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TABLE OF CONTENTS

VOLUME 54 | NUMBER 5 | MAY 2012

BroadcastEngineering®

FEATURES

BEYOND THE HEADLINES

DOWNLOAD

FCC UPDATE

DIGITAL HANDBOOK

TRANSITION TO DIGITAL

COMPUTERS & NETWORKS

PRODUCTION ROOM

continued on page 6

The best broadcast quality mini converters now in both regular and heavy duty models!

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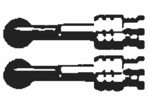

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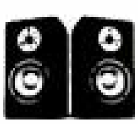

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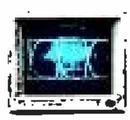

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VOLUME 54 | NUMBER 5 | MAY 2012

ON THE COVER:
The new set for "CBS This Morning" looks to the network's past for inspiration. Some of the highlights include the unique glass desk for the three co-hosts and the 186in "Magic Wall" display screen.

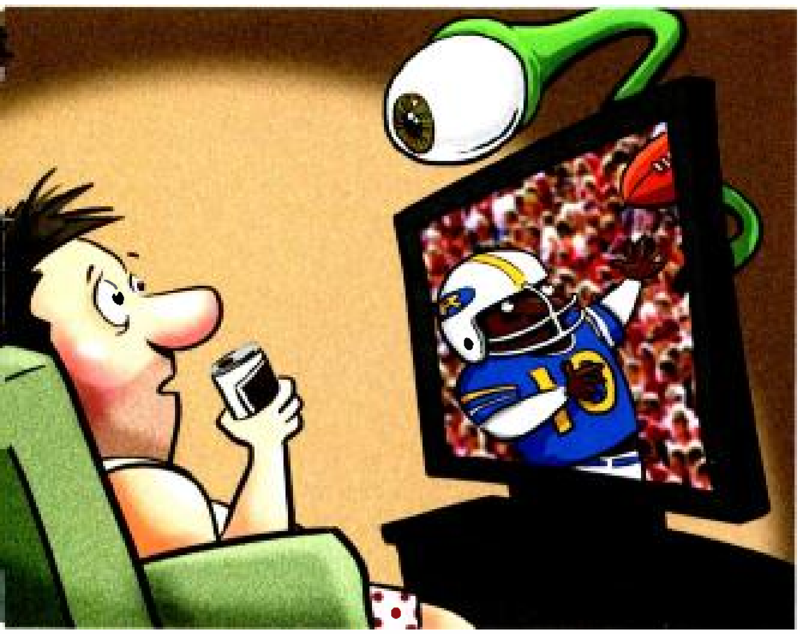
JUST THE FACTS!

The 2012 NAB Show was attended by 91,932 professionals from the worldwide broadcast and professional video production industries, up about 4.5 percent from the 88,044 that gathered in 2011. Dennis Wharton, the NAB's Executive Vice President of Media Relations, said that an estimated $30 billion in commerce was generated by the show, including the business done on the exhibit hall floor by the 1600 exhibitors occupying 815,000sq ft of exhibit space.

Learn more at *www.broadcastengineering.com*

Is your TV watching you?

A recent blog post from the website HD Guru caused the consumer spaces to explode with controversy and apprehension. The article's author wrote about a new series of Samsung LED HD televisions that includes a built-in HD camera, stereo microphones and Internet connectivity. The camera and microphones are built into the top screen bezel of the televisions and face viewers. With the technology, these TV sets provide complete two-way communication, some of which enters the Samsung cloud and may be available to third-party companies.



What might be the advantage of a camera, microphone and Internet-equipped television? For one, grandparents could have two-way visits with grandkids using Facetime. One also could Skype with friends around the world from the living room easy chair. These TV sets also support voice commands, opening new ways to control the TV set. Gosh, this all sounds great doesn't it?

Consumers were not impressed. It seems the ugly theme of Big Brother bothered many readers. Then, there was an apparent lack of transparency by Samsung as to who might be able to control this window into the living room.

Anyone reading *Broadcast Engineering* knows that enabling cozy family conversations was not the reason set makers want to install cameras, microphones and Internet into televisions. They just want to sell TV sets. It is advertisers that want that want to know who's watching.

Samsung is not alone in offering this sort of prying technology. TiVo has applied for a patent that scans users for an RFID. Once detected, the remote control tells the TV device who is operating the controller and then customizes the two-way interface for that person. Adults and children see different content, and the control operates according to user-specific preferences.

Until March 2011, Gerard Kunkel was Comcast's senior vice president of user experience. In an interview with GigaOM, he reportedly said Comcast was experimenting with different camera technologies that could be built into consumer devices. The goal was for the device to recognize people in the room and then make media choices based on viewers' personal profiles. Kunkel said such monitoring represented the "holy grail" for advertisers.

Kunkel has since moved on to Microsoft, which interestingly filed a patent application for similar technology. The application describes a system that would provide personalized TV ads based on facial recognition or a fingerprint scanner contained in the remote control.

My family got our first TV when I was a young lad, perhaps five years old. It displayed black and white images, and we could receive only a single station. One of the first shows I ever saw was "Romper Room." At the end of the program, Miss Nancy would look at the camera through her magic mirror and recite names of the children she could "see" watching her.

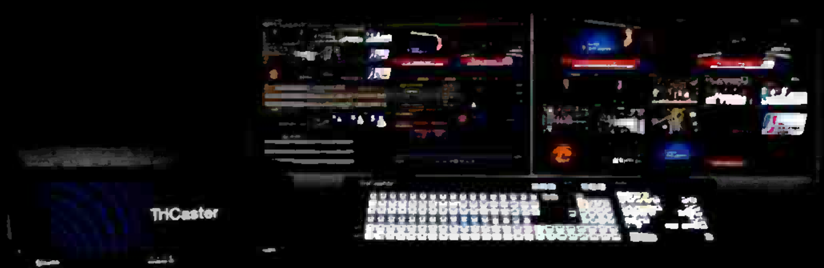
The first time this happened, I freaked out thinking Miss Nancy could see me because I was sitting on the couch, eating cereal, shirtless in my tidy whities. I quickly hid behind the couch, peeking over the top as the show ended. About then, my mother entered the room and asked why I was standing behind the couch. As I explained that the woman on TV said she could see me (in my underwear), mom burst out laughing. She explained that was just a TV show, and people on TV couldn't really see the audience.

While that's still technically true, I'm not excited about the possibility that advertisers may discover that Brad sometimes watches "Swamp People" on the History Channel in shorts and a T-shirt.

Do you care if advertisers can recognize who is in front of your TV set? **BE**

Brad Dick

EDITORIAL DIRECTOR
Send comments to: editor@broadcastengineering.com


TriCaster

Confidence monitors

These tools offer a proactive solution against DTV signal degradation.

BY RICHARD DUVALL

Analog television signals represented video and audio as a continuous range of values that assumed an infinite number of states. Minor imperfections in the channels that distributed or transmitted these signals produced noticeable errors in the picture or sound. Quality decreased steadily with increased degradation in the channel. Analog broadcast engineers recognized the onset of channel impairment by simply watching the television broadcast. With experience, they classified the type and level of impairment and took corrective action before quality degraded to an unacceptable level. Monitoring instruments add precision to this basic quality-control approach.

Unlike analog, DTV signals represent video and audio information as a discrete set of values that can assume only a finite number of states. Minor imperfections in the channels that distribute or transmit these signals generally have no noticeable effect on picture or sound quality. Quality remains high as channel degradation increases until the impairment level reaches a threshold point. At this "digital cliff," quality decreases to an unacceptable level. Thus, digital system engineers cannot detect the onset of channel degradation by watching the broadcast; they can only react to severe quality problems once they appear.

To overcome this, digital broadcasters need monitoring approaches that let them proactively address channel degradation before it leads to noticeable quality problems. Broadcasters that use monitoring instruments that can detect impairments before they impact quality can achieve the same level of confidence in DTV that they achieved in analog. These monitoring instruments are called confidence monitors. Systems built from these instruments are called confidence monitoring systems. Requirements for confidence monitoring instruments and systems for digital television facilities are based on quality control and system management challenges that broadcasters face. While historically measuring RF and TS transmission impairments (QoS), today's confidence monitoring systems now also measure Quality of Experience (QoE).

DTV management

By supporting the convergence of video, voice and data distribution systems, the transition from analog to digital technology also affects digital television system management. Digital telecommunication network operators gain new revenue sources by offering distribution services to broadcasters, and broadcasters can use these services to reduce operating expenses.

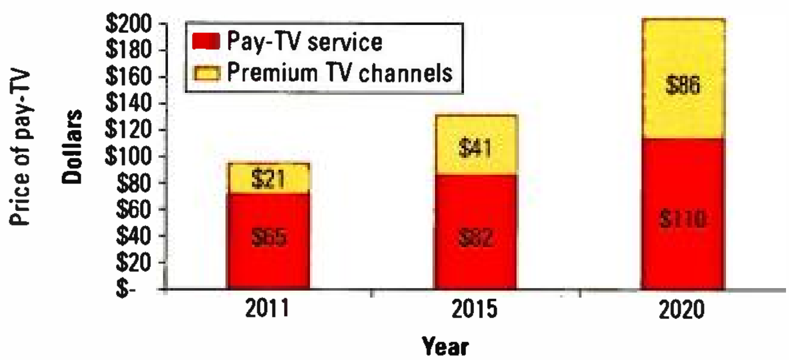
However, this complicates the process of maintaining quality by introducing additional transitions in the distribution chain. As one company hands content off to another, broadcasters must rely on other companies to meet contractual QoS obligations.

Technology convergence has also facilitated new approaches to system management. Many broadcasters are using management techniques that resemble the centralized monitoring and management systems seen in telecommunication facilities. These systems rely on network-capable confidence monitoring devices that can report status and send alarms to a central Video Network Operations Center via standard network communication protocols. The digital-cliff effect, the increase in the number of handoffs and new centralized management approaches are factors driving the characteristics of confidence monitoring systems in DTV.

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

Pay-TV bills $200 by 2020?

Growing at an average rate of 6 percent per year, estimates are that current, average pay-TV bills of $86 will reach somewhere around $200 by the end of the decade.



Source: "Digital Video Outlook" report www.npd.com

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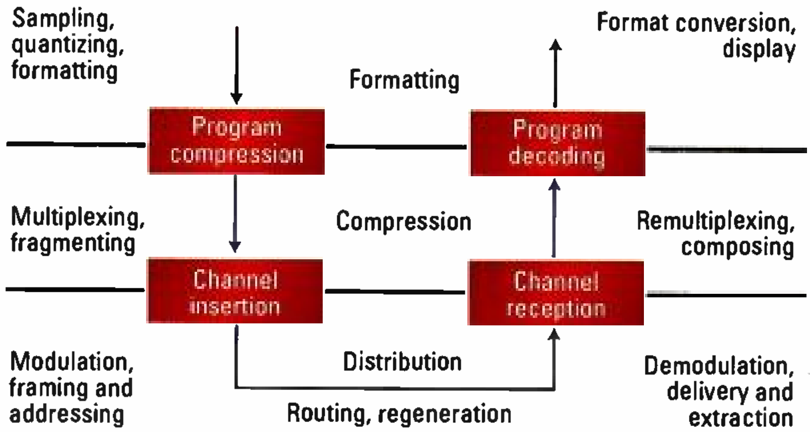

Figure 1. DTV distribution and transmission channels contain sequences of signal and data processing steps outlined in the three-layered model shown here.

Confidence monitoring solutions must also address the quality control challenges arising from the layered structure of digital television systems. As broadcasters transition from analog to DTV, fundamental differences in these technologies are leading to new approaches for ensuring broadcast quality and reliability. In this primer, we describe quality control and system management challenges digital broadcasters face and the developed monitoring devices to address them.

Examining layers

With DTV networks, broadcasters use digital signal processing and digital data processing techniques to improve quality and efficiency in their broadcast networks. Hence, distribution and transmission channels in digital television systems contain sequences of signal processing and data processing steps. We can best understand how these steps interact and impact broadcast quality by organizing them. (See Figure 1.) Specifically, we can use three layers to model a digital television broadcast system.

In the Formatting layer, TV content producers create and format the video and audio that broadcasters deliver to the consumer. Signal processing in this layer includes: the sampling, quantizing and formatting steps needed to create DTV signals; conversion between digital formats; and displaying a digital signal on a TV or picture monitor.

In the Compression layer, content producers and broadcasters compress and aggregate content for storage, distribution or transmission. Signal processing in this layer includes video and audio compression. Data processing here includes: multiplexing programs and system information into a single data stream; fragmenting this stream into a packet protocol; and recomposing programs from packets for decoding.

In the Distribution layer, broadcasters process content for distribution over internal networks or delivery to the end consumer through DTV transmission systems. Signal processing in this layer includes techniques for modulating digital signals onto RF carriers. Data processing includes error correction algorithms for transmission and formatting needed to embed content into network communication protocols used in internal distribution.

Quality-control challenges

Adding digital signal and data processing to broadcasting introduces new sources of errors, with different types of errors in each system layer. At the Formatting layer, broadcasters face challenges in dealing with the wide array of new formats for both standard and high-definition DTV. They need to ensure correct colorimetery and verify conformance to standards. In addition, they may need to convert from one format to another, such as downconverting HD content for broadcast on an SD system. These format conversions can introduce quality errors. Also, separate processing of digital video and audio can lead to synchronization problems.

Compression introduces new types of quality defects, like blockiness. Errors can occur during the process of multiplexing programs and system information into a single data stream. Errors in timing and synchronization parameters can compromise the decoding process and lead to noticeable content quality errors.

At the Distribution layer, broadcasters encounter familiar RF technology in the transmission networks; however, these systems use different modulation techniques and offer new challenges in understanding coverage and interference problems. For internal distribution, broadcasters are increasingly relying on IP networks, introducing problems with latency and packet loss.

From source to consumer, program content typically moves through these system layers many times. Transitions between layers can dramatically alter the nature of the digital information — for example, moving between uncompressed digital video at the Formatting layer and compressed digital video at the Compression layer. The additional processing needed to move across layers increases the probability of quality errors at these transitions.

Moreover, errors in one layer can cause errors in a different layer, in some instances masking the original error source. For example, blockiness errors can arise from problems in a compression step (Compression layer) or as a consequence of uncorrected bit errors in the receiver (Distribution layer). Similarly, transmission errors can occur due to failures in the modulation steps (Distribution layer) or from variations in the data rate from the multiplexer feeding the studio-to-transmitter link (Compression layer).

To meet the quality control and system management challenges described above, confidence monitoring systems should have the following characteristics:

- Layer-specific probes that detect the different types of errors seen in digital television systems;
- Extended monitoring capability that gives broadcasters advanced notification of system degradations before they become quality-affecting problems;
- Multi-layer monitoring that lets broadcasters quickly isolate the root cause of a quality problem; and
- Network control that supports the new system management challenges.

Layer-specific probes

In a confidence monitoring system, we can think of each monitoring device as a probe, monitoring quality at a particular point and layer in the distribution and transmission chain. Broadcasters need to use different probe types for quality control at different layers. At the Formatting layer, digital waveform monitors or rasterizers help broadcasters detect many quality problems. These probes monitor characteristics of the digital signal, including gamut errors, audio loudness and ANC data parameters.

The MPEG-2 standard defines the basic processing steps and techniques used at the Compression layer. Broadcasters need MPEG monitors capable of detecting problems in basic MPEG processing, as well as the additional processing defined in the DVB, ATSC or ISDB-T/Tb broadcasting standards based on MPEG. These MPEG monitors can also decode the elementary streams and detect blockiness and other picture impairments.

At the Distribution layer, broadcasters need MPEG monitors with RF interfaces to detect quality problems in a wide variety of distribution and transmission channels. MPEG monitors can monitor RF transmissions in DVB-S/S2 or ATSC formats. MPEG monitors can also be used at test points with fiber-based GigE IP backbones.

Extended capability

We can also distinguish confidence monitoring probes by the level of monitoring that the probe offers. Basic confidence monitoring probes track a small set of key quality parameters. They act as an "indicator light," telling broadcasters when something has gone wrong. However, basic confidence monitoring probes do not offer a complete solution. While they can enhance broadcasters' ability to react to a quality problem, they do not give the information needed to proactively address system degradation before it becomes a quality issue.

Extended confidence monitoring probes use more sophisticated analysis to make additional measurements of quality parameters. They act as "indicator gauges," telling broadcasters when something is going wrong. RF transmission monitoring offers a good example of this distinction.

Basic RF confidence monitors measure bit-error-rate (BER). BER will remain low until the transmission approaches the digital cliff. Then, it will increase dramatically as the transmission falls off the cliff. This gives broadcasters only slightly more time to react than they would have by watching the transmission on a picture monitor.

Extended RF confidence monitors add additional measurements like Modulation Error Ratio or Error Vector Magnitude. These measures will noticeably change as system performance degrades, giving broadcasters early warning of potential quality problems, and an opportunity to make necessary adjustments or seamlessly transition to their backup systems.

Multi-layer monitoring

To have confidence that their facilities are operating correctly and efficiently, broadcasters generally need to probe at all layers. Probing at only one layer can give a misleading picture of system health. We began with a simple example of this problem. By watching the broadcast on a waveform monitor or rasterizer, broadcasters are probing quality at the Formatting layer. Monitoring at this point before encoding offers little information about the digital transmission system.

Similarly, monitoring just the MPEG protocol or the RF transmission will only yield partial information. To gain a complete picture of system quality, and to quickly detect and isolate quality problems, broadcasters need multi-layer confidence monitoring solutions. (See Figure 2.)

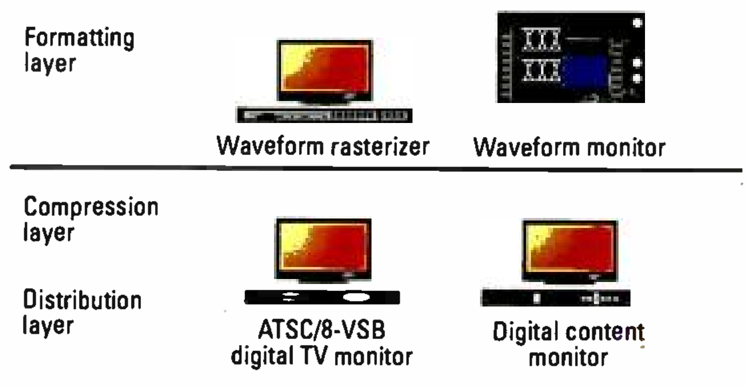

Figure 2. To gain a complete picture of system quality, and to quickly detect problems, broadcasters need multi-layer confidence monitoring solutions.

Network control

System management concerns also impact confidence monitoring. Broadcasters often need to monitor at geographically separated locations. For example, broadcasters accepting contribution feeds over a telecommunication network may want to install confidence monitoring probes at the network operator's points-of-presence. These distributed probes will need network capability so that they can report status and also alarm conditions to a central location. Network monitoring software can correlate this information to help engineers identify the root source of any quality problems. (See Figure 3.)

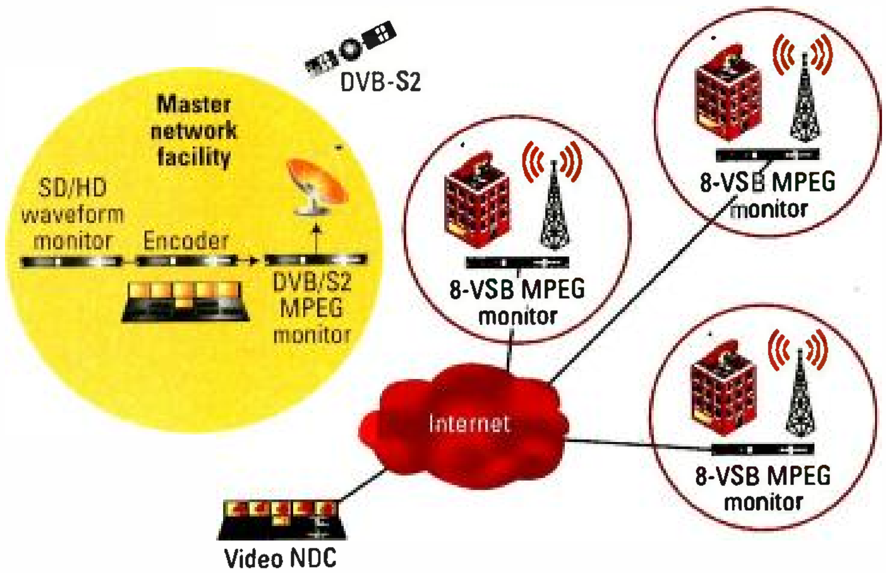

Figure 3. There is often a need to monitor geographically separated locations. The solution is to install confidence monitoring probes with network-wide capability at points-of-presence. The probes can then quickly alert broadcasters of issues that need to be corrected.

Physical, economic factors

Form factor and cost are additional considerations for broadcasters in developing a confidence monitoring system. Depending on the need, large, card-modular solutions may work well in central nodes with a large number of signals and multiplexes, while small single-channel probes may work better in remote locations like transmitter sites.

Conclusion

Because of the digital cliff, broadcasters can only detect the onset of quality problems by viewing the broadcast and, therefore, will need to use confidence monitoring systems. Combining digital signal processing with digital data processing creates layers in DTV systems, driving the need for multi-layer confidence monitoring systems that contain layer-specific probes designed to quickly detect and isolate quality problems. These systems need extended monitoring capability to help broadcasters proactively identify, assess and address performance degradations before they become quality-affecting problems. The systems also need network-capable probes in a variety of form factors to integrate effectively into emerging system management approaches.

As DTV evolves, broadcasters will need to increasingly rely on these distributed, multi-layer confidence monitoring systems in order to ensure optimal performance in both their distribution and transmission systems. BE

Richard Duvall is the senior video marketing manager for Tektronix.

Band clearing continues

The FCC is targeting Class-A stations.

BY HARRY C. MARTIN

The thinning of the ranks of Class-A television stations continues. The FCC has begun downgrading a number of these stations to LPTV status, thereby making them vulnerable for displacement — presumably to make more room for wireless broadband operations on current television channels.

