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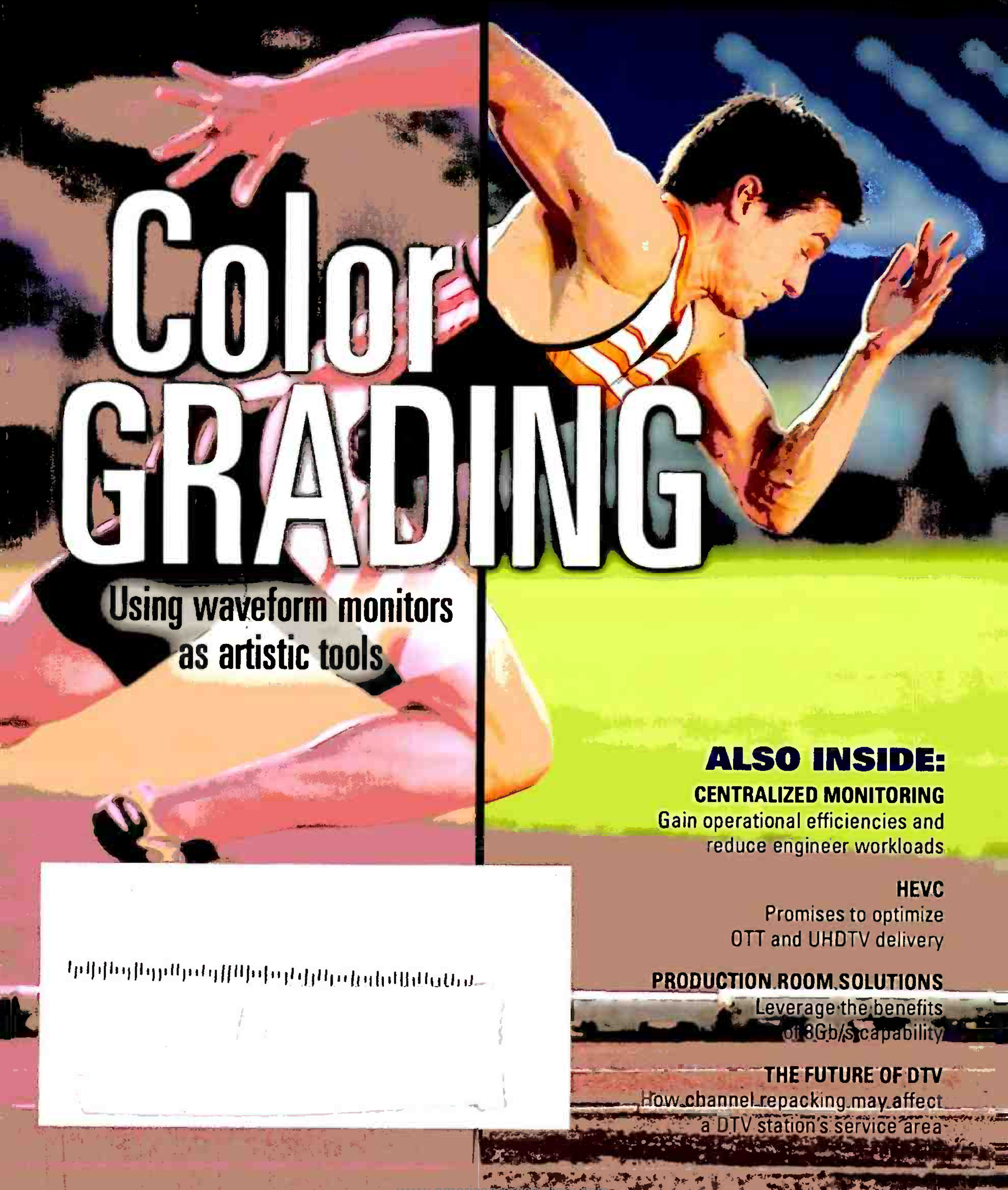

