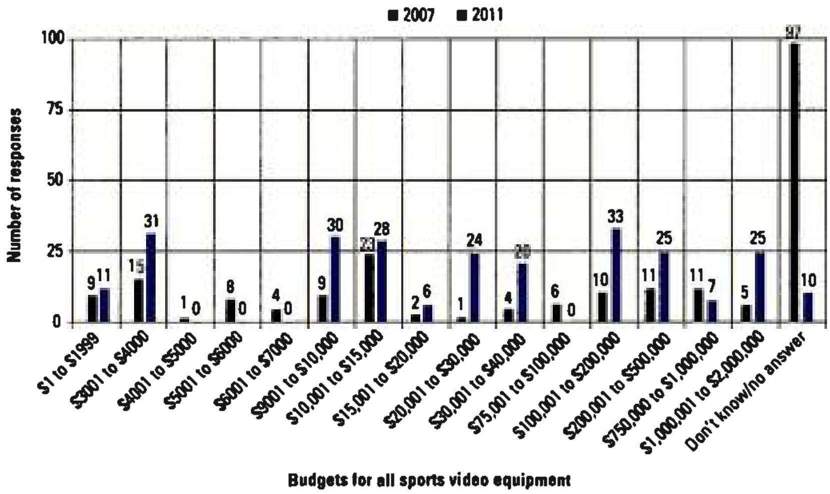

Figure 1. One of the charts from D.I.S. Consulting's "Sports Video World 2012" study demonstrates the dynamic level of growth in budgets for sports video equipment between 2007 and 2011.

Sports — then and now

I grew up in a working-class neighborhood in Philadelphia, in the halcyon pre-cable and pre-satellite days. I recall seeing banners splayed with the words "Watch New York Games Here" or "Yankees TV Here" hanging over the doorways of local street-corner taverns. Atop the roofs of those taverns were huge TV antennas mounted as high as possible to capture a few microvolts of snowy signal from New York television stations some 90mi distant. Those precious signals were then transported via the most basic of transmission lines — 300Ω twin lead — to a set of screw terminals on the back of a 21in television receiver. Those 21in sets, representing the largest screen size then available, were usually mounted at squint distance: up high and at the end of a long bar. Sports of old, in microcosm — even then, in its own way, creating revenue and driving investment.

Flash forward 50 years, and we find today's typical sports bar wallpapered with large, flat-screen televisions displaying various games, reports and analyses emanating from the myriad of sports channels flowing through that fiber or coax cable or satellite dish to a high-tech internal distribution center.

Sports revenue

I spoke with Doug Sheer, the CEO and chief analyst of D.I.S. Consulting about the study. "The sports video equipment market is experiencing dynamic growth," he said, and then called sports video spending "amongst the most attractive in the entire professional equipment marketplace" and described it as occupying a "consistently stable place among many much less predictable ones. Figure 1 shows one of the charts excerpted from the D.I.S. study, demonstrating that dynamic level of growth in just the 2007-2011 time frame that Sheer was alluding to.

Despite encroachments by sports cable channels, the televising of sporting events remains a major revenue generator for local broadcasters. The "big three" in local ad revenue are news, political spending and sports. News revenue is king, not to be dethroned any time soon. Political spending adds greatly to local ad revenue, but is cyclical in nature as a function of election years and is not always dependable as campaigns move spending around to where it is needed.

Sports ad revenue, although varying through the year as a function of the popularity of the major sports, is there consistently. And, local pre-game and post-game shows provide yet another source for sports ad revenue.

As the political spending cycle is coming to a rapid close, local broadcasters might want to take a fresh look at revenue sources and ensure they are maximizing their sports revenue opportunities. Equipment suppliers can maximize their own sales by joining with broadcasters in that look. BE

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

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


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