The stations targeted in the first round of this effort had failed to file Children's TV Reports, as required for Class A but not LPTV stations, and also failed to respond to FCC inquiries about why such reports had not been submitted. The FCC later fined a number of other Class-A television stations which, although failing to file the requisite reports, avoided downgrading because they had at least responded to the FCC's inquiries.

In a later round of inquiries, 16 more Class-A stations are facing the prospect of being demoted to secondary LPTV status. Like the first group, they have been targeted for not filing Children's TV Reports. In response to the FCC inquiry about those missing reports, each of the licensees acknowledged their failures to file the reports. In so doing, they told the FCC their respective stations had operated, at most, sporadically over the last several years.

Two blamed the economy for the extended darkness. One claimed that the non-operation of its two stations was due to the need to locate permanent transmitter sites. Others said their stations no longer had main studios and, thus, no public files located at main studios.

In order to qualify for Class-A status, a licensee must maintain a main studio and broadcast a minimum of 18 hours per day, with an average of at least three hours weekly of locally produced programming and three hours of children's programming. From the responses described above, the commission concluded that none of the 16 stations still qualified to be Class A; accordingly, they are likely to be downgraded.

The FCC suggests that Class-A stations that find themselves temporarily unable to meet the minimum regulatory requirements for Class-A status may, in some circumstances, be eligible for special temporary authority to operate at variance from those requirements. But such STA would be only temporary and would not cover extended time periods of noncompliance, particularly when the reason for the STA is financial distress. The commission is particularly skeptical about stations that close their main studios or abandon their transmission facilities. The result of this strict approach, of course, is to impose the greatest hardship on the most vulnerable stations.

Of course, the FCC is not proposing to take away licenses. Rather, the agency's initiative against Class-A stations involves, at least at this point, only a status downgrade from Class A to LPTV. However, at this point the FCC has no plan for accommodating LPTV stations when the processes of band clearing and repacking are completed. Class-A stations, on the other hand, will be protected when the television band is reduced by as much as 20 channels.

Status quo remains for "specialty stations"

The U.S. Copyright Office recently updated its list of "specialty stations" — those which, when carried on cable systems as distant signals, trigger lower royalty burdens for the cable operator than do other distant stations. Despite protests from MPAA, the Copyright Office refused to provide an opportunity for protests with respect to the stations that certify to specialty status. Such certifications are based on the "honor system." Thus, for the foreseeable future, challenges can be brought only against individual cable systems when they submit their copyright royalty payments and accompanying statements of account. BE

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

Dateline

- On or before June 1, 2012, noncommercial television and Class-A stations in Arizona, the District of Columbia, Idaho, Maryland, New Mexico, Nevada, Utah, Virginia, West Virginia and Wyoming must file their biennial ownership reports.
- On June 1, 2012, television stations, Class-A television, LPTV stations and television translators in the District of Columbia, Maryland, Virginia and West Virginia must file their license renewal applications. Television and Class-A television stations in those locations must begin their renewal post-filing announcements on June 1, 2012.
- On June 1, 2012, television and Class-A television stations in North Carolina and South Carolina must begin their pre-filing renewal announcements in anticipation of an Aug. 1, 2012, renewal application filing date.
- On June 1, 2012, television and Class-A television stations must place their 2012 EEO reports in their public files and post them on their websites: Arizona, the District of Columbia, Idaho, Maryland, Michigan, Ohio, New Mexico, Nevada, Utah, Virginia, West Virginia and Wyoming.

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

Interactive TV

Development on truly tying broadcast and connected worlds together is under way.

BY ALDO CUGNINI

Consumers are increasingly staying connected to their content world through fixed and mobile devices. This connectivity requires a level of interactivity that is far-reaching as well as easy-to-use. This month, we'll look at some of the technical initiatives under way to bring interactivity to the broadcast television experience.

Interactive TV has seen few applications to date that tie together the consumption of broadcast with true user involvement. While Internet TVs have been available for several years, the apps available on these products do not truly integrate the broadcast and connected worlds; they are essentially separate means of consuming content on a common display. Interactivity that can provide new broadcast features to users, while at the same time providing new business opportunities to broadcasters, is still an untested business model. However, the potential is there.

These new features include video-on-demand, click-through information and advertisements, ad verification, interactive polling, interactive overlays, chat sessions, and E-commerce. But, supporting interactivity broadly and efficiently requires standardized technical solutions. The good news is that some elements are already available, and additional work is under way.

New ATSC work

In the United States, the ATSC has several interactive technologies defined, and more in development. ATSC A/96, Interaction Channel Protocols, describes interactivity protocols, based on IETF and W3C standards, enabling interactive TV applications using a two-way channel in combination with an OTA broadcast channel. (See Figure 1 on page 22.) Published in 2004, A/96 defines an interactive applications framework, using a five-layer reference model with a data-link layer, a network layer, a transport layer and an application protocol layer. The network layer-related protocols are based on a TCP/IP and UDP. At the application level, A/96 uses standard HTTP 1.1 protocols.

ATSC A/101, the Advanced Common Application Platform (ACAP), revised in 2009, was developed so interactive application developers would have means to ensure interoperability between applications and compatibility with different devices. ACAP was developed as a harmonization effort between the ATSC DTV Application Software Environment (DASE) and CableLabs' Open Cable Application Platform specifications.

The A/96 and A/101 standards have not seen widespread implementation, however, pre-dating the recent swarm of Internet TVs and now potentially being overtaken by a new suite of standards. Under the umbrella of ATSC 2.0 will be a complete suite of new services for fixed DTV receivers, including Non-realtime (NRT) and Triggered Downloadable (or Declarative) Objects (TDOs).

NRT provides a framework for pushing content to fixed and mobile broadcast receiving devices in advance of consumption. Together with TDOs, services such as personalized content, targeted or telescoping content/ads, Internet content, audience measurement and second-screen content can be supported. A TDO is a Declarative Object (a list), associated with a virtual channel, that carries out a programmed routine when activated; a Declarative Object can support an interactive application by using HTML, JavaScript, CSS, XML and multimedia files. ATSC 2.0 will use transport and signaling based on NRT, and will

FRAME GRAB

A look at tomorrow's technology

TV shipments down in 2011

NPD DisplaySearch said worldwide TV shipments fell for the first time since 2004, the first year it began tracking shipping data.

Technology	Q4'11 units	Q/Q growth	Y/Y growth
LCD TV	64,237	24%	1%
PDP TV	5195	26	-8%
OLED TV	0.1	470%	-73%
CRT TV	4772	-25%	-43%
RPTV	32	46%	-51%
Total	74,236	19%	-4%

Source: "Quarterly Global TV Shipment and Forecast Report" *http://www.displaysearch.com*

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harmonic

ENABLING THE VIDEO ECONOMY™

incorporate elements in common with Hybrid Broadband Broadcast TV (HbbTV) and the Open IPTV Forum (OIPF).

European development

HbbTV is a pan-European specification, based on HTML and web technologies, targeted to hybrid terminals (e.g., connected TVs) that receive an over-the-air transmission and can be connected to the Internet via a broadband interface. HbbTV is based on several standardized technologies developed by CEA, DVB, OIPF and W3C.

DVB has numerous elements that support interactivity, many of which are defined in ETSI TS 102809, "Signaling and carriage of interactive applications and services in Hybrid Broadcast Broadband environments." These applications, in turn, rely on MHP, the Multimedia Home Platform.

One of the many useful elements of MHP is Application Signaling. It defines a service information table — the Application Information Table (AIT). Sent in the main signal transport stream, the AIT lists all available applications to the receiver. It also contains information the receiver needs to run each application. Applications are transported using Digital Storage Media Command and Control (DSM-CC) object carousels. Part of MPEG-2, DSM-CC defines a commands set that can provide VCR-like functions over a client-server connection. DSM-CC further uses "stream events," markers embedded in a transport stream via MPEG-2 private sections. Each marker has an identifier and time reference. Similar to some aspects of TDOs, these stream events can thus synchronize elements of OTA broadcast and Internet-provided content.

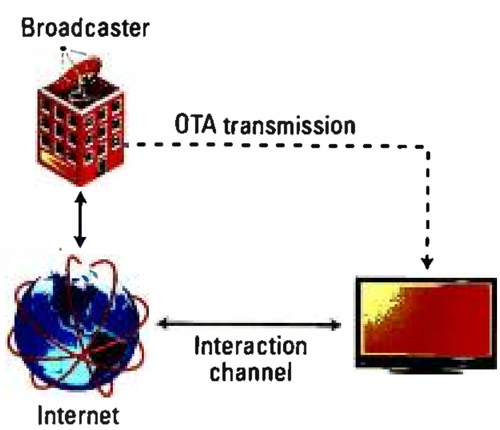

Figure 1. Interactive broadcast TV requires an interaction channel to maximize the potential of the service.

CEA-2014 is the web-based Protocol and Framework for Remote User Interface on UPnP Networks and the Internet (Web4CE), also known as CE-HTML. The standard provides a structured way of accessing a user interface and related content over an IP network, in a manner that is optimized for CE devices. Used in HbbTV, CEA-2014 is a subset of W3C specifications and image formats, using XHTML and JavaScript APIs in an on-demand media environment. OIPF, which defines a Declarative Application Environment, incorporates aspects of CE-HTML, as well as JavaScript APIs for the TV environment. With these, applications such as channel tuning, advanced EPG, PVR functions and control of in-home networked devices are possible.

HbbTV supports XHTML (EXtensible HyperText Markup Language), a W3C standard, which is a better-defined version of HTML. XHTML is almost identical to HTML 4.01, and is therefore supported by major browsers. HbbTV also incorporates CSS 2.1, CSS-TV, DOM-2 (including XML Document support) and ECMAScript. Cascaded Style Sheets (CSS) define how web pages are displayed on devices, and the CSS-TV Profile further defines color specifications tailored to needs and constraints of TV displays. DOM-2 specifies an interface that works across platforms and languages, and allows programs and scripts to dynamically access and update the content and structure of documents. ECMAScript (originally, the European Computer Manufacturers Association) is a scripting language, based on JavaScript (from Netscape) and JScript (from Microsoft), used for performing computations and manipulating objects within a processing device. It was originally developed to allow web applications to access processing power of the host PC.

HTML5 is a new specification under development to replace existing HTML used by web browsers. It includes functions for embedding and controlling video and audio, graphics and interactive content, and supports local offline storage of session data. HTML5 has been shown as a component of an HbbTV browser.

New businesses

While many of these concepts apply most directly to content authoring and control, they give an idea of what new elements will appear in interactive streams, and how different devices can be made to react consistently and universally. Digital transmission, while offering the potential for extensive interactivity, has so far only scratched the surface, due to the rapid change of content consumption business models. The tools described here will facilitate exploration and development of interactive TV for a new realm of products. BE

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Network protocols

As broadcasters build more IT-based facilities, certain core protocols are emerging as critical.

BY BRAD GILMER

There is a core set of protocols critical to the operation of computer networks. Some of the most important protocols include IP, Transmission Control Protocol (TCP), Address Resolution Protocol (ARP) and Internet Control Message Protocol (ICMP). Of course, these protocols are critical to broadcasters as well since many broadcast facilities now rely on computer networks.

Ethernet

Ethernet is both a protocol and a hardware specification. The Ethernet standard specifies the electrical signals and voltages on the wire (or the RF transmission scheme in the case of wireless), but it also lays out the way Ethernet packets are built and what the Ethernet headers contain. You have probably heard of these standards — IEEE 802-x, where "x" designates various parts of the standard. For example, 802-3 covers wired networks, while 802-11 covers wireless Ethernet.

Ethernet addresses, which are inserted into each Ethernet packet header, are different from IP addresses. Ethernet addresses refer to a particular physical device; they are similar to a Vehicle Identification Number that is used to uniquely identify a specific automobile. This is significantly different from IP addresses, where the end user can assign a particular IP address to any IP network device.

IP

IP is a core protocol, whether you are talking about IT or broadcast applications. IP's job is to get datagrams from one device to another, and IP packets typically ride on top of Ethernet networks, although IP data can travel over other physical networks as well. (Note: A datagram is a self-contained, independent entity of data carrying sufficient information to be routed from the source to the destination computer, without reliance on earlier exchanges between the source and destination computers and the transporting network.)

It is the job of the IP layer to interface to these lower layers, while presenting a uniform computer network-addressing scheme to the layers above it. The IP layer prepares data sent to it by higher protocols for transmission across a specific logical network, taking into account things such as the packet length, hardware addressing structure and how data should be split across multiple packets.

User Datagram Protocol

User Datagram Protocol (UDP) is used to send datagrams from one application running on a computer to an application running on another computer. The UDP header contains a port number. The port number is typically used to indicate that the packet is destined for a particular application on the receiving computer. You probably already know, for example, that port 80 is typically used for HTTP in web applications.

It is important to know that nothing in the UDP protocol guarantees that packets sent across the network will reach the other end. In fact, UDP explicitly does not check to see that packets have been received (as compared to TCP, which does ask for the retransmission of missing packets). The up side of this is that UDP is an extremely lightweight protocol to implement, and it is very fast. Furthermore, UDP does not introduce delays while it requests and subsequently receives lost packets.

The size of UDP packets can vary, and, in some cases, they can be large. This brings up the issue of fairness. Large UDP packets may hog bandwidth on a network, causing other traffic to suffer. For this reason, and for other security reasons, some system administrators choose not to permit UDP traffic to cross their firewalls. This can cause headaches for broadcasters.

Real-time Transport Protocol

As the name implies, Real-time Transport Protocol (RTP) is a protocol intended for the transmission of data in real time. Quoting directly from the Internet Engineering Task Force Request For Comment 3550 (IETF RFC 3550), "RTP provides end-to-end network transport functions suitable for applications transmitting real-time data, such as audio, video or simulation data, over multicast or unicast network services."

As with other protocols described in this article, RTP contains a payload and an associated header. The RTP header contains two significant items. The first is a sequence number. This number is incremented for each RTP packet that is transmitted during a session. If you are an RTP receiver, and you miss a sequence number, you know that a packet has been dropped. It is then up to the receiving application to decide what to do.

RFC 3550 includes a retransmission mechanism within a sub-part called the RTP Control Protocol (RTCP). However, in many video applications, retransmission is not an option. By the time a receiver notices that a packet has been dropped, requests a replacement packet and decodes and prepares the content for display,

it will be too late. In this case, FEC or concealment may be reasonable alternatives, since neither of these require lost-packet retransmission.

RTP provides one other facility that is critical for the reconstruction of real-time data, and that is a timestamp field. When a video feed is presented to a computer for transmission, that feed is isochronous; it is coming in at a fixed rate that does not vary. But, when these packets arrive at a receiver, the inter-packet arrival time can vary tremendously depending upon congestion, routing and many other factors. The RTP timestamp allows a receiving application to recreate the stream with the same pacing as was present at the input to the sender.

Encapsulation

Many computer protocols build upon one another. The process starts with an application passing data to a network protocol stack. The top protocol in the stack takes this data and puts it into the payload section of a packet. Then, it pre-appends a header. The header typically contains information about the payload, information about the source and destination of the packet, or both.

Figure 1 shows how this encapsulation process works. Assuming we start with a streaming application, video and audio is MPEG compressed and put into MPEG TS packets. As part of the process of creating the MPEG TS packets, headers are created. These, among other things, describe the video and audio contained within the MPEG TS packets. These MPEG TS packets are placed in the payload portion of RTP packets. Note that all of the MPEG content, including the MPEG headers, are enclosed in the payload section of the RTP packets. The RTP packets, including headers, are then encapsulated in the payload section of a UDP packet. UDP headers then are added. The UDP headers are simple and include information about the source port, the destination port, packet length and a checksum.

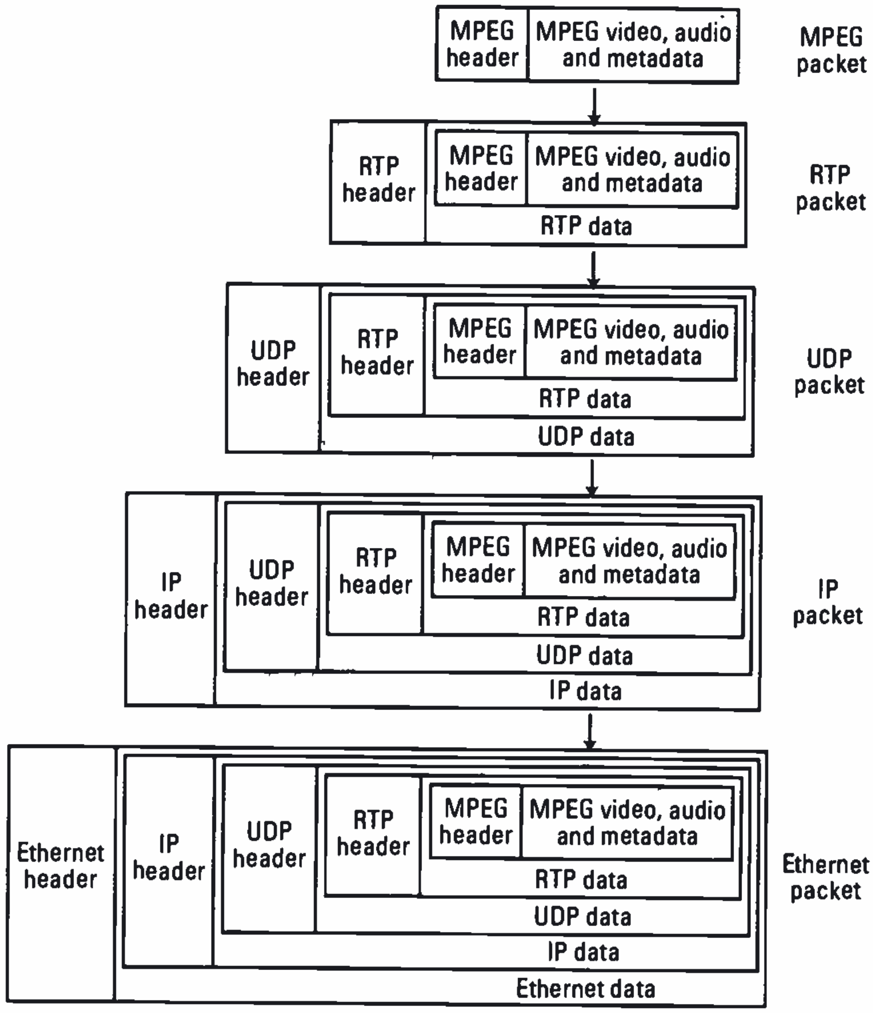

Figure 1. This shows the encapsulation of an MPEG video stream over Ethernet.

UDP packets are inserted into the payload section of IP packets, and IP headers are added. The IP headers, among other things, contain the sender and receiver's IP logical network addresses. Finally, the IP packets are inserted into Ethernet packets, and Ethernet headers are added. The Ethernet headers contain the source and destination Media Access Control (MAC) addresses.

At first, this may seem like an incredibly inefficient way of getting an MPEG stream from one place to another — and from a pure efficiency standpoint, you would be correct. But, it is important to realize that each layer has a job to do. In a well-designed system, it should be possible to replace equipment that operates at one layer with equipment from another vendor that operates at the same layer without having to rebuild the entire system. Encapsulation allows system designers to separate network functions, and to present information contained in the headers at the appropriate layer of the network.

As broadcasters build more IT-based facilities, certain core protocols are emerging as critical for our industry. Encapsulation is the key that will allow us to change and adapt these protocols as our industry matures in this area. BE

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Compression for digital cinema cameras, part 2

"Digital negatives" can replace 35mm film.

BY STEVE MULLEN

Most broadcast HD camcorders use straightforward DVC, MPEG-2 or MPEG-4 (H.264/AVC) compression. This orderly world of intraframe and interframe codecs is becoming more complex as digital cinema tools are adopted for high-end broadcast productions. In part 1 of this series (April 2012), we examined the processed category: compressed and uncompressed.

In part 2, we will focus on the technologies involved in recording motion pictures. The unprocessed category represents cameras that do not employ de-Bayering. (See Figure 1.) These cameras record RAW images. Think of RAW as a digital negative.

The majority of the cameras we will look at use a Bayer filter. This requires post-production software perform a de-Bayer before an image is obtained. A Bayer-filtered sensor has only half the number of green samples per row and half the number of green samples per column as it has rows and columns. One of the functions of the de-Bayer process is to re-create as much missing green information as possible. The amount that can be recovered can be called "de-Bayer efficiency." A working value for a high-quality process is 78 percent.

For a single-sensor camera to provide luminance resolution equivalent to that from a three-chip camcorder, the image to be de-Bayered must be equal to, or larger than, 3.4MP (HD) or 13.6MP (4K2K).

In the traditional compression world, the maximum recorded bit depth is 10 bits. Unfortunately, 10-bit linear values are not capable of carrying the dynamic range obtained by today's CMOS sensors. These sensors output samples with 12 or more bits. One solution: Use a codec such as AVC-Intra Class 4:4:4 that can record 12-bit data. Another solution is to record logarithmic data. (See Figure 2.) An 800 percent to 1000 percent greater dynamic range is made possible by outputting, for example, 10-bit log values from 16-bit samples. Figure 1 highlights those cameras that record linear data and those that record log (nonlinear) data.

	Processed	Unprocessed	
	De-Bayered	Not de-Bayered (RAW)	
	Linear	Linear values	Nonlinear values
Compressed recording		RED EPIC Sony F65	Sony F3 Panavision Genesis Silicon Imaging SI-2K
Uncompressed recording		Vision Research Phantom Flex WEISSCAM HS-2	Sony F3 ARRI ALEXA

Figure 1. Storage options for motion pictures

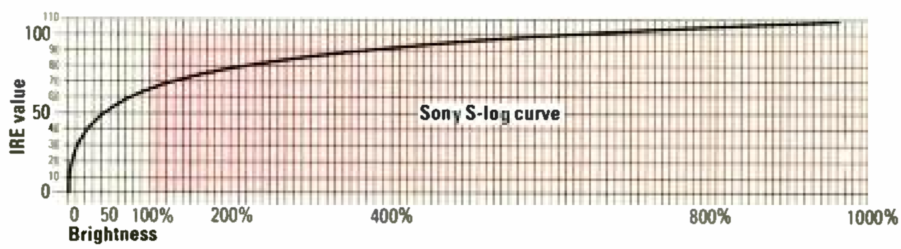

Figure 2. S-log provides 800 percent to 1000 percent greater dynamic range.