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Using waveform monitors as artistic tools

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Promises to optimize OTT and UHDTV delivery

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BOSTON

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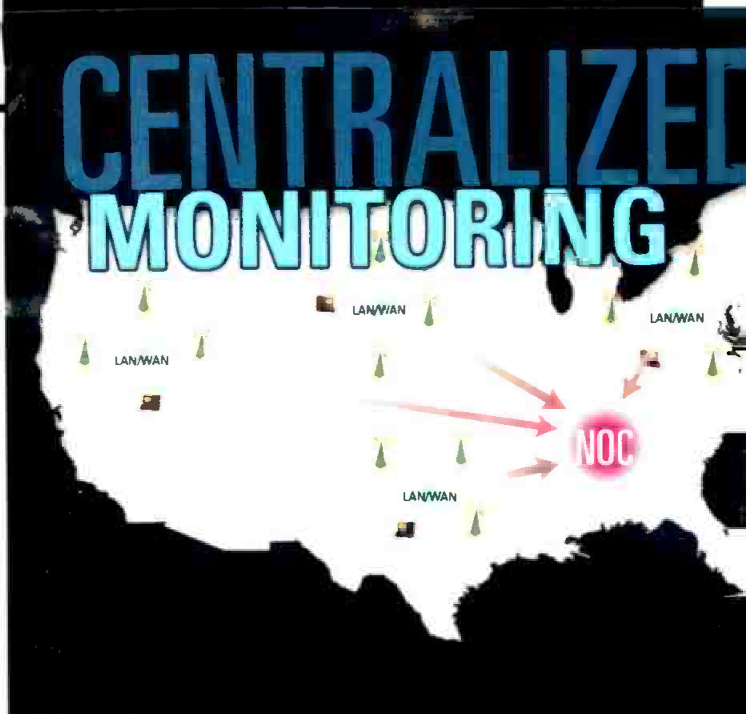

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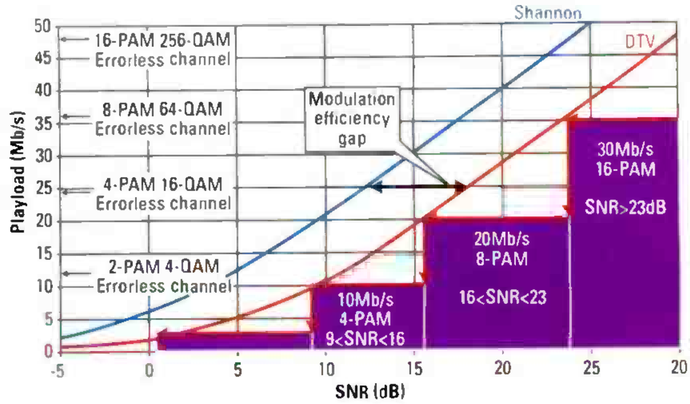

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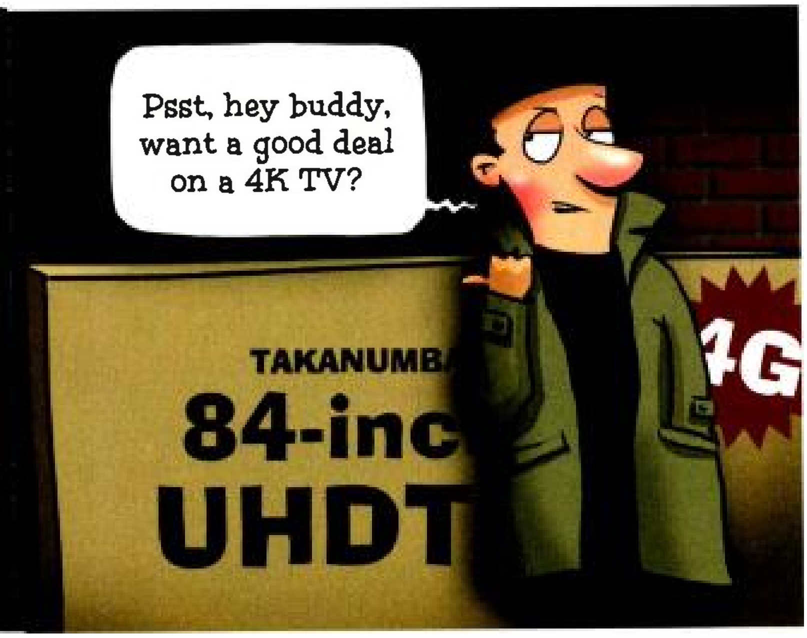
UHDTV: A bridge too far?