Unprocessed/compressed — linear

The RED EPIC captures sequential RGB data from its 5K MYSTERIUM X sensor. (See Figure 3 on page 30.) Data are sent into two paths. One path de-Bayers the data, thereby converting RAW sensor data to 2048 x 1080-pixel 12-bit RGB data. These data may be modified by the operator using ISO, white balance and other RGB color space adjustments. They are then scaled and gamma corrected to provide 4:2:2 10-bit YCbCr or 4:4:4 8-bit RGB monitor output. Operator adjustments make no changes to the recorded image.

Wavelet compression is applied to the RGB data sent down the second path. RED's "visually lossless" compression scheme is called REDCODE. Compressed image data and adjustment metadata are written to an SSD-based REDMAG drive.

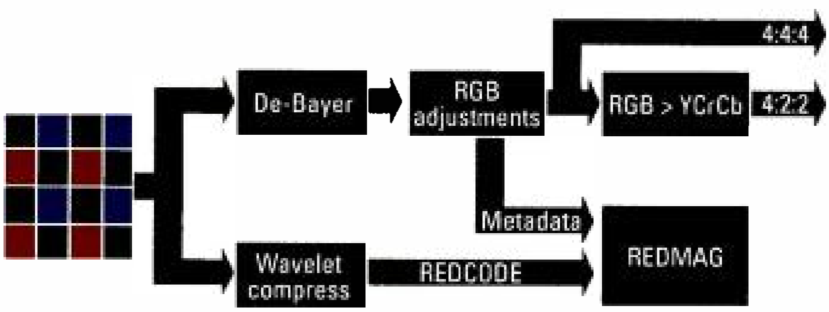

Figure 3. A simplified schematic of a RED EPIC

A Sony F65 camera has a 20MP sensor with a 1.9:1 aspect ratio that matches the 4K DCI projection standard (4096 x 2160). Effective sensor resolution is about 18.3MP.

The 18.3 million sequential RGB samples from the sensor are 16-bit values. At 24fps, the sensor's output data rate is approximately 7Gb/s. At 60fps, the data rate is approximately 17.6Gb/s. Lossless compression is applied in-camera to drop the data rate by 3.2x to 2.2Gb/s (24fps) or 5.5Gb/s (60fps). These 16-bit data, called F65RAW, are sent via a fiber-optic connection to a docked Sony SR-R4 field recorder. F65RAW data are written to SRMemory cards.

From the 18.3 million digital values, post-production software can generate 8K (UHDTV), 4K2K, Quad HD, 2K and full HD. The latter three formats are super-sampled. However, before editing, F65RAW must first be uncompressed and demosaiced to a frame of RGB values.

To facilitate broadcast production, an F65 can output 10- or 12-bit S-log RGB data. These 1920 x 1080 data are obtained from a built-in down-converter that takes in 18.3 million pixels and outputs HD. When these F65 data are fed to an SR-R4, they are recorded using the MPEG-4 Studio Profile (SStP) codec. This codec uses an intraframe compression algorithm that has three bit rates: 220Mb/s (SR-SQ Lite), 440Mb/s (SR-SQ) and 880Mb/s (SR-HQ). Compressed data are written to SRMemory cards.

Unprocessed/uncompressed — linear

The Phantom Flex is capable of frame rates up to 1455fps using a one microsecond global shutter with a resolution of 2560 x 1600 pixels. The sensor outputs sequential 12-bit RGB data. These 12-bit RAW data are written using Vision Research proprietary uncompressed "cine" files to internal RAM. When the RAM is full, data are offloaded to a computer.

The WEISSCAM HS-2 has a 2048 x 1536 Super35 CMOS sensor with a global shutter that can shoot 2K at 1500fps and HD at 2000fps. The HS-2 can output an RGB stream that employs Weisscam's "RAW IN HD SDI" mapping that transports 12-bit uncompressed RAW files. These data can be recorded by a WEISSCAM DIGIMAG DM-2 recorder.

Unprocessed/compressed — nonlinear

The Sony F3 records 35Mb/s 4:2:0 MPEG-2 to SxS cards. The F3's secondary path outputs 10-bit S-log RGB data. (See Figure 4.) This path does not allow image adjustments. (Only white balance can be specified.) Output of RGB values is via dual-link HD-SDI ports. A Sony SR-R1 field recorder stores the 10-bit S-log RGB data. The SR-R1 records SR-SQ Lite, SR-SQ and SR-HQ compressed data to SRMemory cards.

The Panavision Genesis has a 12.4MP (5760 x 2160 pixels) Super35 CCD. (See Figure 5.) You'll note that a Bayer pattern is not used. Instead, the sensor is binned to a 6.2MP, 14-bit per-color signal that is converted to Panalog data.

Panalog, developed by Panavision, transforms the internal 14-bit linear digital signal into a 10-bit quasi-log signal. RGB output is by dual-link HD-SDI connectors. A Sony SR-R1

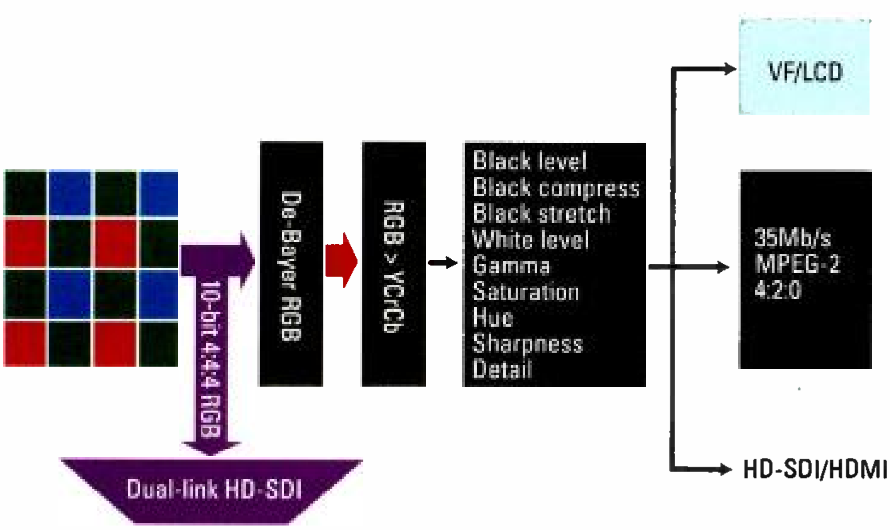

Figure 4. A simplified schematic of the Sony F3 camcorder

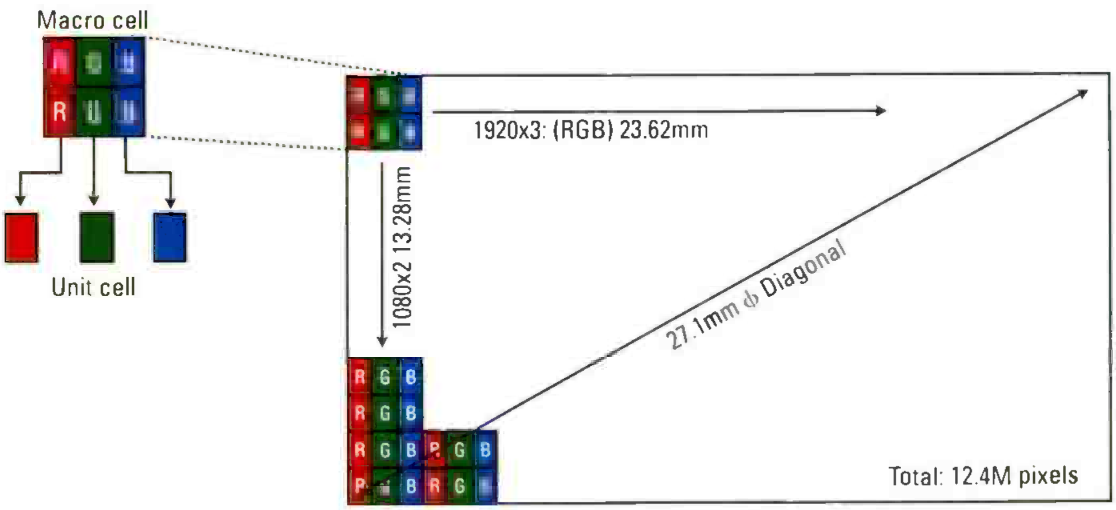

Figure 5. Panavision Genesis 12.4MP Super35 CCD

field recorder can record these data using SStP compression.

The Silicon Imaging SI-2K and SI-2K MINI camcorders have a 16:9, 2/3in CMOS sensor with 2048 x 1152-pixel resolution. Analog samples are converted to digital values by a 12-bit A/D. RAW 10-bit log data are then processed using the visually lossless CineForm wavelet-based codec. Direct-to-edit AVI and QuickTime files compatible with CineForm Prospect 2K are then written to an internal interchangeable hard drive.

The SI-2K is under the control of built-in software called SiliconDVR. IRIDAS Speedgrade is one of the functions of SiliconDVR. Speedgrade enables a camera operator to set metadata for a clip. When editing, after de-loging and de-Bayering image data, metadata can be applied in real time to a clip.

	Processed	Unprocessed	
	De-Bayered	Not de-Bayered (RAW)	
	Linear	Linear values	Nonlinear values
Compressed recording	DVC MPEG-2 MPEG-4 YCrCb 4:2:0 / 4:2:2 8- / 10-bit	4:4:4 RGB wavelet 12-bit 4:4:4 RGB wavelet 16-bit	4:4:4 RGB wavelet 16-bit S-log 4:4:4 RGB SStP 10-bit log 4:4:4 RGB wavelet 10-bit log
Uncompressed recording	YCrCb 4:2:2 8- / 10-bit	4:4:4 RGB 12-bit	4:4:4 RGB 10-bit S-log 4:4:4 RGB 12-bit log

Figure 6. Compression options for motion pictures

Unprocessed/uncompressed — nonlinear

As shown by Figure 4, a Sony F3 outputs 10-bit S-log RGB via a dual-link HD-SDI connection. When an F3 is connected to an SR-R1 field recorder that has an SRK-R311 option, data can be recorded without compression and written to SRMemory cards.

The ARRI ALEXA has a single 3392 x 2200 photosite CMOS sensor that has 2880 x 1620 effective 16-bit pixels. For maximum quality, 2880 x 1620 pixels are output as ARRIRAW. ARRIRAW is log 12-bit uncompressed RGB data. ALEXA's output port is called T-link. It sends data as packets. The T-link physical connection is a dual-link HD-SDI connection. ARRIRAW can be recorded using a Codex ARRIRAW Recorder.

To support broadcast production, HD (1920 x 1080) video is obtained using 1.5x oversampling from the 2880 x 1620 pixels. After de-Bayering and conversion, YCrCb values are compressed using ProRes 422 Proxy, ProRes 422 LT, ProRes 422 or ProRes 422 HQ. Compressed 10-bit data are recorded to SxS cards inserted into the camcorder.

Post-production workflows for digital negative cameras will be more complex than those for ENG/EFP camcorders using traditional compression systems. (See Figure 6.) Digital negative workflows require specialized knowledge and can be time-consuming. Nevertheless, these camcorders and their workflows provide a true 35mm film digital replacement system for the production of episodic television and commercials. BE

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HTTP ABR streaming

Adaptive bit-rate protocols can help ensure high QoE when delivering video over IP.

BY JAMES WELCH

Cisco Systems Visual Networking Index (VNI) predicts that more than 50 percent of all global Internet traffic will be attributed to video by the end of 2012. It also confirms, in addition to television screens, video delivery to cell phone and computer screens will be increasingly common

Globally, Internet video traffic is projected to be 58 percent of all consumer Internet traffic in 2015, up from 40 percent in 2010. At that time, three trillion minutes of video content are projected to cross the Internet each month, up from 664 billion in 2010, when 16 percent of consumer internet video traffic in 2015 will be TV video. There is no doubt that if you are in the business of transmitting video, you will likely be using IP in the near future.

Delivering acceptable video quality over IP to TV viewers and other devices has led to a still-evolving delivery infrastructure. The required network scale has higher packet loss and error rates than smaller managed networks. Adaptive Bit Rate (ABR) delivery protocols like Apple's HLS and Microsoft's Silverlight, among others, help address these issues. These protocols use HTTP over TCP to mitigate data loss by dynamically adapting bit rates to adjust to networks that can provide only unpredictable instantaneous bandwidths.

Using a CDN to distribute the content to a range of servers located close to the viewers is another key feature to successful deployments to avoid the congestion and bottlenecks of centralized servers. Yet, despite more complex protocols to handle a range of transport issues, high-quality performance is not guaranteed. Cost-effective operations and a good viewer experience depend on good monitoring observability and targeted performance metrics for rapid problem identification, location and resolution.

ABR protocols

ABR video delivery mechanisms over IP that enable this rapidly growing Internet video market are effective, but complex. Not only do they require the usual video compression encoders to achieve practical bit rates, but they also require a host of other devices and infrastructures, including segmenting servers, origin servers, a CDN and a last-mile delivery network.

ABR protocols help deliver a quality video experience to viewers by overcoming common IP data network performance issues such as packet arrival jitter, high loss rates, unpredictable bandwidth and security firewall issues. HTTP delivery solves most firewall issues as it is almost universally unblocked since it is also used for web browsing. HTTP, which uses TCP, assures loss-free payload delivery as well. While predictable instantaneous bandwidth levels are a challenge in unmanaged networks, by using variable encoding

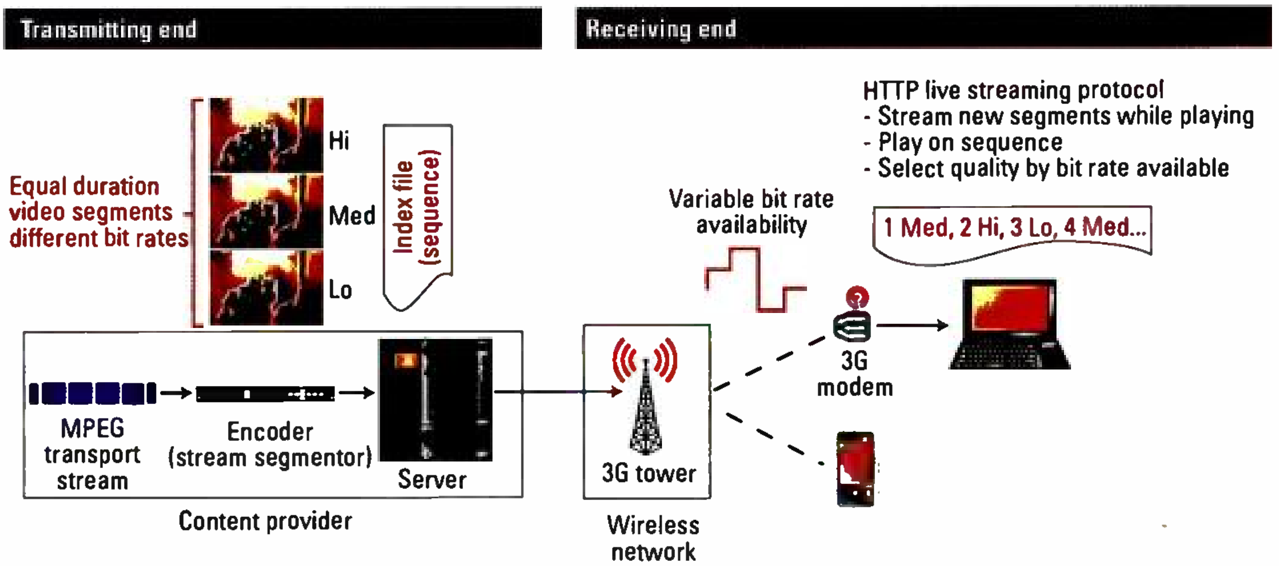


Figure 1. On the transmitting end, the adaptive encoder creates segments with fixed duration at different bit rates and an index file that acts as a playlist to indicate the sequence of the segments. On the receiving end, the adaptive protocol buffers video segments in the correct sequence, selecting the best quality possible for the bit rate available at each interval before playing them seamlessly.

rates and these protocols, the viewer's client device can dynamically select the best stream bit rate for the instantaneously available bandwidth.

Apple's HTTP Live Streaming (HLS) is an example of a protocol that successfully navigates the challenges of unmanaged networks to transfer multimedia streams using HTTP. To play a stream, an HLS client first obtains the playlist file, which contains an ordered URI list of media files to be played. It then successively obtains each of the media files in the playlist. Each media file is, typically, a 10-second segment of the desired multimedia stream. A playlist file is simply a plain text file containing the locations of one or more media files that together make up the desired program.

The media file is a segment, or "chunk," of the overall presentation. For HLS, it is always formatted as an ISO 13818 MPEG-2 TS or an MPEG-2 audio elementary stream. The content server divides the media stream into media files of approximately equal durations at packet and key frame boundaries to support effective decoding of individual media files. (See Figure 1 on page 33.) The server creates a URI for each media file that allows clients to obtain the file and creates the playlist file that lists the URIs in play order.

Multiple playlist files are used to provide different encodings of the same presentation. A variant playlist file that lists each variant stream allows clients to dynamically switch between encodings. Each variant stream presents the same content, and each variant playlist file has the same target duration. If the playlist file obtained by the client is a variant playlist, the client can choose the media files from the variants as needed based on its own criteria, such as how much network bandwidth is currently available. The client will attempt to load media files in advance of when they will be required for uninterrupted playback to compensate for temporary variations in latency. The client must periodically reload the playlist file to get the newest available media file list, unless it receives a tag marking the end of the available media.

1	**Severe underrun**	Interval between segments and the file transfer time are slower than the drain rate.
2	**Underrun**	Segment interval is slower than the drain rate, but file transfer time is faster than the drain rate.
3	**Warning**	Interval between segments and the file transfer time are marginal.
4	**Growing buffer**	Interval between segments and the file transfer are faster than the drain rate.
5	**Balanced system**	Interval between segments is balanced, and the file transfer is faster than the drain rate.

Figure 2. In adaptive streaming environments, QoS should be monitored post caching server and at the client. This chart shows how the VeriStream metric characterizes instantaneous network delivery quality on a 1-5 scale.

CDN operation

Using HTTP client-driven streaming protocols like HLS effectively supports adaptive bit rates, handles high network error rates and firewall issues, and supports both on-demand and live streaming. However, with millions of clients establishing individual protocol sessions to receive video, scalability must be considered.

Content distribution and management strategies are critical in a CDN for efficient delivery and high-quality performance.

Further challenging the system design are sudden spikes in requests from "flash crowds" or "SlashDot effects" that may be caused by current events where a sudden, unexpected demand overwhelms servers, and content becomes temporarily unavailable.

The CDN is a collection of network elements that replicates content to multiple servers to transparently deliver content to users. The elements are designed to maximize the use of bandwidth and network resources to provide scalable accessibility and maintain acceptable QoS. Particular content can be replicated as users request it or can be copied before requests are made by pushing the content to distributed servers closer to where it is anticipated users will be requesting it.

In either case, the viewer receives the content from a local server, relieving congestion on the origin server and minimizing the transmission bandwidth required across wide areas. Caching and/or replica servers located close to the viewer are also known as edge servers or surrogates. To realize the desired efficiencies, client requests must be transparently redirected to the optimal nearby edge server.

Content distribution and management strategies are critical in a

CDN for efficient delivery and high-quality performance. The type and frequency of viewer requests and their location must dynamically drive the directory services that transparently steer the viewer to the optimum edge server, as well as the replication service, to assure that the requested content is available at that edge server for a timely response to the viewer. A simplistic approach is to replicate all content from the origin server to all surrogate servers, but this solution is not efficient or reasonable given the increase in the size of available content. Even though the cost of storage is decreasing, available edge server storage space is not assured. Updating this scale of copies is also unmanageable.

Practically, a combination of predicted and measured content popularity and on-demand algorithms are used for replication. Organizing and locating edge server clusters to maintain optimum content availability relies on policies and protocols to load balance the servers. Random, round robin or various weighted server selection policies, along with selections based on number of current connections, number of packets served, and/or server CPU utilization, health and capacity are all utilized and varied based on load persistence considerations.

Quality assurance

Cost-effective operations rely on good monitoring observability and performance metrics for rapid problem identification and resolution. QoS performance monitoring metrics provide needed information about stream delivery quality, key information about the types of impairments and their causes, as well as warnings of impending impairments for ABR streaming networks. Combined with end-to-end monitoring, QoS monitoring used in production network monitors network delivery quality of the flows and for other applications such as system commissioning and tuning. (See Figure 2.)

Such metrics are intended to analyze streams susceptible to IP network device and client/server impairments. For adaptive streaming environments, it is also important to monitor QoS at the client end point, which can be used to assess the dynamic performance of network and system delivery. QoS metrics for ABR must continuously analyze the dynamic delivery of stream segments. An example of this summary is shown in Figure 3.

Summary

Leaving the well-managed network domain of provider IP networks requires new adaptive bit-rate protocols that are rapidly proving their effectiveness. A comprehensive, end-to-end monitoring strategy gives content and service providers the streamobservability and fault-isolating capabilities needed for timely and efficient adaptive bit-rate network delivery deployments. **BE**

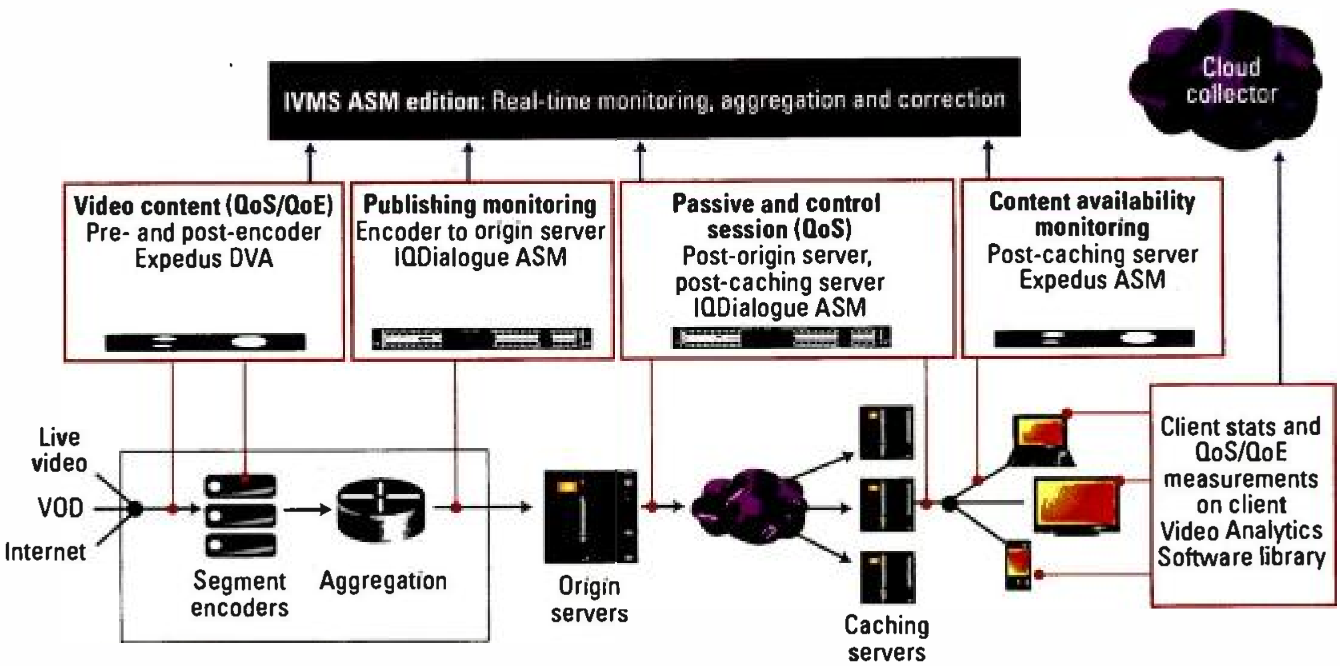
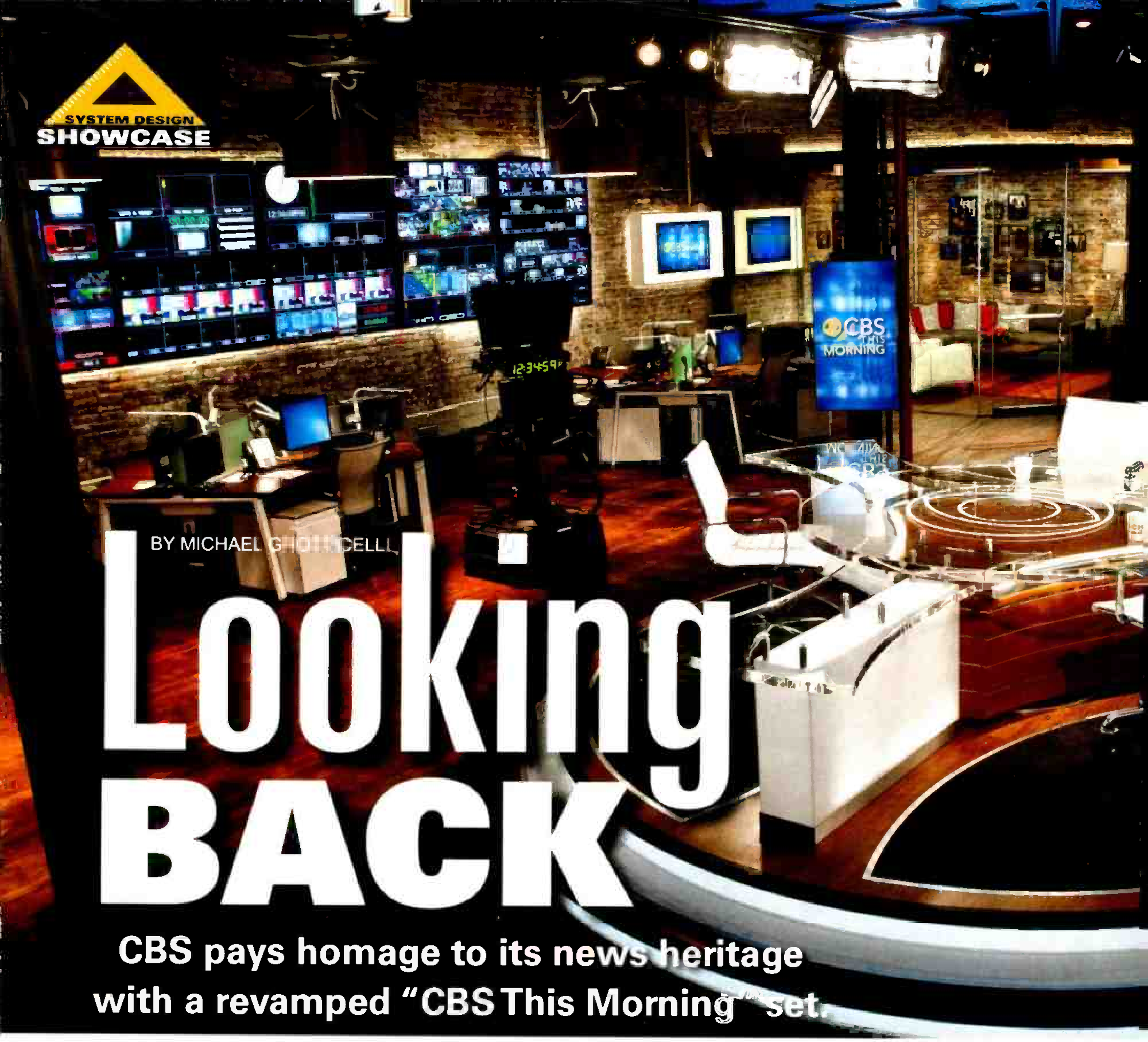


Figure 3. Comprehensive monitoring in real time at strategic network locations for rapid problem detection and fault isolation can be combined with control plane and content quality monitoring for optimum system management.

James Welch is senior consulting engineer for IneoQuest Technologies.



SYSTEM DESIGN SHOWCASE

BY MICHAEL GROTTICELLI

Looking BACK

CBS pays homage to its news heritage with a revamped "CBS This Morning" set.

Looking around the new "CBS This Morning" production studio at CBS in New York City, one is reminded of an earlier time, when the network ruled the news business and professional broadcast TV equipment was light-years behind where the technology is today.

The idea for the retro set originated with "CBS This Morning" executive producer Chris Licht, who wanted to remind viewers of the legacy that CBS News had built up while lending integrity to the "new" morning news show. The set is designed with a lot of open space to give producers the option to shoot in different areas and have alternate looks. It also allows camera operators to shoot "in the round," from different angles. Extensive use of LED highlight lighting also helps set different moods.

Harkening back to the days of Walter Cronkite and even earlier, the production space — designed by JackMorton/PDG — is heavy on history and hard newsgathering. Its welcoming, exposed brick walls frame a collection of historical memorabilia that includes several early TV sets, a reel-to-reel audio recorder and some old ENG cameras — an Ikegami HL-35 and a Sony BVP-300 — on a display shelf along one side. There's also the actual map used by Cronkite during his days as anchor of the "CBS Evening News."

Yet the Studio 57 set also is quite modern in its accoutrements. The 4050sq-ft set was built inside an existing space owned by CBS, which amounted to a large square box. It features an unusual glass table at the center of the set, featuring a round top with three spokes and a triangular base (with a CBS logo etched in the middle), where the show's three new co-hosts — Erica Hill, Gayle King and Charlie Rose — sit around and discuss events of the day. To one

The new set for "CBS This Morning" features a large glass table that the three hosts sit at. There is a greenroom area for guests, and next to that is the 186in "Magic Wall" display.

side is a greenroom area, where celebrities and other guests wait (but it's also used for teases and other on-air segments as well) and towards the center in back, a 186in "Magic Wall" display screen.

Virtual guests join the conversation

The set also features an impressive virtual monitor wall on one side that replicates the same multifeed view used by the director in an adjacent, separately located HD control room, known as Control Room 47. Remotely located guests can appear live via satellite feed on eight 46in LCD monitors on set (each of the four columns have two monitors, mounted back to back) that are mounted on a special rig that extends closer to the table during interviews.

Frank Governale, vice president of operations for CBS News, said, "We wanted to show the strength in the worldwide operations and engineering prowess we've had over the years here at CBS. We've pioneered a lot of technologies in the newsgathering and broadcast transmission areas. I wish we could show it all [on set]."

The new studio was repurposed from space formerly used by the CBS.com staff (60 people) as a large newsroom. Seventeen years ago, it was used for a cable TV show. The internal brick walls were uncovered during the renovation. It had a small lighting grid, so fluorescent, LED and incandescent lighting fixtures had to be added, all controlled by a mixture of DMX controllers and dimmers. Extra power had to be added as well, so they installed two services, a UPS system and an emergency lighting service, which both have generator backup in case they lose electricity.

Camera operators literally walk around on set with Sony HDC-1400 cameras: one on a Steadicam, one on a mini-jib arm, three on Vinten Radamec Fusion robotic pedestals and one used handheld style. This gives the show a look that's different from other morning shows.

Shared resources

The show shares Control Room 47 with the "CBS Evening News" and other special events programming. The control room is about 100ft from the new set in an adjacent building and is tied into a centralized rack room inside the new space. This control room was upgraded to full HD functionality in 2008. There are plans to relocate the HD control room at the GM building (where the former "The Early Show" was produced), which will also be tied into the same central rack room.

Governale said the network will not relocate "CBS This Morning" from Control Room 47 if another show needs it, but instead will add the new control room and have the option to use either (or both), depending upon the requirements at that moment. This will allow the network to leverage the new set for major events like election night coverage.

HD swinging

When there are conflicts with two shows, engineers can simply reroute signals and manage a new program out of either of the two rooms. There is an Evertz 80 x 40 routing switcher (within a 576 x 576 frame) dedicated to "swinging" the control rooms and the different stages. If a show in Control Room 47 is going to be used with Studio 57's floor, an engineer simply pushes a salvo button on the router and all of the tie lines and A/V feeds get instantly rerouted to/from Studio 57 and 47's control room.

Camera operators literally walk around on set with Sony HDC-1400 cameras. One is in a Steadicam rig, another is on a mini-jib arm, three are on robotic pedestals and the last is hand held.

The existing control room features a Sony MVS-8000G switcher, an Evertz VIP-driven virtual monitor wall, Avid Multi Stream servers, EVS DDR with IPDirector and Vizrt graphics. There are two Calrec audio mixing consoles: an Alpha for the show mix and an Omega for the music mix. The new second control room will be identical in every way.

Letting viewers monitor production

VGA feeds are split out from the actual control room and displayed on a dozen flat-screen monitors (two

Design team:

CBS News
Chris Licht, Executive Producer, "CBS This Morning"
Frank Governale, Vice President, News Operations
Robert Klug, Creative Director
Philip Selby, Director Studio Operations

CBS Facilities
Francis Coiro
Gustavo Vazquez

Architects
Meridian Design Associates:
Antonio Argibay, Principal
Charles Mallea, Associate

Facility engineers
CSA Group
Richard Thomas, VP Operations
Cornelius Vinatoru, Manager, Electrical

Set Design — JackMorton/PDG
James Fenhagen, Production Design
Larry Hartman, Production Design
Juliann Elliot, Design
Patrick Howe, Set Decorator

Lighting Design — NYC Lights
Deke Hazirijian, lead designer
Kathleen Dobbins, designer
Kevin Fox, CBS Lighting Director

Display and Projection Design
Videofilm Systems:
Dale Cihi

Engineering Design and Install
CBS Engineering
Howell Mette, VP Engineering
John Ferder, Director Studio and Post Production Engineering
William Grieco, Director of Facility Operations
James Valvo, Assoc. Director Operations and Engineering
James Oster, Sr. Project Engineer
Rhina Fernandez, Project Engineer
Kevin Coleman, Director Transmission Engineering
William Lovallo, Director Construction

rows of six 55in Samsung LCD/LED displays) on one side of the new studio. A monitor wall that spans about 20ft is made up of 25 Orion seamless displays (five rows of five, each 42in), and it is fed by a high-powered Vista Systems Spyder video processor. There are eight outputs from the processor, four of which feed that monitor wall. When one monitor image is changed or rescaled in the control room, every image on the wall of the set is refreshed as well. Using this processor, the wall can be broken up into four different sections, as needed.

The other four outputs of the processor feed the flat-panel screens on the set that extrude from poles around the main set table. There are two monitors, one on each side of the posts (back-to-back). They allow the show to bring in virtual guests to join the conversation at the table. Graphics can also be "slid" from one monitor to the next, if a desired effect. The two monitors can also be brought together side-by-side. These monitors are mounted on special rigs that can rotate the panels horizontally or vertically. The CBS Scenic shop fabricated the mechanical arms that allow the screen to extend towards the table and swing around the post.

The set's stunning "Magic Wall" is a Stewart AeroView 70in screen, which is bonded to an acrylic RP screen (15.5ft x 8ft) that is fed by two Panasonic PT-D12000U DLP projectors stitched together. The screen hangs from the ceiling on thin aircraft cables that makes it appear to float in space. (If someone touches it, it starts to sway, so on-air talent has been warned.)

The new "CBS This Morning" show shares Control Room 47 with "CBS Evening News" and other special events programming. The control room is about 100ft from the new set in an adjacent building.

While the set was finished in early January, construction continued on other parts of the surrounding space for several more months. CBS built a networked newsroom behind the new set. Above are new offices and talent accommodations. The newsroom space used to be production studio space owned by Unitel Video (for all of you video industry history buffs). One side of the newsroom has a glass wall facing 57th Street. The newsroom has a raised floor for cabling and dozens of workstations and truss for monitors; there's a monitor everywhere. Two skylights bring in light from above, to provide "a nice light environment where our people can be creative and efficient," Governale said.

An Associated Press ENPS computer newsroom system is used throughout the News Division, so the

new space has continued that tradition. For "CBS This Morning," the network has implemented MOS control to streamline graphics creation and playout control. Vizrt graphic templates (in Vizrt's Media Engine processor) created within ENPS are used for all lower-thirds and other graphics. An Avid Multi Stream server with Command software is used for playout.

Technology at work

- Associated Press ENPS newsroom computer system
- Avid NewsCutter, Media Composer workstations, Multi Stream servers
- Autoscript teleprompter
- Calrec Alpha, Omega audio consoles
- Canon XJ22x7.3BIE-D lens with SS-41-IASD servo control
- ETC Ion lighting consoles
- Evertz EQX HD routing switcher, MVP multiviewer software
- EVS DDR w/IPDirector
- Kino Flo LED lights, incandescent lights
- Lectrosonics and Phonak wireless IFB
- Orion seamless plasma video displays
- Panasonic PT-D12000U HD projectors
- Sony MVS-8000G HD switcher, HDC-1400 HD cameras
- Steadicam rigs
- Stanton camera jib
- Sennheiser dual true diversity mics, receivers, bodypack transmitters
- Telex BTR-800, BTR-80N wireless communications systems
- Vinten Radamec Fusion robotic camera pedestals
- Vista Systems Spyder video processor
- Vizrt graphics platform

Collaborative digital news production

The construction folks were finished with the newsroom space in mid-February, and the "CBS This Morning" news team was online by the end of March. The original plan was to open up the brick wall and have full access to (and see into) the newsroom. However, the building's age and existing infrastructure made that prohibitively expensive and would have increased the build timeline, which no one wanted to do.

Now that it's finished, Governale said the newsroom is "light-years" ahead of where other CBS newsrooms have been in the past. It is used for "CBS This Morning," the 4 a.m. "Morning News," the "Up To The Minute" network newscast and other CBS properties as well. There is GigE connectivity at every desktop, allowing everyone to browse low-resolution clips from across the CBS properties. Programs are edited on Avid NewsCutter and Media Composer editing workstations that work off a large Avid Interplay/ISIS system, which is connected to a Media Archive (and also available to anyone in the newsroom as well as the rest of the company).

Literally dozens of routing switcher panels are located throughout the newsroom so that producers can see anything that comes into and goes out of the building. They can also preview any clip on the IT network, even if it's not on a local server. This networked infrastructure — where fiber-optic cable is everywhere to move HD clips around — fosters collaboration among all of the various creative and engineering teams.

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In conjunction with building the new set, the CBS engineering crew also increased the size of its Evertz EQX video routing switcher (to 576 x 576 I/O) that manages the facility. The system's design is such that the router sees all of the equipment (in both control rooms) as one large control room that has two of everything. It's that seamless. The network can begin broadcasting a show from

...e campaign ... Studio 57's ... their affecting ... viewers will never ... [illegible] ... hopes its new program (formerly called "The Early Show") will one day dominate the highly competitive national morning show category. With the ghost of Walter Cronkite in the room, it's a good bet to take. **BE**

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

On-set museum

To establish the tone for the new "CBS This Morning" program, CBS has populated one wall of the set with a series of shelves displaying a variety of CBS TV memorabilia. The props were researched and acquired by Patrick Howe, through Jack Morton Worldwide.

There are four vintage televisions, four radios and multiple broadcast/recording microphones spanning several decades of the 20th century. The oldest TV is a Pilot brand, which also made radios. It was the first TV to retail for less than $100. It has a 3in screen, and at the time it was recommended that viewers sit 1ft away for every inch of the screen.

The on-set props include:

- A gold metal RCA TV from the mid-1950s;
- A Panasonic TV from the 1970s, commonly referred to as a "Flying Saucer" model;
- A late 1970s Panasonic, color TV with multiple channels;
- A 1930s cathedral-style radio, a 1940s wood cabinet radio and a 1950s white plastic radio;
- Ten broadcast microphones from the 1930s through the 1960s. One is the Shure 55 "Fat Boy," which was popular in the 1950s;
- An early 1970s Sony hand-held BVP-300 ENG camera and an early '70s Ikegami handheld (HL-35). Both were used extensively by CBS News crews;
- A 7in reel-to-reel tape recorder, used on remotes for recording interviews;
- The first control room show timer from the opening of "60 Minutes;"
- Three professional portable typewriters from the early to late 1950s;
- A CBS journalist's protective helmet worn while covering the Democratic convention;
- Assorted photos, books and memorabilia of other CBS broadcasters, including Edward Morrow, Walter Cronkite and others. There's even a pic... Captain Kangaroo.

...nline captioning compliance

FCC has issued captioning requirements for all ... video. Learn how to meet the requirements of the ...ules and how to automate the technical process.

BY BILL MCLAUGHLIN

...treaming video has ... a major part of ...adcaster's tech- ...business plans ...tober 2010, ...nce of on- United ...enty- ...and ...h

In January 2012, the FCC released a Report and Order detailing the types of Internet video content that would be subject to closed captioning requirements, and providing a schedule for compliance. These rules will eventually require captioning for all "full-length" video programming that has also been aired over traditional TV channels with closed captions. Consumer-generated and other videos that are shown only over the ...nternet, or videos that are only clips ...outtakes of full TV programs, will ...e covered.

...t's the timeline? The compli- ...dlines provided by the com- ...provide broadcasters with six ...ths (September 2012) to comply for new, prerecorded, programming; 12 months for new, live, programming such as news and sports (March 2013); and 18 months to provide full compliance for archival material that was already publicly streaming before the passage of the rules.

Compliance challenges

While most major broadcasters' online streaming sites have already begun to implement closed captioning in some form, few, if any, are already in compliance with the full regulations. This is especially true because the new FCC rules require that the "online captioning experience is equivalent to the television captioning experience." The rules specifically state that this will

S[illegible]lio 57 and seamlessly move cam-e[illegible] and intercoms to Studio 57's co[illegible]ol room [illegible]ithout ever affecting the o[illegible] air sign[illegible]. Viewers will never know th[illegible] latter [illegible]ce.

At the e[illegible] day — or less than four months [illegible] CBS initially broke down walls (and r[illegible]located CBS.com staffers) [illegible] the new studio sets the standard [illegible] state-of-the-art, multipurpose TV studio. Governale said it was the largest complex build he has ever been involved with, and he's worked on some major projects — like the CBS studios in the GM Building, built in 1999, which took six months and are about the same size and complexity. In this case, management dictated that the show had to be on the air by Monday, Jan. 9, 2012. And — with everyone working in parallel teams and often around the clock — the show was, at exactly 7 a.m. Eastern.

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Online captioning compliance

The FCC has issued captioning requirements for all online video. Learn how to meet the requirements of the new rules and how to automate the technical process.

BY BILL MCLAUGHLIN

Online streaming video has become a major part of every broadcaster's technology and business plans over the last few years. In October 2010, this new mainstream acceptance of online video was reflected in the United States by the passage of the Twenty-First Century Communications and Video Accessibility Act (CVAA), which instructed the FCC to create rules ensuring that Internet-delivered videos would be held to similar standards for accessibility as traditional television. The most important of these requirements is mandatory closed captioning for the deaf and hard-of-hearing, which has been a requirement for most television programming since 1996.

In January 2012, the FCC released a Report and Order detailing the types of Internet video content that would be subject to closed captioning requirements, and providing a schedule for compliance. These rules will eventually require captioning for all "full-length" video programming that has also been aired over traditional TV channels with closed captions. Consumer-generated and other videos that are shown only over the Internet, or videos that are only clips or outtakes of full TV programs, will not be covered.

What's the timeline? The compliance deadlines provided by the commission provide broadcasters with six months (September 2012) to comply for new, prerecorded, programming; 12 months for new, live, programming such as news and sports (March 2013); and 18 months to provide full compliance for archival material that was already publicly streaming before the passage of the rules.