Without a doubt, the top theme at this year's NAB show was 4K. There were 4K cameras, video routers, recorders, multiviewers, fiber, projectors, slo-mo systems, 4K cine lenses and, of course, 4K editing, grading and production systems. Wow, with all that stuff available, why would anyone buy yesterday's 3G and HD equipment?

Maybe because hype from the Consumer Electronic Show (CES) doesn't quite glaze the eyes of video professionals at the NAB Show. Sure, vendors at NAB are only too willing to meet perceived demand, lest they get caught behind the technology curve. They want to show their technology capability. But, are the demos real?



Let's look a bit closer at the 4K, or UHDTV, phenomenon. Launched at this year's CES show, it quickly became the dominant theme. Television-set vendors were eager to demonstrate their latest iterations of UHDTV. About the only thing these new, larger TV sets don't claim to do is to grow hair on bald guys and magically reduce a person's weight.

The basic theme is that a UHDTV displays 4X the resolution of a standard HD TV set. At CES, many displays were as large as 84in, with one vendor highlighting a 152in plasma display. Why is there such a rush to UHDTV? It is because bigger sets equal higher profits.

So, is the U.S. marketplace rapidly moving to UHDTV? No, and outside China, penetration may be painfully slow.

According to the publication *DIGITIMES*, the penetration rate of UHDTV (3840 x 2160) TV-panel shipments may reach 20 percent in 2013, but only because of high demand from China-based TV manufacturers making sets for domestic consumption. China-based TV vendors have reportedly been placing orders for UHDTV panels from manufacturers (such as Innolux Corporation) in sizes ranging from 39in to 85in. Another panel maker, AU Optronics, is said to have received orders from vendors for UHDTV panels sized 55in and 65in.

There are two things to keep in mind about these reports. First, these Chinese TV-set makers are basing their orders not on U.S. sales, but Chinese consumption. Second, the UHDTV panels cost about twice as much to manufacture as do standard HD displays.

And, here's just a final dose of reality before you drop money for a full 4K plant. It is true that HD is the standard technology for American viewers. More than 75 percent of U.S households now own an HDTV set. According to Nielsen, that's up 14 percent from last year, and the research firm says nearly 40 percent of those homes have multiple HD sets. Do you think those set owners will be eager to replace their "young" TV sets, even for 4K resolution?

The adage, "You can lead a horse to water, but you can't make it drink," echoes with 4K. Despite virtually all OTA stations transmitting some HD, and 61 percent of all prime viewing is done on an HD set, that doesn't mean the viewer is getting HDTV imagery. According to Nielsen, only 29 percent of English-language broadcast prime viewing and 25 percent of cable prime viewing was in "true HD." If you're watching shows like "Dukes of Hazzard," they probably are not HD.

All of these issues mean that we still have a gap between HD potential and true HD viewing, and that may be a wide river for consumers to bridge. If so, does that, for now, make UHDTV a "bridge too far"? **BE**

Brad Dick

EDITORIAL DIRECTOR

Send comments to: editor@broadcastengineering.com

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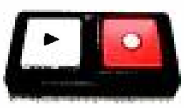

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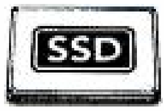

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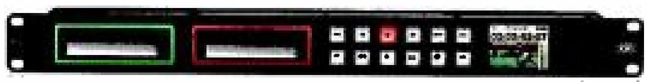

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HEVC

The compression technology promises to optimize OTT and UHDTV delivery.