Compliance challenges

While most major broadcasters' online streaming sites have already begun to implement closed captioning in some form, few, if any, are already in compliance with the full regulations. This is especially true because the new FCC rules require that the "online captioning experience is equivalent to the television captioning experience." The rules specifically state that this will require site operators to provide advanced decoder options such as adjustable colors and sizes. It also may exclude altogether the now common practice of providing captions in a separate, non-integrated window from the video presentation. These may seem like small details for the many broadcasters who have no captioning for online content yet, but they are essential to take into consideration at an early stage to avoid future problems.

The most difficult task for many broadcasters will likely be the development of a workflow for streaming captions authored in real time during live news and sports. For simulcasts, where the program is distributed concurrently through broadcast and online, this requires a system where broadcast caption data is captured while being encoded on the production video signal, and uplinked in real time to the streaming media source server for synchronized delivery with the consumer video streams.

An additional difficulty for live news captions is that while many existing streaming media player technologies have built-in support for display of captions from a previously prepared caption file, most are not prepared to display the incremental, roll-up style of captioning that is used during news broadcasts. Smooth integration with existing automation systems that recognize commercials and various other forms of content in the streaming feed is also a concern.

Current streaming captioning solutions

Solutions to the challenge presented by streaming live captions taken from broadcast may need to vary significantly, at least at an early stage, for different server and player technologies. Adobe Flash, for PC browser viewing, and HTTP Live Streaming, for Apple iOS devices, are currently the most relevant technologies for sites seeking the broadest possible compatible user base, but Microsoft Silverlight also maintains a presence, and use of new HTML5 video technologies is widely expected to grow in the next several years.

At present, there is no single file type that works across all stream types; the FCC recommended (but did not require) use of the Timed Text format, but many commonly used players do not yet read these files. Meanwhile, there is even more variation in player support for real-time captions, since a previously recorded file will not be available at the beginning of the stream.

Assuming for a moment that a suitable format (or set of formats) has been settled on, the requirements broadcasters should set for a solution are clear. The system should:

- Repurpose the closed captions already in use in the broadcast, with little or no additional labor required on the part of the provider of the real-time transcription service or master control staff;
- Enable both live simulcasting of the captions with minimal delay, and archival recording of the captions for use in future on-demand streaming;

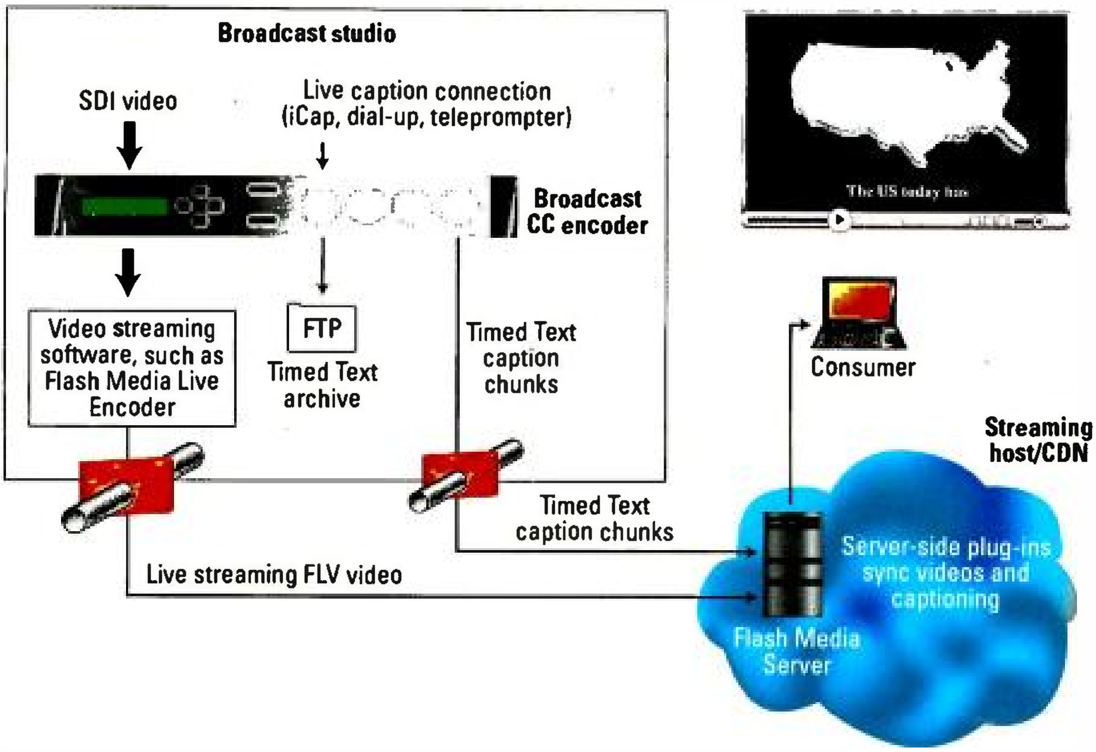

Figure 1. Shown here is an end-to-end system for streaming live broadcast captions online using a Flash platform. Similar architectures are possible targeting iOS and other formats.

- Use existing automation systems to recognize commercials and other content that will be replaced on the streaming feed; and
- Make use of a decoder on the consumer end with a maximal feature set to satisfy the "equivalent experience" mandate from the FCC rules.

Signal path example

To demonstrate the type of system that could enable efficient repurposing of live broadcast captions while meeting many of the above requirements, Figure 1 shows an example workflow using Adobe's Flash Media Server technology.

In this workflow, software included on the broadcast closed caption encoder directly uplinks closed captions in the Timed Text format to the Flash Media Server, with the same destination and required network routing as the video streaming software (Adobe's Flash Media Live Encoder).

The closed caption encoder is a logical uplink point because there is already direct access to all captions for the program, regardless of source, including remote delivery by IP or modem, locally connected teleprompters and captions already included in the upstream video. Automation can be used to block caption uplink during commercials and interstitials, as ad content is likely to differ between the broadcast and online feeds.

Uplinking directly from the closed caption encoder also provides a new opportunity to reduce caption delay on the online stream; while live broadcast captioning is always several seconds behind due to the transcription delay, this delay can be removed from the online feed in a programmable way, since it is likely that the total latency of the video path through the streaming compression software is greater than the original caption latency.

At the Flash Media Server, the uplinked closed caption data merges again with the compressed video, and is at this point synchronized permanently to the stream. All consumers will see the captions synchronized perfectly to the video, regardless of their connection quality. Also, if archival recording is performed on the server, the synchronized captions will be preserved within the saved video file for future on-demand playback. Additional recording capability is available on the caption encoder, which can provide complete Timed Text files, saving the real-time broadcast captions as commanded by the automation system.

Consumers will view the captions through the streaming player provided on the broadcaster's website. A component included in Adobe's basic development kit will play the Timed Text captions, though without some of the features standard on typical television decoders. Additional third-party plug-in components are available to augment these features, providing the rich experience captioning users are accustomed to.

For broadcasters seeking to offer a live simulcast of all of their televised offerings, this system would provide a single workflow that would automatically ensure that all content captioned on the broadcast feed would also have equivalent captioning on the online stream. In other environments, a system like this could be used for news and live events only, while caption files obtained from the original post-production captioning vendors would be posted separately to the media servers for pre-recorded content.

Meeting the deadline

Full streaming caption compliance, on the tight deadlines specified by the FCC, will be a big subject this year for many broadcasters. As with many streaming media tasks, the proliferation of format technologies will be one of the biggest challenges to identifying the required solutions, and demonstrating compliance with the necessary set of supported software and devices.

Successful implementations do exist that will provide broadcasters with compliance certainty, while providing consumers with the level of experience they have come to expect of broadcast captioning in the past 20 years. BE

Bill McLaughlin is Software Systems Manager at EEG.

AVC-I offers significant bit-rate reduction, a valuable benefit to stadium broadcasts or trucks like NBC's "Swamp Boy." (Image courtesy Carl Stewart/Shutterstock.com.)

AVC-I

There are benefits to using an intra-based codec for broadcast contribution.

BY PIERRE LARBIER

Broadcast contribution applications like newsgathering, event broadcasting or content exchange currently benefit from the large availability of high-speed networks. These high-bandwidth links open the way to a higher video quality and distinctive operational requirements such as lower end-to-end delays or the ability to store the content for further edition.

Because a lighter video compression is needed, the complexity of common long-GOP codecs can be avoided, and simpler methods like intra-only compression can be considered. These techniques compress pictures independently, which is highly desirable when low latency and error robustness are of major importance. Several intra-only codecs, like JPEG 2000 or MPEG-2 Intra, are today available, but they might not meet all broadcasters' needs.

AVC-I, which is simply an intra-only version of H.264/AVC compression, offers a significant bit-rate reduction over MPEG-2 Intra, while keeping the same advantages in terms of interoperability. AVC-I was standardized in 2005, but broadcast contribution products supporting it were not launched until 2011. Therefore, it may be seen as a brand new technology, and studies have to be performed to evaluate if they match currently available technologies in operational use cases.

Why intra compression?

Video compression uses spatial and temporal redundancies to reduce the bit rate needed to transmit or store video content. When exploiting temporal redundancies, predicted pixels are found in already decoded adjacent pictures, while spatial prediction is built with pixels found in the same picture. Long-GOP compression makes use of both methods, and intra-only compression is restricted to spatial prediction.

Long-GOP approaches are more efficient than intra-only compression, but they have also distinctive disadvantages:

- Handling picture dependencies may be complex when seeking in a file. This makes editing a long-GOP file a complex task.
- Any decoding error might spread from a picture to the following ones and span a full GOP. This means that a single transmission error can affect decoding for several hundred milliseconds of video and, therefore, be very noticeable.
- Encoding and decoding delay might be increased using long-GOP techniques compared to intra-only because of compression tools complexity.

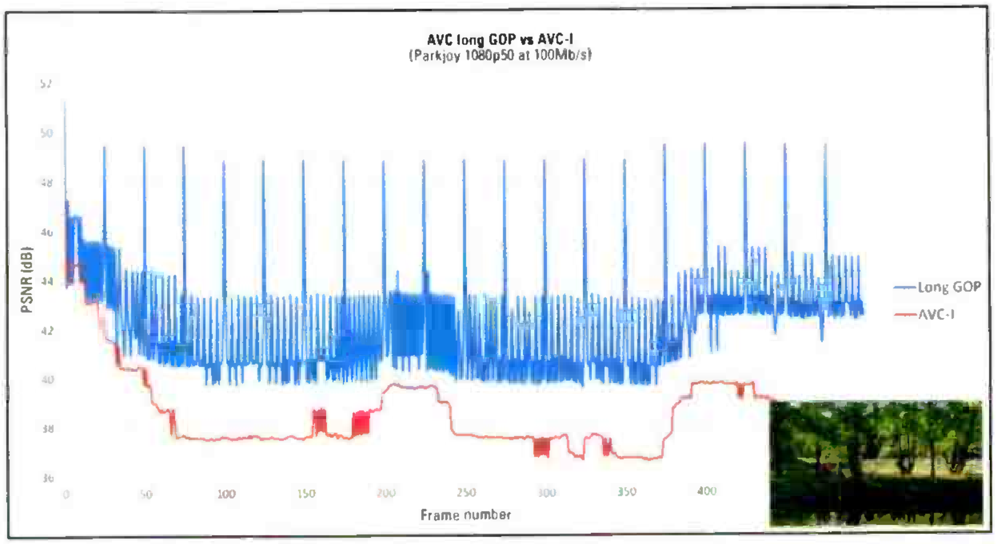

Figure 1. This figure shows long-GOP versus intra-only compression.

Another problem inherent to long-GOP compression relates to video quality that varies significantly from picture to picture. For example, Figure 1 depicts the PSNR along the sequence *ParkJoy* when encoding it in long-GOP and in intra-only. While the quality of the long-GOP pictures is always higher than the one of their intra-only counterparts, it varies considerably. On the other

H.264/AVC Intra profiles	Based on:	Summary of the restrictions to the base profile
High10 Intra	High 4:2:2 profile (targets mainly Contribution applications with up to 4:2:2 10-bit pixels)	All pictures are IDR* (no P or B pictures) Limited to 4:2:0 chroma format (no 4:2:2 chroma format)
High 4:2:2 Intra		All pictures are IDR (no P or B pictures)
High 4:4:4 Intra	High 4:4:4 Predictive profile (targets mainly Archiving applications with up to 4:4:4 14-bit pixels)	All pictures are IDR (no P or B pictures)
CAVLC 4:4:4 Intra		All pictures are IDR (no P or B pictures) Only CAVLC entropy coding

Table 1. This shows the different H.264/AVC Intra profiles. (IDR = Instantaneous Decoder Refresh, CAVLC = Context Adaptive Variable Length Coding)

hand, the quality of consecutive intra-only coded pictures is much more stable.

Therefore, intra-only compression might be a better choice than long-GOP when:

- Enough bandwidth is available on the network;
- Low end-to-end latency is a decisive requirement;
- Streams have to be edited; and
- The application is sensitive to transmission errors.

Several intra-only codecs are currently available to broadcasters to serve the needs of contribution applications:

- *MPEG-2 Intra* — This version of MPEG-2 compression is restricted to the use I-frames, removing P-frames and B-frames.
- *JPEG 2000* — This codec is a significantly more efficient successor to JPEG that was standardized in 2000.
- *VC-2* — Also known as Dirac-Pro, this codec has been designed by BBC Research and was standardized by SMPTE in 2009. Like JPEG 2000, it uses wavelet compression.

Older codecs like MPEG-2 Intra benefit from a large base of interoperable equipments but lack coding efficiency. On the other hand, more recent formats like JPEG 2000 are more efficient but are not interoperable. Consequently, there is a need for a codec that could be at the same time efficient and also ensure interoperability between equipment from various vendors.

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What is AVC-I?

AVC-I designates a fully compliant variant of the H.264/AVC video codec restricted to the intra toolset. In other words, it is just plain H.264/AVC using only I-frames. But, some form of uniformity is needed in order to ensure interoperability between equipment provided by various vendors. Therefore, ISO/ITU introduced a precise definition in the form of profiles (compression toolsets) in the H.264/AVC standard.

H.264/AVC intra profiles

Provision to using only I-frame coding was introduced in the second edition of the H.264/AVC standard with the inclusion of four specific profiles: High10 Intra profile, High 4:2:2 Intra profile, High 4:4:4 Intra profile and CAVLC 4:4:4 Intra profile. They can be described as simple sets of constraints over profiles dedicated to professional applications. Table 1 gives an overview of the main limitations introduced by these profiles.

Because the intra profiles are defined as reduced toolsets of commonly used H.264/AVC profiles, they don't introduce new features, technologies or even stream syntax. Therefore, AVC-I video streams can be used within systems that already support standard H.264/AVC video streams. This enables the usage of file containers

Bit rate in AVC-I	Remarks
≤ 50Mb/s	Video quality is too low for high-quality broadcast contribution applications
50Mb/s - 75Mb/s	Acceptable on low-noise sources but poor on most sequences
75Mb/s - 90Mb/s	Acceptable
90Mb/s - 110Mb/s	Good
110Mb/s - 150Mb/s	Excellent
≥ 150Mb/s	Visually lossless

Table 2. This shows AVC-I bit rate versus quality for 1080i25 to 720p50 content.

like MPEG files or MXF, MPEG-2 TS or RTP, audio codecs like MPEG Audio or Dolby Digital, and many metadatastandards.

AVC-I video quality

Many academic papers have compared the coding efficiency of H.264/AVC in intra-only mode versus other intra codecs. But, those performance comparisons are carried out using objective metrics like PSNR or SSIM. (Structural SIMilarity, when referred to as SSIM Index, is based on measuring three components — luminance similarity, contrast similarity and structural similarity — and combining them into a result value.) It is important to realize that PSNR or SSIM may not reflect actual visual perception. Consequently, studies published to date do not necessarily reflect the visual experience of a given codec in the context of broadcast contribution.

The outcome of the investigation is that two codecs are most suitable for high bit-rate Intra uses — AVC-I and JPEG 2000.

For this reason, we have performed a visual evaluation of various intra codecs intended for broadcast contribution applications. The tests involved a range of products that could encode and decode AVC-I and MPEG-2 Intra up to 150Mb/s, across multiple vendors, and reference software. This investigation was done by expert viewers on a large set of test sequences representative of high-definition broadcast contribution content, mostly interlaced.

The outcome of this evaluation is that two codecs are most suitable for high bit-rate intra uses — AVC-I and JPEG 2000. The detail level appears to be about the same with both codecs on bit rates ranging from 50Mb/s to 150Mb/s. This confirms that the coding efficiency of AVC-I and JPEG 2000 is close. However, coding artifacts are different.

AVC-I and JPEG-2000 artifacts

Below 100Mb/s, a problematic defect was observed similarly on both codecs: Pictures can exhibit an annoying flicker. This issue is caused by a temporal instability in the coding decisions, amplified by noise. It seems to appear below 85Mb/s with JPEG 2000 and below 75Mb/s with AVC-I. And, it worsens as the bit rate decreases. At 50Mb/s and below, the flicker is extremely problematic, and it was felt that the video quality was too low for high-quality broadcast contribution applications, even when the source is downscaled to 1440 x 1080 or 960 x 720.

Around 100Mb/s, both codecs perform well, even on challenging content. Pictures are flicker-free, and coding artifacts are difficult to notice. However, noise or film-grain looks low-pass filtered, and its structure sometimes seems slightly modified. Even so, it wasn't felt this was an important issue.

All those defects are less visible as the bit rate is increased. But, while AVC-I picture quality raises uniformly, some JPEG 2000 products may still exhibit blurriness artifacts, even at 180Mb/s. Using available JPEG 2000 contribution pairs, a bit rate at which compression is visually lossless on all high-definition broadcast content was not found. On the other hand, some encoders appeared visually lossless at 150Mb/s, even when encoding grainy content like movies.

Bit rates in contribution

The subjective analysis of an actual AVC-I implementation on various broadcast contribution content allows us to categorize its usage according to the available transmission bandwidth. On page 48, Table 2 presents findings on 1080i25 and 720p50 high-definition formats.

Because AVC-I does not make use of temporal redundancies, 30Hz content (1080i30 or 720p60) is more difficult to encode than 25Hz material. Additionally, to achieve the same perceived video quality level, bit rates have to be raised by 20 percent.

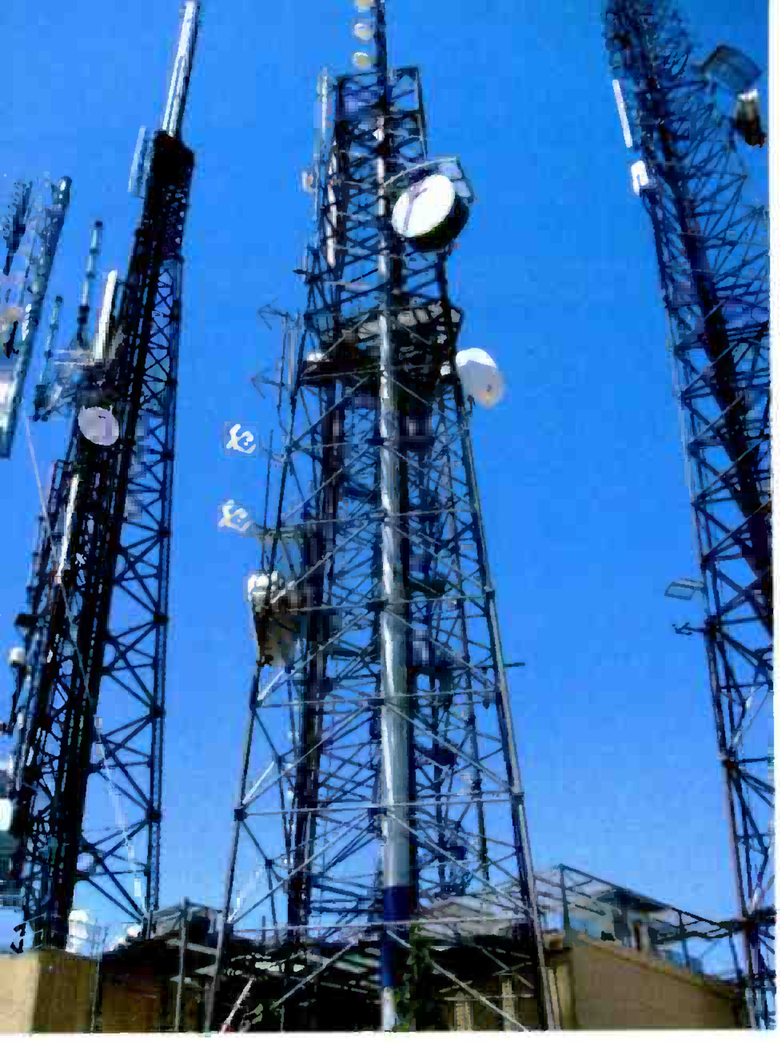
Conclusion

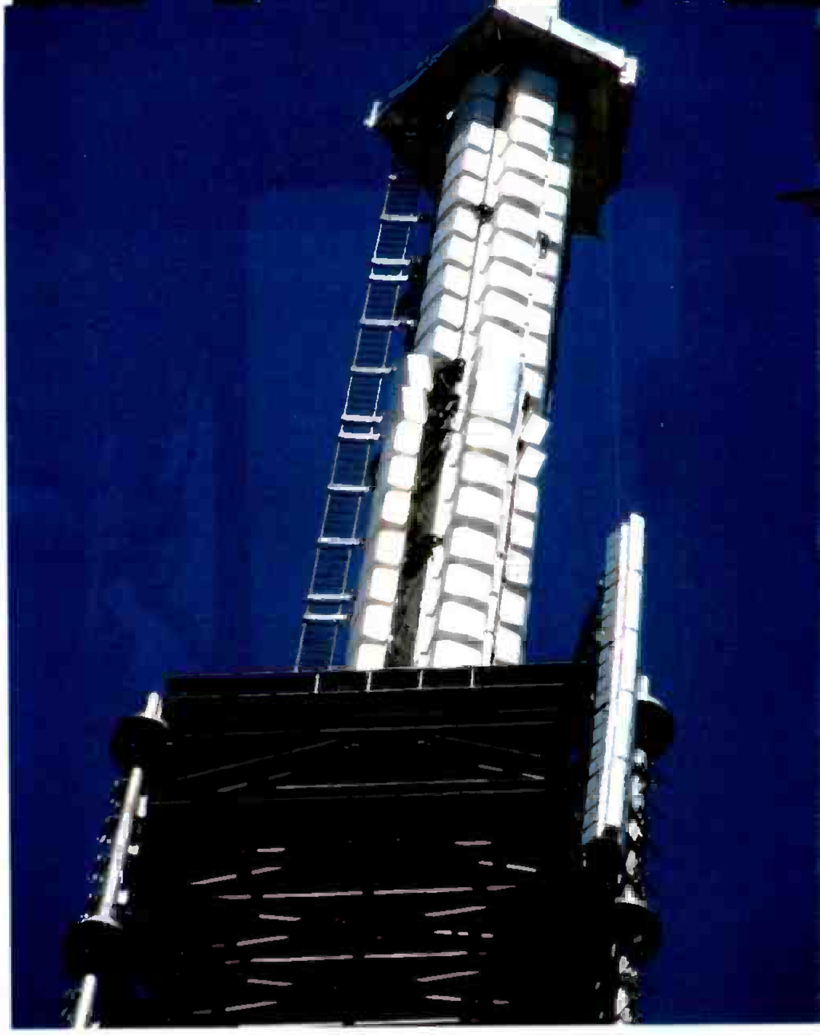
The availability of high speed networks for contribution applications enables broadcasters to use intra-only video compression codecs instead of the more traditional long-GOP formats. This allows them to benefit from distinctive advantages like: low encoding and decoding delays; more constant video quality; easy edit ability when the content is stored; and lower sensitivity to transmission errors. However, currently available intra-only video codecs require one to choose between interoperability and coding efficiency.

AVC-I, being just the restriction of standard H.264/AVC to intra-only coding, avoids making difficult compromises. It is more efficient than other available intra-only codecs, but, more importantly, it benefits from the strong standardization efforts that permitted H.264/AVC to replace MPEG-2 in many broadcastapplications.

Finally, a subjective study across a range of products from multiple vendors identified specific coding artifacts that may occur and confirmed the visual superiority of AVC-I versus MPEG-2 and JPEG 2000, when measured at high bit rates. BE

Pierre Larbier is CTO for ATEME.





Simple checks

A Los Angeles broadcaster uses a simple method to monitor data integrity in transport streams.

BY DAVID WOOD

This discussion focuses on a signal chain where sound and picture live in a transport stream as it moves from studio to relay point to transmitter. This transport stream may travel as DVB-ASI or SMPTE 310M on copper or fiber, or perhaps through an IP network via paths as diverse as the public Internet or private IP channels.

In the real world, the transport stream often must survive through a fairly complex path. This article looks at one example: the signal chain that runs from the Los Angeles-based studios of KJLA, KVMD and KXLA to their respective transmitter sites.

From A to a distant Z

All three stations are operated from KJLA's main studios in West Los Angeles near the campus of UCLA. The KJLA transmission facility is located atop Mount Wilson, while the DTV transmitter supporting KVMD is located at Snow Peak, nearly 100mi to the east. The KVMD transport stream is multiplexed with KJLA and delivered by microwave to Mount Wilson. From there, the path consists of a microwave link to a repeater at Blue Mountain and a final link to the KVMD transmitter at Snow Peak.

This complex path offers great potential for signal loss or data integrity impairment. And if trouble occurs, access to the Blue Mountain repeater site is arduous even in good weather.

Three Los Angeles-based studios, KJLA, KVMD and KXLA, send a multiplexed microwave signal to a transmit site atop Mount Wilson, which is north of the city in the Angeles National Forest. Photos courtesy Ken Brown.

The complex signal path offers many opportunities for signal loss or data integrity impairment. In addition, none of the transmit sites are easy to access in the winter. KJLA chief engineer Ken Brown ended up with a monitoring system that inserts checksum packets into the MPEG transport stream. The system uses about a tenth of a percent of total signal bandwidth.

Ken Brown, chief engineer of KJLA, was looking for some way to monitor each section of this complex path so he could tell when and which part of the path failed. Much of the test equipment used in monitoring and maintaining transport streams focuses on the original construction of the stream. These instruments are superb analysis tools for looking at the performance of encoders and multiplexers. The first question becomes, "How suited are they to the task of fault finding in a signal chain?"

One possible monitoring solution is to think of the issue as a data integrity problem. The assumption was made that the studio would output a properly constructed MPEG signal. The goal is to deliver that signal, ideally with perfect data integrity, to the desired transmitter. In addition, an important system component is to be able to identify if and where any failures occur.

Data integrity

By its very nature, MPEG compression is resilient and tolerates a certain degree of signal loss or corruption. Especially critical packets are frequently repeated, so the loss of a packet is seldom catastrophic. The effect of data corruption is therefore dependent upon the specific piece of data that is corrupted. The random nature of atmospheric impairments to microwave links suggests that some faults would be detected while others would not.

Using a page from the SDI world, it seemed logical to introduce checksum or CRC packets into a transport stream. The system calculates a checksum across a group of data packets. By inserting a checksum (or better, a CRC packet) 10 or 20 times per second, it becomes straightforward to identify when an error occurs at any downstream point.

This proved to be a successful technique to ensure data integrity. And because it operated independently of the content itself, the analysis does not require any prior knowledge of the content being transmitted. In fact, as long as the packet construction adheres to the transport stream specification, this technique also works with encrypted or scrambled data.

Checksums

This system works by removing one of the null packets and replacing it with a checksum packet. Using null packets, which are already present in some quantity, allows the carriage of the checksum without affecting the stream's bandwidth. The checksums are inserted at an approximate 10Hz rate. This means that over the course of a second, data packets are segregated into 10 distinct blocks, separated by checksum packets. Each checksum packet contains the computed checksum and CRC for all of the data packets since the previous checksum. What emerges at the far end of the link is the original material plus the checksum information.

At a monitoring point, the same checksum and CRC algorithm is applied to the incoming data. When a checksum packet arrives, it is compared to the local calculation. Identical results indicate perfect data integrity for that set of packets, but if the local calculation is different, then there is corruption somewhere in that set of packets. This approach provides an unambiguous answer about data integrity.

In addition to testing the checksums at the ultimate destination, it is also possible to break a path into sections that can each be tested independently. This capability can be achieved by, at each relay, calculating the incoming checksum to test the incoming integrity, then calculating a new checksum that is inserted at the output. In this way, the newly inserted CRC packet contains the history of the upstream links. The entire history of each link in the path is therefore accumulated as the signal propagates from point A to B to ... Z.

Hopping to success

To test the system over a real-world STL path, a CRC inserter was installed at the studio and at each relay/repeater site. KJLA's transmitter, located at Mount Wilson, which experiences freezing winter conditions, is fed by a single link. But multiple links are required to reach the KVMD DTV transmitter.

The system inserts checksums at the studio in Los Angeles and then adds link history as the signal passes through each of two microwave relays. These CRC packets eventually flow through into the OTA transmission. They are recovered with a professional receiver at the L.A. studios, and the transport stream is converted back to DVB-ASI, which feeds an MPEG stream processor for data analysis. Initial tests showed perfect data integrity through the complex path running at 19.3Mb/s.

Because a new measurement of data integrity is generated every 100 milliseconds, it's easy to provide an error-seconds count for the link. For example, if the system shows that in the course of 24 hours a count value of 2 was reached, it means there were two seconds during which an error occurred.

One of the benefits in having channel error detection with both fine granularity and fast response is that when a data error occurs, the operator knows about it within a tenth of a second. This is much faster than the analysis response time for traditional MPEG analyzers. The response from the CRC test can be used to generate system alarms or to initiate automatic switching to backup systems.

Simple solution

The system is appealing in its simple implementation. Because it's simple and the impact is small, the test signal can be carried through multiple paths and components in a transmission chain. The CRC relay function can be accomplished with little more complexity than a distribution amplifier. It also has a near-zero demand on bandwidth in a conventional OTA transmission — only about a tenth of a percent of total signal bandwidth.

This technique is also content-agnostic as it does not analyze or decode the stream. It simply tests to see if the data was delivered accurately. That means that it's compatible with unreferenced PIDs that would escape analysis by conventional tools. It works with encrypted or proprietary data that may not lend itself to open-book decoding.

When a data error occurs, the operator knows about it within a tenth of a second.

Perhaps best of all, a CRC insertion system is especially helpful for multiple point installations. It provides information on each relay position by hop count and forwards the history of the previous link all the way to the end of the path. Users can also monitor status at links that may have gone down by using an Internet or other connection. **BE**

David Wood is chief design engineer and president of Ensemble Designs.

Circular polarization for mobile services

BER testing confirms that CP benefits reception on linearly polarized handheld devices.

BY JOHN L. SCHADLER

The success of Mobile TV is dependent upon service reliability. Generally speaking, people have been trained to accept poor cellular voice service and intermittency. Dropped calls are not a big deal since the information can be repeated on another hopefully successful attempt. Video is much different. Gaps in reception result in a lost experience and will not be acceptable to the viewer.

Testing history

Over the last four years, extensive testing has been conducted to quantify the benefits of transmitting circular polarization (CP) to a linearly polarized mobile handheld.

In 2007, it was concluded that small handheld devices are limited to linear polarization; there was defined margin improvement; and tests in a controlled environment showed, on average, that transmitting circular polarization provides 5dB of margin improvement over linear polarization. In 2008, tests in a controlled environment showed that, compared to CP, elliptical polarization with a 66-percent Hpol/33-percent Vpol split provides the highest margin improvement in heavy scatter environments. Also that year, it was discovered that adding a separate vertically polarized antenna to an existing horizontally polarized antenna provides 2dB of margin improvement.

The next year, in 2009, outdoor field tests showed that, on average, transmitting circular polarization provides 5dB of margin improvement over horizontal polarization and 7.5dB of margin improvement over vertical polarization. And, in 2010, tests showed transmitting VHF circular polarization to a small, linearly-polarized handheld provided

3.5dB of margin improvement over horizontal polarization. Also, mobile UHF had a 15dB gain margin advantage over VHF. BER testing confirmed all of those results in 2011.

Even though the testing quantified the margin improvement when using circular polarization, there was still concern over the benefits since all measurements were based on signal strength. Many believed that to truly prove the margin benefit gained by circular polarization for digital transmission, the measurements must be based on bit error rate (BER). In March of 2011, in a joint effort with the West Central Florida Group, the opportunity to conduct measurements based on BER became possible.

BER vs. SNR curve

BER is the number of bit errors divided by the total number of bits. The relationship between BER and SNR is inversely related by a waterfall curve — general examples of which can be found in most communication text books. Two BER measurements can be converted to an expected margin improvement. (See Figure 1.)

These general curves are typically published for free space and static conditions, neither of which is true for real-life conditions. In order to be able to relate true, expected SNR based on BER measurements, the curve must be adjusted for multipath fading and the modulation scheme used within the communication channel. In mobile handheld situations, a fading channel is best represented by a Rayleigh

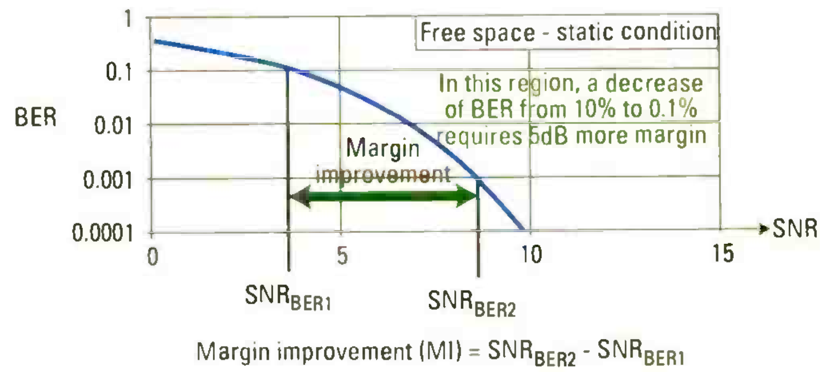


Figure 1. BER is the number of bit errors divided by the total number of bits. Two measurements can be converted to an expected margin improvement.

distribution where there is typically no dominate line of site signal. The equipment used in the experiment was an ICOM LMR 450MHz system, which is based on non-coherent 4 level frequency shift keying (4FSK). The probability of signal, in a Rayleigh fading environment when using non-coherent 4FSK, can be determined as shown in Figure 2.

The BER vs. SNR curve can now be adjusted for the experiment situation and used for determining margin improvement from measured average BERs. It should be noted this adjustment highlights the need for higher SNR in real-life conditions in order to reduce the BER.

A circularly polarized antenna was placed next to a vertically polarized antenna at 800ft on the ATC broadcast tower in Riverview, FL. Also, a mobile unit simulating a linearly polarized mobile handheld was constructed. A motorized dipole was used to measure in parallel mode as if the user was holding the handheld in the upright position and perpendicular mode as if the user was holding the handheld horizontal to the ground. While continuously measuring all orientations, the mobile unit was moved over a long run in location. At the base station, a logging program was used to continuously sample the BER and GPS location.

In order to ensure a fair comparison, the circularly polarized antenna was designed to provide similar coverage on the main beam as the vertically polarized antenna. In doing so, the estimated field strengths per polarization are calculated to be equal from 3mi out in free space. For this reason, all measurements were taken within 60 degrees of the main azimuthal beam and no closer than 4mi from the tower. The data was collected in three different environments: outdoor, indoor and driving. Multiple experiments were conducted in each of the three environments, including: open areas, city, residential, mall, office complex, and inside and outside of a vehicle.

A large number of samples were recorded, and the average BER in each run was calculated for both the circular polarization and linear polarization. The margin improvement was then figured by transposing average BERs onto the BER vs. SNR curve.

When averaging all of the outdoor tests, the average margin improvement of circular polarization was 8dB in the parallel mode and 7.9dB in the perpendicular mode. It may appear strange that the average margin improvement of the perpendicular mode is not higher than the parallel mode since, in the perpendicular mode, the receive dipole is

$$\rho_s = \frac{2^{x-1}}{2^x-1} \sum_{k=0}^{m-1} \frac{(-1)^{k+1} \binom{m-1}{k}}{1+k\,(1+SNR)}$$

Where:

$$\binom{p}{n} = \frac{p!}{n!(p-n)!}$$

$$x = \log_2(m)$$

The expected BER is then given by:

$$BER = 1-\rho_s$$

Figure 2. The probability of signal, in a Rayleigh fading environment when using non-coherent 4FSK, can be determined through the formula shown above.

held horizontal to the ground and should be completely depolarized from the vertical signal. The answer is that small-scale fading has created as much vertical component in the horizontal plane as there is in the vertical plane. Multipath has completely depolarized the signals. If this is the case, then logically: If the vertically polarized signals are so depolarized, then the received signals should be independent of orientation and location. So, why does circular polarization provide 8dB of margin improvement?

That answer is because circular polarization is made up of two orthogonal polarizations time-shifted by 90 degrees. The odds of both polarizations destructively interfering at the same time and same location is much less than a single polarization.

For the indoor cases, the average margin improvement of circular polarization was found to be 6.8dB in the parallel mode and 8.3dB in the perpendicular mode. Note that both the indoor and outdoor measurements produced similar results for both the parallel and perpendicular cases with an overall average margin improvement of 7.5dB. This is explained by understanding circular polarization primarily helps mitigate the effects of small-scale fading that is present both indoors and outdoors. Large-scale fading, such as attenuation through structures, tends to only shift the mean signal strength. As that strength decreases, BER increases. But, the margin improvement gap remains the same. This is due to the effect of Rayleigh fading has flattened out the SNR vs. BER curve in the region of usable operation. It can now be said the benefits of circular polarization hold true both indoors and outdoors.

Maxwell's equation

The next tests were performed both inside and outside of a moving vehicle during long drives of 25 to 60 miles. The first test was inside of a hatchback car. On average, it was found that vertical polarization actually provided 0.5dB more margin improvement than circular polarization. The second test was with a small monopole on top of the car. Results showed circular polarization started to provide a benefit with margin improvement being 1.5dB over the vertical polarization. The third test was with a larger monopole farther above the top surface of the vehicle. Margin improvement here was 2.5dB.

The results provide an interesting insight into why circular polarization does not provide any benefit inside a vehicle, and only starts to provide benefit when raised off the surface of the top of the car. The answer lies in a boundary condition commonly used to solve Maxwell's equations. It states:

"The E-field tangent to a ground plane is zero."

Inside a vehicle, there is basically a ground plane above and below the linearly polarized antenna of a mobile handheld. Therefore, most of the horizontally polarized signal is filtered out, leaving only the vertically polarized component of the incoming circularly-polarized signal. When the antenna is placed on top of the vehicle, there is only a ground plane below it. As the antenna is raised higher above the ground plane, the circularly polarized signal begins to retain shape. This concept can be demonstrated using HFSS modeling software by launching a circularly polarized wave at a low grazing angle onto a ground plane as shown. (See Figure 3.) Note that only the vertical component exists near the ground plane, but, a few wavelengths above the ground plane, the circularly polarized signal is fully intact.

It must be mentioned here that this situation should not discourage the use of circular polarization for mobile applications. Who needs margin? It's not the fireman or policeman inside a vehicle. They have the option to use larger, more efficient external antennas in conjunction with much higher-power radios. The users that need margin are the ones that are carrying small, inefficient, low-power handheld devices, and this is where circular polarization provides a significant advantage in reliable connectivity over liner polarization.

In summary, margin equals reliability, and BER testing confirms that transmitting circular polarization to linearly polarized handheld devices provides necessary margin that will be imperative to the success of Mobile TV.

(Note: The author would like to thank the West Central Florida Group, especially acknowledging Ed Allen and Paul Toth for their support in conducting these tests.) BE

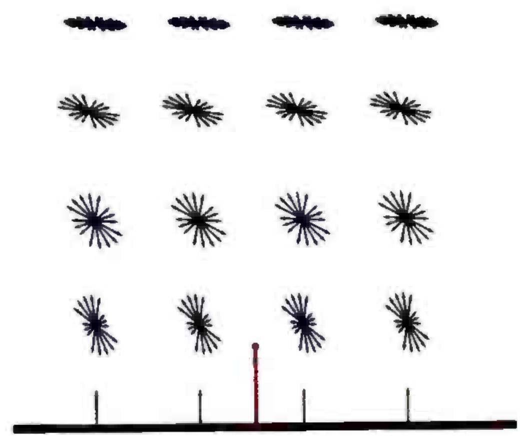


Figure 3. Using HFSS modeling software, this image demonstrates a circularly polarized wave at a low grazing angle onto a ground plane.

John L. Schadler is director advanced antenna systems development for SPX Communication Technologies.

High-density multi-tier active archiving is now the standard approach to long-term preservation and accessibility for broadcast environments.

DESIGNING
an active archive system

BY PETER HALPERN

Content, regardless of age, must be accessible when it's needed and retrieved in a timely manner — seconds or minutes as opposed to days or weeks — to support a competitive and growing model, and an active archive allows just that. An active archive can be defined as tiered storage that provides access to data across a virtualized file system capable of migrating data between multiple storage systems and media types using solid-state drive, hard disk drives, magnetic tape and even optical disk.

An active archive should be viewed as a content management framework. With the right software tools, an active archive provides a framework for moving and managing content, a framework that is heterogeneous by nature and allows for data management flexibility, and that provides a global namespace where users can share and access content transparently. At the core of that active archive framework is the ability to back up and protect content, offer long-term preservation and ultimately lower the cost per GB of managed storage. (See Figure 1.)

The biggest driver to implement an active archive stems from exponential storage growth. It's not realistic to continue taking a linear approach to an exponential problem. Assuming a 50 percent annual growth rate of storage requirements, which is a conservative estimate to many, means that 100TB of storage needs today will grow to 760TB just five years from now. Engineers can no longer think of storage in the same terms as before.

Before you start designing your own active archive solution, however, there are three key points to consider first. Failure to fully understand the implications of any one of these criteria could prove costly to your organization.

Evaluating the medium

The most prevalent two storage mediums today are tape and disk. When looked at side by side, tape is incredibly more reliable than disk, creating far fewer bit errors. If you hear that tape is unreliable, often times people are referring to tape of eight to 10 years ago. Whenever you compare a technology of today to a countering technology of a decade ago, of course there are going to be differences.

In a study of bit errors recorded on various storage mediums, it was found that the hard error rate was 1 bit in 1 x $10E^{14}$ bits for a desktop SATA drive and 1 x $10E^{15}$ bits for an enterprise SATA drive. When looking at an enterprise fibre channel or SAS drive, that jumps an order of magnitude to 1 bit in 1 x $10E^{16}$ bits.

When tape is compared to those disk statistics, tape is far more reliable, with an error rate of 1 bit in 1 x $10E^{17}$ bits for LTO-5 and 1 x $10E^{19}$ bits for IBM's TS1140 media. These numbers mean that you're likely to see a hard error on average every 11.3TB for a SATA disk drive and every 113.6TB for a FC drive. Disk bit errors are much more frequent than tape, with hard errors occurring on LTO-5 on average every 1.1PB, or every 10.6EB for TS1140. Fortunately, disk vendors have come up with ways to minimize the impact of these errors through RAID, striping and other methods so that users can continue to rely on tier one disk for the storage of frequently accessed data and feel confident in moving

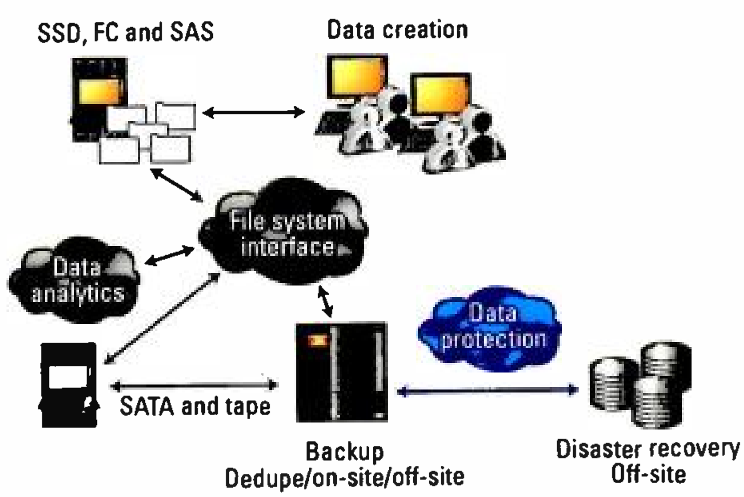


Figure 1. At the core of that active archive framework is the ability to back up and protect content, offer long-term preservation and ultimately lower the cost per GB of managed storage.

the less frequently needed data down to lower tiers in an active archive.