BY DR. PAUL HASKELL AND THIERRY FAUTIER

As consumers increasingly view live and VOD television on a broader range of IP-connected devices, broadcasters are struggling to deliver these high-bandwidth services. However, a new video compression standard called High-Efficiency Video Coding (HEVC) promises to ease broadcasters' pain. Using HEVC, broadcasters can reduce the data rate needed for high-quality video coding by approximately 50 percent over the current MPEG-4 standard, enabling them to deploy higher quality OTT video services using the same amount of bandwidth.

In addition to improving OTT delivery, HEVC also has the potential to support a broad range of current and future applications, including 4K x 2K UHDTV, making it an exciting technology that pushes the consumer experience to the next level. (For more information about 4K UHDTV, read the ITU recommendation on the technology, available online at *www.itu.int/net/pressoffice/press_releases/2012/31.aspx*.)

Evolution of compression

An uncompressed HD video signal consumes approximately 1.5Gb/s to 2Gb/s of bandwidth. In the 1980s, when video compression was in its infancy, the goal was to compress this down to 130Mb/s. Today, content providers are able to encode HD video between 5Mb/s to 10Mb/s using H.264/MPEG-4 AVC, depending on the quality target resolution and encoding scheme (CBR or VBR). HEVC is designed to push that envelope even further by reducing the bit rate of MPEG-4 by 50 percent, as shown in Figure 1.

But, before discussing the improvements of HEVC, it is important to understand the key technologies that HEVC builds on. MPEG-2, in the broadcast and entertainment TV world, was a huge success. It offered full SD quality at 4Mb/s, but the industry quickly realized that MPEG-2 could also enable HD for bandwidth-sensitive networks. Using MPEG-4 AVC compression, it became affordable to transmit HD to the home.

To profile or not to profile?

A significant portion of the standardization effort has been spent debating whether the compression gains of various compression tools justify the tools' complexities. What we learned during the development of H.264/MPEG-4 AVC technology is that, although a Baseline profile (no CABAC and no B frame) was recognized as a good technology trade-off in 2002, those restrictions didn't pay off in the long run. In 2012, with the standard in full swing, some phone and tablet silicon manufacturers decided to implement only that profile, preventing additional savings of approximately 20 percent to 30 percent in the mobile network, a substantial amount of wasted bandwidth. Additionally, it forced operators to encode, store and serve two different profiles, depending on the device capability.

Benefits of HEVC

HEVC achieves improved coding efficiency by introducing additional tools to exploit spatial and temporal correlations. Specifically, HEVC incorporates enhanced motion-compensated filtering, multiple coding block sizes and expanded loop filters, including de-blocking, sample adaptive offset and an adaptive loop filter.

Some of the key improvements in HEVC are due to the use of larger block sizes, making the standard well-suited for 4K x 2K UHDTV. The larger block sizes enable more efficient coding of large images, especially of regions with few changes in the picture content. Improved intra-frame prediction enables better prediction of pixels by exploiting redundancy within the current frame. The proposed tools offer more prediction