What's more, failures on disk subsystems are typically event-driven. A failed component is often the result of a power outage, a temperature spike or electrical spike. If one component fails, the likelihood of additional failures increases. During a RAID rebuild, the rest of the system has to work that much harder, further increasing the likelihood of additional failures. Keep in mind that most systems today use up to 3TB disk drives with 4TB drives right around the corner. What are rebuild times going to look like then? How exposed is your content going to be?

Evaluating the cost

The faster your storage requirements grow, the closer you need to look at containing cost. When considering the TCO a data storage solution, there are several factors to consider — equipment costs, ongoing support, media costs, floor space required and power consumption.

The Clipper Group published a study in December 2010 that analyzed all of these factors. The study looked at storing 1PB of data over a 12-year period assuming a 45 percent annual growth rate on an all-disk solution versus an all-tape solution. In the end, the tape solution was found to be more than 15 times less expensive than disk — $67 million for disk versus $4 million for tape. In fact, the power costs alone for the disk-based system totaled more than the 12-year total cost of the tape-based system. Now, an active archive is neither completely tape-based nor completely disk. By using the two technologies together in the most appropriate configuration, an organization can realize major cost savings.

In addition, when one factors in tape's future, the cost story becomes more compelling. While the cost per GB of disk storage decreases at a slow pace, the cost per GB of tape has fallen more steeply. About five years ago, the cost per GB for tape was about 25 cents for LTO-2, while today the cost is under 4 cents per GB for LTO-5. Now consider that two years ago, IBM and Fuji developed a prototype tape where they "recorded data ... at a density of 29.5 billion bits per square inch — about 39 times the areal data density of today's most popular industry-standard magnetic tape product ... these new technologies are estimated to enable cartridge capacities that could hold up to 35 trillion bytes (terabytes) of uncompressed data." (Visit "IBM Research sets new record in magnetic tape data density" at http://www.zurich.ibm.com/news/10/storage.html.) At 35TB per cartridge, the future cost per GB looks promising.

Bottom line: Multiple offline copies on data tape are necessary. With the cost of tape media below $60 for 1.5TB, it's easy and inexpensive to make multiple copies, and most archive applications today have the ability to create multiple instances on multiple pieces of media.

Evaluating long-term content preservation

Lastly, any archive solution must provide a framework for long-term content preservation. LTO has a long shelf life of 30+ years, and vendors have shown proven methods for migrating data from one generation to the next. Additionally, the LTO consortium developed Linear Tape File System (LTFS). Specifically, LTFS provides users with the ability to read and write data irrespective of an archiving application. Ten or 20 years from now, LTFS will offer the potential to retrieve content off a tape even if the archive application that wrote the needed file is no longer in use. Because of its interoperability, LTFS shows a lot of promise of staying power.

Not all archives are created equal

In the end, there are many factors to consider when designing an archiving solution for a media and entertainment environment; archives are not all created equal. A robust and efficient archive solution should not only factor in performance characteristics, but also carefully take into account reliability, cost and a future platform roadmap.

It is difficult to find two environments that are identical, so care must be taken so that the specific requirements of any given environment are met. Remember, an archive, specifically an active archive, is a content management framework that provides content protection and preservation, and a framework for lowering cost per GB of managed storage. Within an active archive framework, the archive management application extends the file system across multiple tiers of storage, including tape; allows policies to migrate content from one tier to the next; and allows users complete and uninterrupted access to any asset — all of which are transparent.

The media and entertainment industry is a prime example of an industry faced with exponential content growth, and one where an active archive framework can deliver a highly cost-effective solution. BE

Peter Halpern is Broadcast Sales Specialist, Spectra Logic.

Elemental's Live

The encoding system provides WWE with real-time encoding for streaming.

BY FELIPE NEGRON

World Wrestling Entertainment (WWE) is an integrated media organization with a portfolio of businesses that create and deliver original content to a worldwide audience. The company distributes its content across a variety of platforms, including weekly television programming, pay-per-view, digital media and publishing.

When WWE brought its pay-per-view television programming to the Web, it needed an enterprise streaming system to deliver live video to an online audience. The digital media group deals in complex content punctuated with fast motion, quick scene changes and bursts of light that is tricky to encode for Web-based viewing. Compressing and delivering this type of video in real time over the Internet requires an encoding platform capable of generating a wide range of outputs simultaneously while maintaining superior video quality.

Challenge

The shift to the Internet as a video delivery platform offers enormous opportunity while presenting unique challenges in preparing and delivering Web-targeted video content. For an online audience, source material must be compressed to very low bit rates for reliable and efficient delivery on a massive scale. At the same time, distributed video must retain high visual and audio quality to meet or exceed the expectations of viewers accustomed to the premium broadcast experience available with more traditional video platforms.

Quick movement and scene changes, elaborate stage lighting and even pyrotechnics all make WWE action extremely challenging to encode. Fast motion and bursts of lights are generally recognized as encoding tasks with a high degree of difficulty. With complex content, typical H.264 encoders have a hard time delivering acceptable video quality for live event streaming. Compressed video can exhibit loss of detail, blurring, wash out, macroblocks and other artifacts.

An advanced H.264 codec is required as is the ability to fine tune encoding settings. Beyond the ability to adjust parameters such as resolution, frame rate and bit rate, exposed controls that allow for GOP adjustment and insertion of an IDR frame for a scene change are essential. The ability to perform deinterlacing, adaptive quantization, anti-alias scaling and noise reduction are also key functions in generating the highest quality video for adaptive bit rate (ABR) streaming.

In addition to the challenges inherent to delivering high-quality video online, WWE needed to bring its events to viewers live, in real time. Live event streaming is a high-wire act with no margin for error. Fans who have invested a significant amount of money to view premium content expect an uninterrupted viewing experience, and that requires fail-safe technology on the back end.

Solution

To simulcast its pay-per-view programming on the Web, WWE deployed Elemental Live into its video production workflow as an alternative to existing encoding options. Elemental Live is a massively parallel

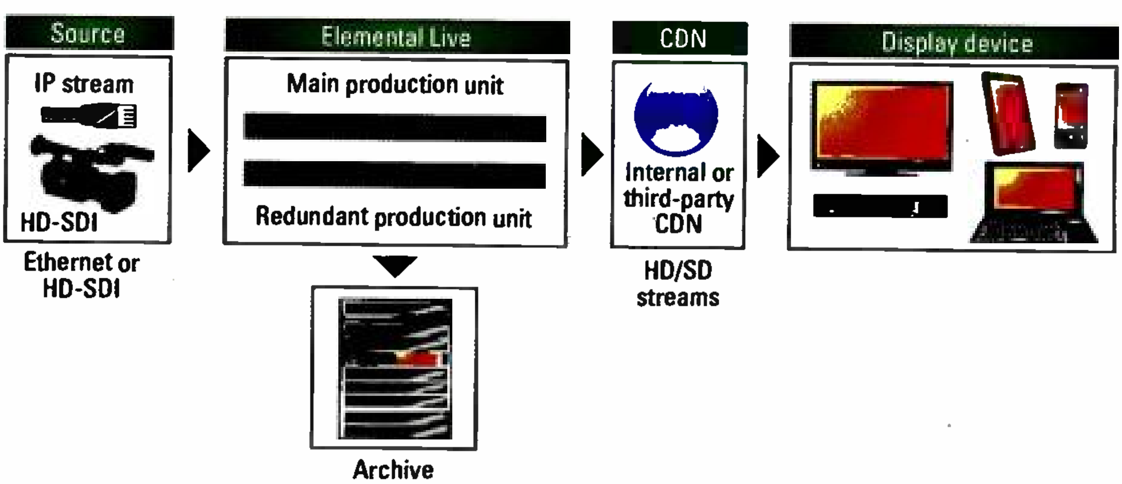


Figure 1. The WWE event workflow begins with a live 1080i camera feed. The signal is deinterlaced, processed and compressed. Multiformat live outputs are then sent to a content delivery network for distribution to various display devices.

video processing system that provides video and audio encoding for live event streaming to online and mobile platforms. Powered by GPUs, the system enables high-quality live video streaming to a Brightcove-supplied Flash player implemented on the WWE website.

The event workflow begins with a live 1080i camera feed sent to the system's HD-SDI input. (See Figure 1.) The signal requires deinterlacing, which is a computationally intensive process employing complex algorithms. Video processing is performed by the system's software, which is optimized to perform functions such as deinterlacing, anti-alias scaling and noise reduction using GPUs. Because these functions can be performed in parallel on the GPU, a single unit provides both the capacity and speed required to deliver multiple simultaneous streams for the live broadcast. The result is a tremendous density advantage compared to CPU-only systems, and it allows WWE to deploy a single encoding platform to replace eight previously installed encoding units.

Once incoming video has been deinterlaced and the required video processing and compression functions are executed, multiformat live outputs are sent to a content delivery network (CDN) for distribution. Elemental Live's one-click CDN integration makes this step easy. The user interface exposes a drop down menu allowing the operator to simply select the desired distributor from a list. WWE opted to serve its programming via Akamai's streaming media service, sending its multibit rate Flash streams worldwide.

In addition to overcoming the speed and performance limitations of existing systems, the system also supplies compressed video with superior quality. Rather than relying on third-party technology, the system employs an H.264 codec developed specifically for the GPU instruction set. Even at very low bit rates, converted video retains the detail, true color and seamless scene changes that make for a broadcast-quality viewing experience.

Benefits

With Elemental Live, WWE is able to create all the streams needed for an ABR broadcast from one box. A single system provides an eight-to-one density advantage compared with other systems in the media organization's encoding arsenal. The system merges the benefits of a massively parallel hardware platform with the versatility and forward compatibility of intelligent software to give content providers a good price-performance ratio for video compression. Reducing the number of systems required for large-scale transcoding tasks lowers operations cost and overhead, and eases integration challenges.

ABR streaming is quickly becoming a technology requirement for content providers and distributors supplying video to Web-based devices. For its pay-per-view programming, WWE must encode live video into the format required for the Adobe Dynamic adaptive streaming protocol to display the highest possible quality video via the Web. With complete ABR support, the system allows adaptive streams to be delivered seamlessly to Akamai for playback on the WWE website. In addition, the system's flexibility ensures support for future video delivery standards and protocols.

Perhaps most importantly, the live action produced by WWE is brought vividly to life online using Elemental Live, successfully drawing a pay-per-view audience to the Web and extending the reach of WWE events. BE

Felipe Negron is vice president, WWE Interactive Technology.

S3 Group's StormTest

As DTV platforms grow, this testing tool helps providers with guaranteed validation.

BY JOHN MAGUIRE

Today's DTV offerings need increasingly complex content delivery platforms to maintain pleased subscribers. Content is now delivered across multiple different networks, including broadcast and broadband forms, and consumed on many more devices, both inside and outside the home. This creates a need for guaranteed validation of each platform to be completed by service providers. Some of these networks and device platforms are probably outside the immediate control of providers, which throws up additional new challenges such as how to guarantee QoS levels on third-party networks and devices.

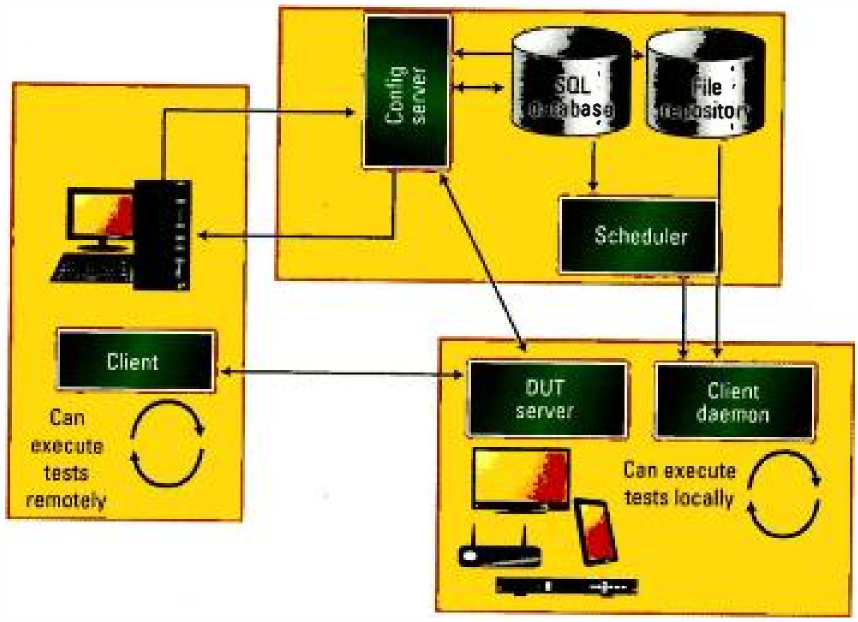


Figure 1. This shows the core software architecture of the StormTest platform. It consists of the Client, Configuration and Scheduling, and DUT subsystems. Only a reliable bandwidth IP connection between sites is needed to connect them.

Software subsystems

To address this evolving challenge, S3 Group has developed a range of products focused on the specific test and validation problem at different stages during the platform lifecycle. These are built on the core StormTest platform, which has been deployed for more than 30 customers worldwide. The majority of these have been DTV operators. The core software architecture of the StormTest platform is outlined in Figure 1.

There are three major software subsystems to the platform:

• The Client Subsystem software allows tests to be authored and dispatched for execution as well as detailed log results analysis;

• The Configuration and Scheduling Subsystem stores all the information required to dispatch tests at appropriate times to the devices under test and to gather results thereafter;

• The Devices-Under-Test (DUT) Server Subsystem controls access to the devices under test. It is paired with daemon versions of the client software to allow tests to be uploaded by clients and run locally with respect to the devices under test, irrespective of how remote the original client is.

Each of these subsystems can be located independently from each other with the only requirement being a reliable, reasonable bandwidth IP connection between each of the sites.

The Client software is typically located wherever test script development and execution is required. In some deployments, these clients have been taken off-shore in order to benefit from better cost efficiencies. In other cases, clients are deployed at multiple different geographic sites with shared access to central test servers that provide a global level of visibility into previously unavailable platform testing activity.

The Configuration and Scheduling subsystem is typically located close to the main IT infrastructure of the customer. As the central storage point for all test scripts, test schedules and results, it is often hosted on a dedicated, high-reliability server and integrated into the IT department's daily backup schedule.

The DUT Server subsystem is usually installed on servers in racks that also contain the DUT. This subsystem is normally located wherever an appropriate test signal can be found to feed to the devices under test. For some test scenarios, such as during new device or application development, test streams may be sufficient as input. This removes any physical limitation on where this subsystem must be based. More typically, however, access to the live signal being delivered by the DTV operator is crucial to the testing operation, and so this subsystem is installed somewhere physically within range of the operator's network.

In addition to these major subsystems, many other subcomponents and integration points shoul be considered in any real deployment. Integration with requirements management tools like HP Quality Center, issue and defect tracking tools like Bugzilla, and automated build systems like Hudson are common.

GUI-based tests

StormTest is a programmable system requiring test scripts to tell it what tests to run. Test scripts can be written using the high-level, drag-and-drop, GUI-based Test Creator or lower-level Python scripting interface. Often, users start with the GUI-based tool to get familiar with the system before moving to the Python level to program more-complex test cases. Any work done can be exported through the GUI tool to Python in order to get a jump start on their work.

Once the test scripts have been written, they can either be run remotely from the devices under test by executing them directly on the client machine, or they can be uploaded to the central Configuration Server for execution locally close to the devices under test.

Any work done can be exported through the GUI tool to Python.

Pros and cons exist to both approaches. Running them on the user's client PC allows rapid iteration of the test scripts during script development and allows users to see feedback from the test script as it executes. Uploading to the central system allows tests to be run automatically based on pre-set schedules without requiring the Client machine to be connected at the time of execution. This is useful for scheduling tests to run repetitively or at anti-social hours, but also can be used to ensure that any Ethernet network impairments between the client and the server don't impact the quality of the test performed on the DUTs by the server.

End-to-end maintenance

In addition to CPE-focused testing, StormTest is increasingly being used by clients during the development, automated test and ongoing maintenance of end-to-end DTV content-delivery platforms. In such scenarios, StormTest is still used to automatically interact with the CPE, but, in addition, the test scripts also use network interfaces to provide test stimuli at various other points across the content delivery platform.

This is to measure their impact on the service delivered to the CPE. S3 Group demonstrated this type of use in a collaborative project done with a number of other participants in the emerging EBIF interactive-TV market in the U.S. last year. In this configuration, StormTest test scripts were driving STBs to launch and interact with EBIF applications. (See Figure 2.) During this interaction, a number of options were selected that resulted in the cable headend executing transactions with other external application servers, e.g. completing simulated purchase of movies. Once the script finished its interaction with the application on the STB, it proceeded to connect directly to the external application server to validate that the transaction had been registered successfully. This completed the full, end-to-end validation of the entire EBIF platform and verified the correct operation of a large number of individual system components that had to interoperate in order for the test to pass.

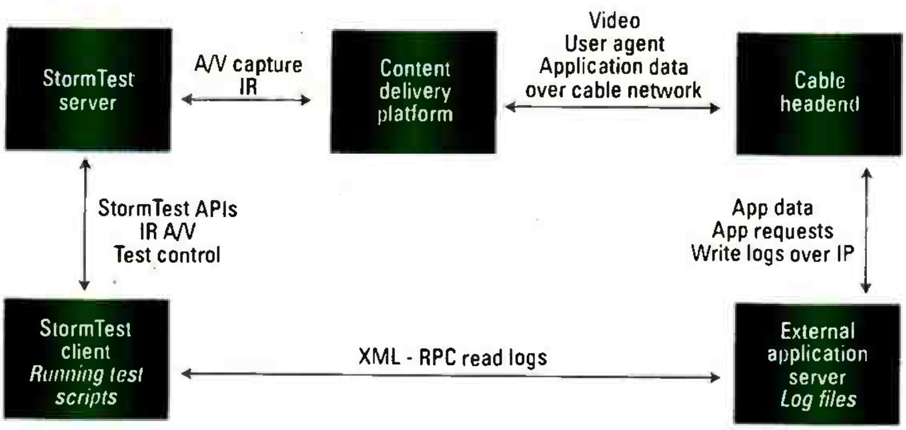


Figure 2. Within a collaborative project in the emerging U.S. EBIF interactive-TV market last year, StormTest test scripts drove STBs to launch and interact with EBIF applications.

As today's DTV operators evolve ever-more complex content delivery platforms, the development and ongoing maintenance of these platforms will require an ever-increasing degree of testing and monitoring. Automation can play a vital role in delivering this while controlling costs. **BE**

John Maguire is the director of product strategy, S3 Group.

BSI's distributed RF system

The system ensures wireless reception for live production, such as the 2012 ESPN X-Games.

BY MICHAEL GROTTICELLI

One of the biggest challenges to producing a live multi-venue event is coordinating all of the wireless signals and getting them back to the production truck in a sustainable (and usable) fashion. This is no easy feat for events like a NASCAR race or ESPN's X-Games, where a myriad of wireless camera systems and audio signals must travel long distances and be brought back to a central location — without interference or the signals breaking up.

A company in Hanover, MD, called Broadcast Sports, Inc. (BSI) — which has worked on virtually every major sporting event in the U.S. — knows a thing or two about wireless transmission and reception.

When it was challenged with managing the signals from four separate venues for the 2012 ESPN X-Games at Buttermilk Mountain in Aspen, CO, it immediately knew the solution: deploy an "intelligent diversity, distributed receive infrastructure," whereby a ring of receive boxes is installed around a desired coverage area and picks up the signals of a camera or wireless mic crossing its path. The camera operator simply moves from one box to the next, and his or her signal is passed off between them and then on to a fiber transceiver (made by Ortel). The fiber transceiver converts the RF spectrum into light and then sends it via fiber cable to the BSI mobile unit on site. Crews then provide one clean feed of every camera and microphone at the event, and the director then chooses among them.

During the X-Games, BSI outfitted three separate "hoop" systems with a 3-D Toshiba FollowCam, monitor and transmitter for use during the SlopeStyle, Pipe and Big Air events. Three experienced skiing camera operators captured the action live in 5-D from the center of the pipe. For faster, downhill events like the Snowboarder X and Skier X, technicians attached a transmitter and remote control system to a FlyCam that operated along the course more than 30ft above the ground and traveled at speeds up to 75mph. The production team had full (remote) control of the pan, tilt and paint functions of the FlyCam rig from the ground.

BSI's "portable" RF infrastructure can include receive sites mounted on a series of booms and works with any DVB-T compliant wireless camera or mic transmitter.

Making sense of RF

Clay Underwood, technology development manager at BSI, said the system is actually made up of two parts: the ring of receivers and an intelligent diversity system that is used to select (at thousands of times per second) which bits of data they want to pass on to decode inside a dedicated BSI production truck on-site. These numerous feeds are then made available to the director overseeing the entire live broadcast inside the main production truck.

The unique BSI infrastructure can work with any DVB-T compliant wireless camera or mic transmitter. The receive boxes, developed and made by BSI, are capable of working within the 1.4GHz to 1.5GHz and 2GHz to 2.5GHz spectrum, depending upon what's available at the time. The box receives the RF signals at their native microwave frequency, downconverts them to UHF, converts them to light, and using special hardware made by BSI (that performs filtering, amplification and other "magic") brings two discreet slices of spectrum back to the truck over a single-mode fiber cable.