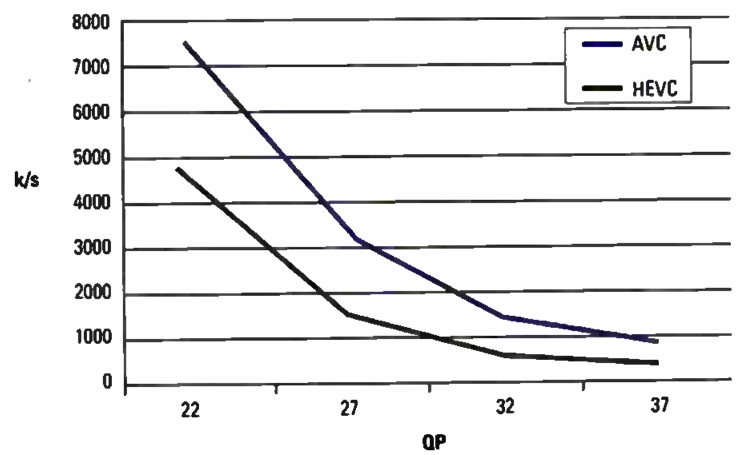

Figure 1. This reduction curve shows bit-rate savings between H.264 and HEVC.

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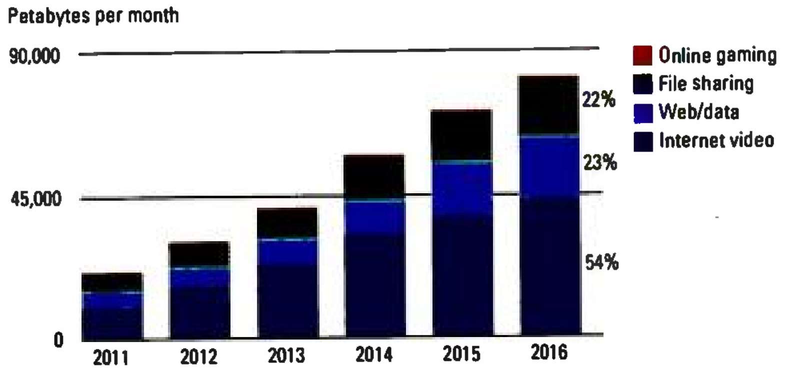

Figure 2. This chart shows video contribution to Internet traffic (Cisco VNI May 2012). HEVC is expected to have a significant impact on OTT video delivery.

directions than AVC, and a more sophisticated way of predicting and coding the intra mode selected.

HEVC also directly addresses the banding problem that can be seen with H.264/MPEG-4 AVC, whereby contouring artifacts appear when coding flat or smooth image backgrounds. An internal increase in precision (greater bit depth) adds greater accuracy to internal calculations. These extra bits help to prevent the banding.

In addition to these benefits, HEVC offers support for interlaced video so that content providers can efficiently compress, store and transmit decades of legacy content. In the future, HEVC may include support for multiview video coding or stereo 3-D video, combined with scalable video coding, enabling a video stream, sequence or image to be represented in multiple ways and multiple formats. This ensures that content can be prepared in different resolutions, frame or bit rates, for viewing on any device, such as an HDTV or smartphone, all while retaining a high level of coding efficiency.

HEVC applications

HEVC has the ability to significantly affect next-generation HDTV displays and content-capture systems that feature progressive scanned frame rates and display resolutions up to UHDTV.

Another application for HEVC is a fixed-point contribution environment, such as newsgathering, live events, sports and concerts, where bandwidth is typically restricted. By replacing today's MPEG-2 or AVC equipment with HEVC technology, broadcasters can reduce the bit rate to cost-effectively deliver more content at a higher quality.

Possibly the biggest application for HEVC is OTT video delivery. Video is expected to represent more than 50 percent of Internet traffic by 2016, as shown in Figure 2, so a reduction of 50 percent of the video bandwidth will have a tremendous impact on the video experience and on the video business model.

Deployment timeline

The HEVC standard is currently under joint development by the ISO/IEC Moving Picture Experts Group (MPEG) and ITU-T Video Coding Experts Group (VCEG). MPEG and VCEG have established a Joint Collaborative Team on Video Coding (JCT-VC) to develop the HEVC standard. A final version of the HEVC standard is expected in early 2013, with approval following in mid-2013. With regards to international adoption of the standard, French media regulator CSA has announced that it will mandate HEVC for 4K x 2K video services starting in 2016.

The first deployments for HEVC are expected to be used for the delivery of HD OTT, and will take place after encoding and decoding equipment is commercially available, approximately in 2014. UHDTV and contribution are other attractive applications that will take more time, as it is a more radical change on the broadcast ecosystems. BE

Dr. Paul Haskell is VP, R&D, Harmonic, and Thierry Fautier is senior director of convergence solutions, Harmonic.

? Send questions and comments to: editor@broadcastengineering.com

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The UTAH-100 family of routing and distribution products from Utah Scientific has a well-earned reputation for value, performance, and reliability. Two new members of the family are adding ***flexibility*** to the list.

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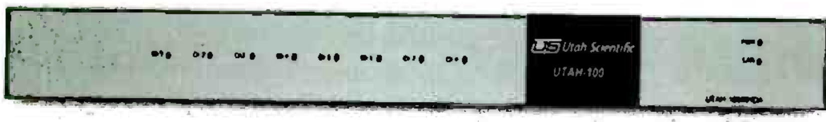

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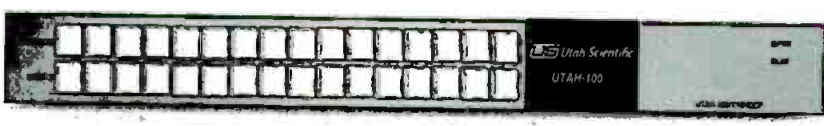

The UTAH-100 family offers a wide selection of routers in all signal formats in sizes from 8x8 to 32x32 with standard built-in web control and options for built-in or remote control panels, third-party control interfaces, redundant power supplies.

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Interactive video

New technologies turn video into a new revenue stream.

BY ALDO CUGNINI

Interactive video as an opportunity for generating revenue still eludes broadcasters, in some part because of limits of the existing broadcast standards. This is about to change, with the advent of various new technologies that will add interactivity in a backwards-compatible fashion.

NRT content delivery emerging

In the U.S., ATSC has endeavored to use Europe's Hybrid Broadcast Broadband TV (HbbTV) and Open IPTV Forum (OIPF) functionality for interactivity. The OIPF has defined an end-to-end solution to allow any OIPF-compliant consumer device to access enriched and personalized IPTV services.

ATSC adds the concept of OTA NRT content. The simplest of these is an ancillary program service, where programmers can break out of the "multicast" paradigm and supply a library of programs and supplemental information to the viewer. NRT also makes it possible to push content to other devices in the home, by embedding special triggers in the broadcast stream.

Advertising content can be similarly augmented by additional interactive information such as demographically targeted and telescoping ad services.

NRT is currently envisioned as supporting three service categories:

- The *Browse and Download service* essentially provides content "ordering," where the content is to be downloaded later, similar to VOD.
- The *Push service* provides an ongoing automatic update of previously requested content, similar to an RSS feed.
- The *Portal service* is similar to Internet browsing, where content is downloaded, stored and available to the user, usually in near real time.

Although the NRT content essence is produced and controlled by the broadcaster, the look and feel of both the Browse and Download service and the Push service is receiver-dependent. Unlike the other two categories, the on-screen appearance of the content provided in a Portal service is defined by the declarative content metadata.

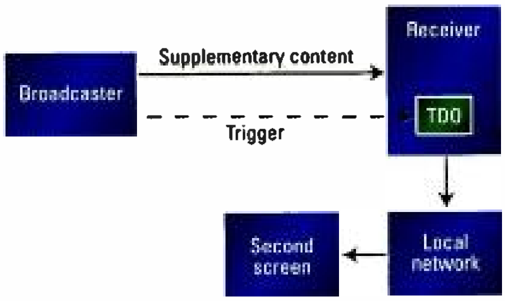


Figure 1. A triggered declarative object (TDO) could be used to push content to a second screen.