In the case of the 2012 X-Games production, each element was composed of two signals — one 2-D (left eye) and one 2-D (right eye) signal — that together deliver the 3-D experience. To save on production costs, ESPN has pioneered new ways of acquiring footage for both live telecasts simultaneously. (ESPN called it a "5-D" production, whereby it used the left-eye view as the typical HD telecast.) Sending the 3-D portion was not a problem, Underwood said, as in essence they were only sending a pair of synchronized 1080i59.94 HD signals over a receive infrastructure that is designed to deliver multiple elements. Ensuring that the signals were perfectly in sync at all times was a tougher issue to tackle.

"We spent several years developing a dual HD-SDI stream miniature transmitter that ensures synchronicity from MPEG-4 encoding through transmission and into decoding," Underwood said.

Intelligent RF switching

All of the hundreds of signals captured on-site are fed into a signal-processing card that makes the intelligent decision about where that signal is coming from and where it needs to be rerouted. The card also converts all incoming UHF signals to a single decodable ASI stream (from multiple locations). BSI typically brings racks of eight input receiver cards so that each one can receive signals from eight different sites. It can gang racks together using ASI switches, so the system can scale as needed. The system is also weather-agnostic, Underwood said, and has held up to harsh conditions in the past.

For the technical director in the truck, the BSI system appears seamless between locations. The camera operator (or wireless mic) easily moves from one coverage area to the next without losing signal strength or experiencing dropouts. Using fiber, the distance limitations of coax are eliminated, and Underwood said the BSI architecture can tolerate about a 4dB of loss in a run of fiber before you start to see the RF signal negatively affected.

BSI developed this "ground-based intelligent receive" capability for NASCAR about six years ago. At that point, it was using wireless cameras inside of the cars and — using a technique it calls "aerial repeating" — bouncing the signals off a helicopter circling overhead in order to get it back to the production truck. This method was tricky and expensive to get right every time, and there was a lot of trial-and-error for each venue.

The receive boxes (seen at the lower left, antenna upper right at track side) work within the 1.4GHz to 1.5GHz and 2GHz to 2.5GHz spectrum and, for NASCAR events, are located at strategic points around a race track.

"For the in-car cameras, we were using an analog system, and we couldn't tolerate the multipath artifacts and dropouts we were getting," Underwood said. "As soon we moved to a digital solution for the in-car cameras, we were able to build a ground-based solution because there, multipathing is not as big an issue."

Rock-solid reception

The system also works well inside buildings, allowing a camera operator to move (while continuously shooting) from the field to the locker room without losing a signal. In this case, a series of receive points can be set up along the route the camera operators is supposed to take. And multiple cameras can use the same distributed architecture.

After six years, Underwood said the system is mature and quick to set up. BSI has 13 production trucks in total, which are all pre-configured before they get to an event, and then the boxes are dropped on-site as needed. At the X-Games production, the company set up seven diversity receive sites around the four disparately located venues on Buttermilk Mountain, which took about two days to deploy and test the system. It worked perfectly for the entire four-day event in January.

Underwood said the "magic" of the system lies in BSI's intelligent diversity receivers, which use both maximum ratio combining and packet switching diversity. As long as you can get all of that RF spectrum back to the truck intact, the brains in the diversity receive system can handle it. BE

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

Backup and UPS power

Are you able to keep your facility from going dark?

BY JOHN LUFF

A few years ago, I visited a satellite transmission facility in a remote location that was designed to operate "off grid" if necessary for a considerable amount of time. In the event one of two sources of power failed, the UPS would take over and generators would immediately start. That might be too simplistic. If power dropped, a UPS system with literally thousands of lead acid batteries — occupying a room better suited for a Kmart — would support the facility for about 20 minutes at 3MW of consumption. At the same time, two turbine-powered generators would fire up and synchronize, and either could support the facility's full load. Just in case one of the generators failed to fire, or synchronization could not be achieved, a third turbine-powered generator was being heated by hot exhaust from the first two so it could start faster. In the ground, enough fuel was stored to keep the whole shop operating for a month, which was not a bad idea since skiing in this location is less dangerous than driving a fuel truck in the winter.

This serves to illustrate that we are highly dependent on the continuous supply of power our facilities require. But failure of the power to a facility is actually not a technology problem. It is, in fact, an economic problem. Our facilities do not exist to protect the public, and despite the introduction to the Communications Act of 1933, our facilities do not exist for the purpose of informing the public. They exist to make money, which is measured in minutes and seconds as much as in dollars.

It therefore follows that protecting power is in the economic self-interest of corporations involved in providing "broadcast" content, however you wish to define that in today's multiverse of delivery options. It falls to the technologists, those who generally read this magazine, to figure out a way to best protect the economic interests at stake by using available technology to keep power flowing.

Keeping the lights on

In general, like layered storage systems, power systems are intended to be both redundant and scaled in capacity relative to the intended usage and frequency of use. UPS, an option for power that is inherently dependent on input power, is a first option but cannot sustain the facility for a long period. UPS can be online at all times, leaving no latency to switch from one source to another. Generators can supply a full facility, but they cannot inherently come online until they "spin up" and stabilize. That stabilization period is dependent on the internal combustion engine warming enough to be reliable, which is the principal source of latency and the need for tertiary sources of power. The simplest redundancy, which is sometimes not possible, and often not considered, is to ask the local power company to supply power from two substations, greatly lowering the likelihood of simultaneous failures killing the input power.

I think the task of the technologist crafting a solution is to evaluate all options and make a recommendation on how to lower the risk. If the ownership has no ability to accept some outage, as was the case with the satellite facility I referenced, then the job is bounded mostly by dollars. If the chances of outage are related to the value of minutes lost in some defined time period, the engineering calculation is bounded by mean time between failures (MTBF) and mean time to repair (MTTR). In the real world, cases of budget insensitivity are few and far between. The usual question is, "What would it cost to provide reasonable protection?" The

In the event of a power outage, this VYCON VDC flywheel system coupled with a battery-based UPS provides Alabama Public Television with temporary power while the station's generator system fires up.

sane response might be, "What do you consider to be a reasonable cost?" I often tell clients contemplating a project to define either the problem to be solved or the budget, but not both at the same time. (See Heisenberg's Uncertainty Principal.)

UPS

People tend to think of UPS as a ubiquitously available option these days. The ability of small UPS systems to locate spots in a plant that need to be protected with high reliability has been used in many facilities. One common motive is to protect software-controlled systems that would take a considerable time to boot up after power failure. A modern video server with a large RAID array can take tens of minutes to return to life after a power failure, for instance. The maintenance of many small UPS systems is a headache, however. A centralized UPS with distribution to "spots" where it is needed solves that problem while leaving less flexibility for incremental change being facilitated.

The easy solution, and the one most likely to be understood by managers who are technology challenged, is using generators. Environmental requirements today make generators considerably harder to implement without referring to zoning restrictions and building code requirements for the management of fuel, noise control and exhaust dissipation. When possible, a generator is a great solution because it is relatively inexpensive and requires only one connection to the switch gear where "shore power" lands. But a large generator capable of holding the entire load of a large facility can still be expensive, and it begs for a redundant generator as an intellectually consistent recommendation. Obviously, the turbine generators I referenced would provide a highly reliable solution, but at an astronomical cost.

Alternatives

Other solutions deserve mention, of course. Battery technology has been rapidly evolving in no small measure due to research into solar and wind power. A UPS system with both shore power and solar (or wind) inputs may well become an attractive option when considering the movement to make facilities "green." The entire goal of a UPS is to store energy for later use, so it matters little where the energy comes from, except when considering cost.

No discussion of storing energy would be appropriate without discussion of storing mechanical energy. Today, even race cars use rotating mass to store energy and then release it to electric motors to both reduce fuel consumption and power past competitors. In our world, a number of companies make systems that use shore power to spin up rotating mass energy storage systems. In the event of (certain, eventual) power failure, the stored kinetic energy of the considerable rotating mass runs a generator that replaces the lost shore power just like a battery-based UPS. There may be fewer environmental concerns with this approach than large battery-based UPS systems that require proper ventilation, at a minimum, by code. In general, rotating mass systems supply short-duration power replacement. Both battery-based systems and rotating mass systems claim better efficiency. Sounds like a lot of claims in our media industry doesn't it? Nothing is certain except that power will eventually be interrupted. BE

John Luff is a television technology consultant.

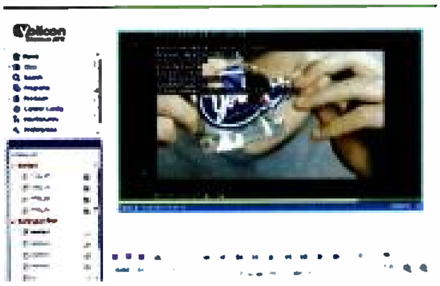
Send questions and comments to: john.luff@penton.com

Snell — Vega

Routing platform is now available in a 192-port, 4RU version; allows users to configure any signal port independently for fiber or coax (copper) connectivity; enables any port to be configured as either an input or output; asymmetric I/O port designation enables users to configure the router with just one input and 191 outputs, 191 inputs and one output, or any combination in between; offers a full range of options — dual crosspoints, dual controllers, dual power supplies and dual fans — all of which are hot-pluggable or replaceable.

www.snellgroup.com

Volicon — NAVE module



Nielsen Audio Video Encoder (NAVE) Decoding, Logging and Alerting module is designed for the Observer digital video monitoring and logging product range; ratings assurance tool enables broadcasters or networks to ensure proper transmission and delivery of NAVE codes to Nielsen monitoring equipment and, in turn, ensure ratings credit for advertisements; unlike standalone equipment, the unit affordably logs NAVE IDs along with the broadcast content.

www.volicon.com

Wohler — DVM line

DVM line has been expanded to include three new MPEG video monitors in larger dual-screen models; the DVM-5210 (shown here) is a 5RU system with two 10in screens; the DVM-4290 is a 4RU system with two 9in screens; the DVM-3270 is a 3RU system with two 7in screens; all of the monitors provide advanced test and measurement features for convenient at-a-lance monitoring of program content from 3G/HD/SD-SDI inputs and MPEG-2/4 ASI streams.

www.wohler.com

FOR-A — LTS-50

Storage appliance uses a linear tape file system (LTFS), which records video on tape as files and enables the reading and writing of files from a PC via FTP; can create original and duplicate copies with the installation of an external LTO drive; can be controlled through the company's LTR Browser software, and another optional proxy generator can be configured to automatically create low-res proxy files and thumbnails when archiving MXF files.

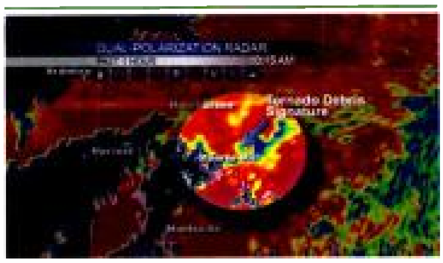
www.for-a.com

Primestream — FORK Production Suite

Now integrates with the Sony XCDAM Station family of professional media recorders; XDCAM Station users can now easily import content into FORK's media asset management software using the FORK Ingest module; in addition, users can now use FORK to control the XDCAM Station in both recording and playout modes, in effect adding master control playout and production automation capabilities to the XDCAM Station.

www.primestream.com

Weather Central — ESP:LIVE



Severe weather system has been enhanced to support new dual-polarization weather radar technology; with precise display of damaging hail, debris in tornadoes, improved flash flood warnings and more accurate identification of winter precipitation, the system is designed to enable users to better inform their viewers when severe weather strikes; features integrated posting to a station's Facebook and Twitter pages, hyper-local mapping and advanced storm tracking algorithms.

www.wxc.om

MultiDyne — FS-6000 Fiber-Saver

Portable CWDM remapper/multiplexer transports up to six digital optical or six SDI signals over a single fiber, allowing users to transport additional signals easily in situations where there is an insufficient amount of available fibers; can easily combine up to six uncompressed 3Gb/s SDI signals onto a single fiber, ensuring a pristine signal through the use of built-in reclockers; can be integrated with any fiber-optic broadcast equipment; works well with any digital optical signal.

www.multidyne.com

TSL — Touchmix Pilot Desktop Remote

Consists of a new Desktop Remote panel with rack-mount host unit; provides one-touch access to any analog or digital audio source material in mono, stereo or surround; allows for the adjustment of levels and balance; delivers the capability to mix together multiple sources; designed to be a complete system for lean-back audio monitoring; features the latest touch-screen technology.

www.tsl.co.uk

Front Porch Digital — LYNXdr

Secure, cloud-based, disaster recovery and long-term asset storage service; ingests file-based video content via networking and data tape shipment; users have the option of managing the ingest and restore processes manually from supplied software, or automating the processes to make ingest and restore invisible and seamless background tasks.

www.fpdigital.com

AJA Video Systems — Ki Pro Mini v4.0

New firmware for the Ki Pro Mini compact field recorder offers support for the Avid DNxHD video codec, thereby enabling further production efficiencies to Avid Media Composer family users; support for Avid DNxHD allows video editors using Avid editing systems to simplify their workflows and improve image quality throughout the editorial process.

www.aja.com

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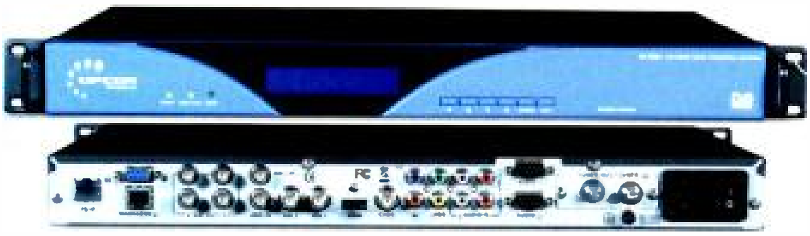

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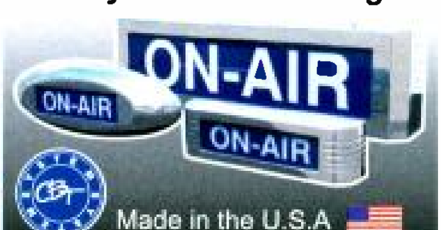

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Broadcast Engineering, May 2012, Vol. 54, No. 5 (ISSN 0007-1994) is published monthly and mailed free to qualified persons by Penton Media, Inc. 9800 Metcalf Ave., Overland Park, KS 66212-2216. Periodicals postage paid at Shawnee Mission, KS, and additional mailing offices. Canadian Post Publications Mail Agreement No. 40612608. Canada return address: Bleuchip International, P.O. Box 25542, London, ON N6C 6B2. POSTMASTER: Send address changes to Broadcast Engineering, P.O. Box 2100, Skokie, IL 60076-7800 USA. CORRESPONDENCE: Editorial and Advertising: 9800 Metcalf, Overland Park, KS 66212-2216 Phone: 913-341-1300; Edit. fax: 913-967-1905. Advert. fax: 913-967-1904.

Strange bedfellows

Politicians have a check in one hand and noose in the other for broadcasters.

BY ANTHONY R. GARGANO

It is a presidential election year — the quadrennial event that all broadcasters look forward to with great relish. For many broadcasters, it is their version of "Black Friday" — a day given its name because retailers, after spending all year in the red, look forward to the day after Thanksgiving to kick off a month that typically provides one-quarter to one-third of the entire year's sales and all of the year's profits. For broadcasters, an election year represents an enormous opportunity for ad sales for political commercials and, in recent elections, even the purchase of entire blocks of time by a candidate or their campaign committee in order to maximize face time opportunities to sway voters and sling mud.

Each successive election seems to rise to new heights of campaign spending. President Obama and the Democratic Party have a stated goal of raising a $1 billion election campaign war chest. Surely, the Republican Party will not be outdone and is certain to be as equally as aggressive with its targets. This is all music to broadcasters' ears, as much of this war chest money will be spent for ads and air time. Having spent most of my career as a technology provider, I know from experience how vendors also look forward to presidential election years as increased revenues to broadcasters mean higher capital budgets and increased equipment purchases. It's a winning time across the industry.

One might conclude, then, politicos and their campaigns are good and will make us profitable. Right? Well, wait just a minute. Aren't these the same politicians who lust after our frequency allocations? That broadcasters will lose additional frequencies is a foregone conclusion. The only discussion is how much will be lost and what will remain to be sardined into. So, the politicos show up with campaign spending money in one hand and a noose in the other — campaign money to spend on air time and a noose to tighten around that spectrum windpipe until it is all but closed. In pondering this relationship of such strange bedfellows, from a broadcaster's perspective, one cannot help but to recall a paragraph opening line from Charles Dickens' "A Tale of Two Cities": "It was the best of times, it was the worst of times."

Aren't these the same politicians who lust after our frequency allocations? That broadcasters will lose additional frequencies is a foregone conclusion.

The spectrum grab romp in Washington is an interesting one to watch. With a former FCC chairman on the board of a company contracted by the current FCC chairman to consult on incentive auctions, it would appear that broadcasters aren't the only ones with "networks." But, of course, it is not just limited to broadcast; the Washington "old boys" network stretches far and wide, and encompasses both political parties. We have a former FCC chairman who is now the president and CEO of the NCTA, with another former chairman on the board on Intel. Commissioners seem to do pretty well also. Not four months after voting in favor of the takeover of a major broadcast network by one of the nation's largest media conglomerates, a commissioner accepted a position as a government affairs executive for that very same media conglomerate.

Certainly, the broadcast community had its opportunity for a "network" connection. When Eddie Fritts ran into an unhappy TV board in 2005, he was forced out and was replaced by none other than the head of the National Beer Wholesalers Association. You can't make this stuff up. Wow, what a great fit that was! Predictably, it wasn't long before the brew went flat, and the NAB had another shot at bringing in a new leader. At least this time they went for a Washington insider and a former senator. But, given the loggerheads relationship between broadcasters and the FCC in recent years, one wonders why not play the Washington game to its fullest and try to attract a former FCC chairman to the spot. Gee, in a crunch, perhaps even just a former commissioner might have considered taking the job.

Well, it is a democracy. Washington will always be Washington, and politicians will always be politicians. As one of my heroes, Winston Churchill, famously stated in a speech to Parliament: "Democracy is the worst form of government, except for all those other forms that have been tried from time to time." Here's hoping your incentive auction check is a large one. **BE**

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

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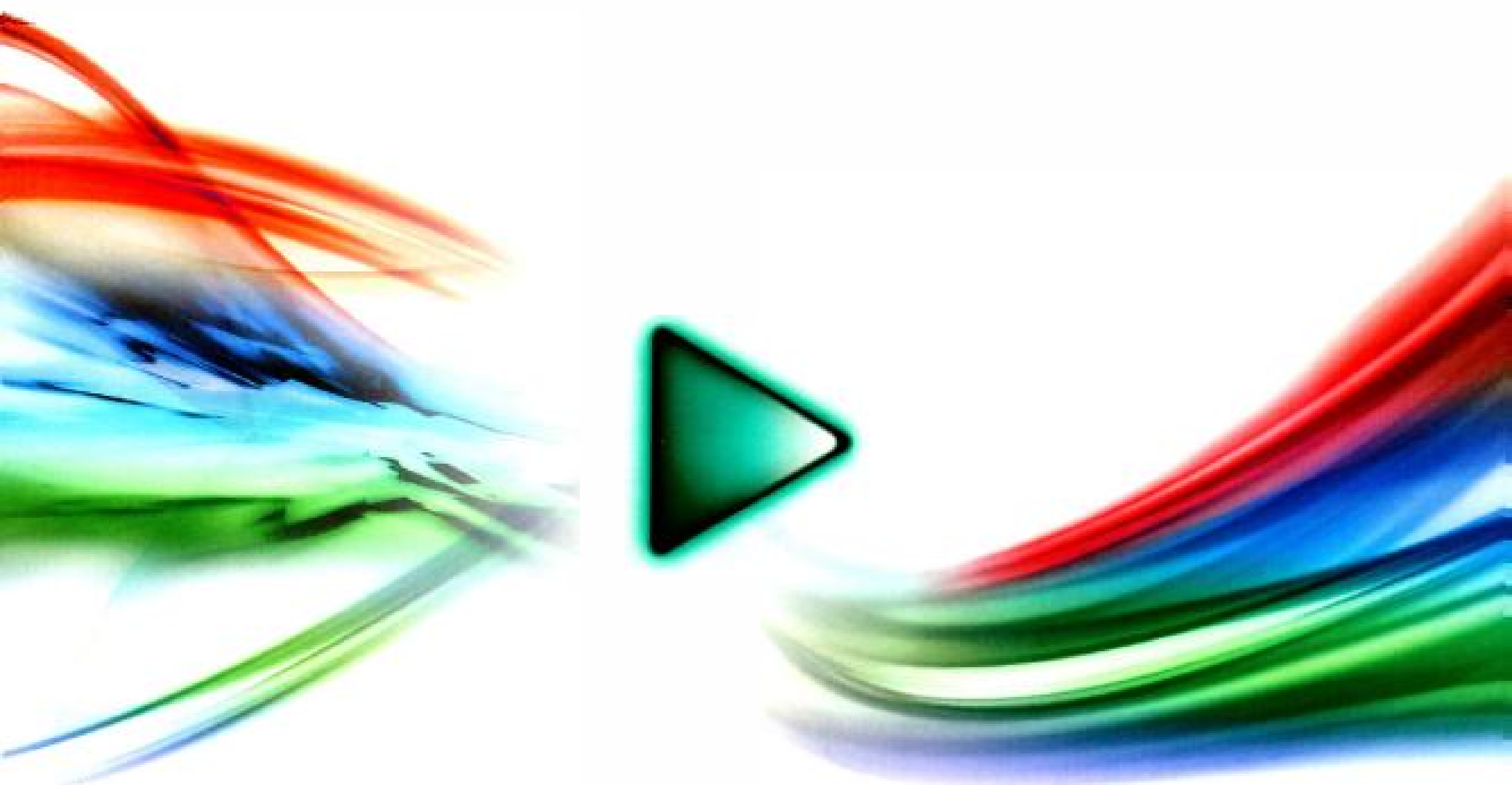

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