TDOs enable interactivity

A Triggered Declarative Object (TDO) is a downloadable software object created by a content creator or service provider. TDOs may contain program-related text, graphics, scripts and audio. TDOs are sent from a service provider and stored in the iDTV receiver. At a later time, one or more triggers are sent in the broadcast stream, signaling the iDTV receiver to carry out a certain action. (See Figure 1.)

Receiver manufacturers will be expected to provide users with a means for identifying NRT content availability. Receivers will provide different levels of functionality, including various codec and file-type support. For that reason, an NRT Baseline Capabilities Receiver Profile has been defined.

Competing in a media-rich world

Ultimately, NRT content delivery can provide the capability to define a consumption model that is "scripted," in which content provided by the NRT service provider establishes the "look and feel" of the user's experience of the service.

With various groups actively developing a next-generation broadcast system, interactivity is expected to soon become an integrated part of broadcast offerings. BE

Aldo Cugnini is a consultant in the digital television industry and a partner in a mobile video services company.

Send questions and comments to: aldo.cugnini@penton.com

ADDITIONAL RESOURCES

The following are available on the *Broadcast Engineering* website:

- Interactive services
- Interactive video — expanded
- Five ABC O&Os adopt interactive touchscreen technology for news presentation

Cyber attack

I was collateral damage in the cyber war.

BY BRAD GILMER

About a month ago, I became unable to access e-mail, and I was also unable to log in to some of my servers. The problem persisted for an hour or so and then cleared up. A few days later, the problem reoccurred. Since the servers are located remotely, and since I was unable to log in to the servers during the time of the outage, it was not possible to see what was going on in real time. I looked through various mail server logs and system logs but could not find anything that looked particularly out of the ordinary.

Finally, one day, the problem persisted for several hours. After several attempts, I was able to remotely log in to one of my routers, and after enabling the system monitor (on Cisco routers by issuing the *term mon* command), I started to see repeated buffer overflow messages. This was my first clue that something was wrong since a buffer overflow message from a router indicates that the router is having serious issues managing the amount of traffic present on its interfaces.

Next, I issued a *show process cpu history* command to the router to view a graph of router CPU load. I immediately saw that, for the past several hours, my router had been operating near or at 100-percent capacity. I used the *show if fa0/1* command to review statistics for the WAN facing interface on my router and noted that I had more than 7 million dropped packets in the last week. For some reason, someone on the Internet was directing a huge amount of traffic my way — so much that my router had failed to deliver seven million packets. I do not know how many packets were successfully handled by my router during the last week, but that number is probably hundreds of millions.

My first indication of what was going on came when I looked at where this traffic was directed — all at my Domain Name Server (DNS). What followed was a crash course in something called a DNS amplification attack — just one of the many weapons used in an increasingly hostile Internet environment.

Domain Name Servers are a critical part of the Internet. Humans use domain names to access servers on the Internet, but browsers and other applications use IP addresses. As Figure 1 shows, DNS servers resolve a domain name to an IP address. Any computer on the Internet may ask a DNS server to find the IP address for a particular domain name — broadcastengineering.com, for example. If the DNS server is authoritative for that domain, meaning that it is the original source of information about that domain name, then it will give the answer. However, a properly configured DNS server will not return an answer if it is not authoritative. If you ask the DNS server at broadcastengineering.com for the IP address of google.com, the *Broadcast Engineering* DNS server should not give an answer.

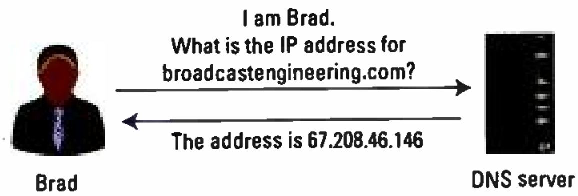


Figure 1. Any computer can ask a DNS server to find the IP address for a particular domain name. An answer is given if the server is authoritative for that domain.

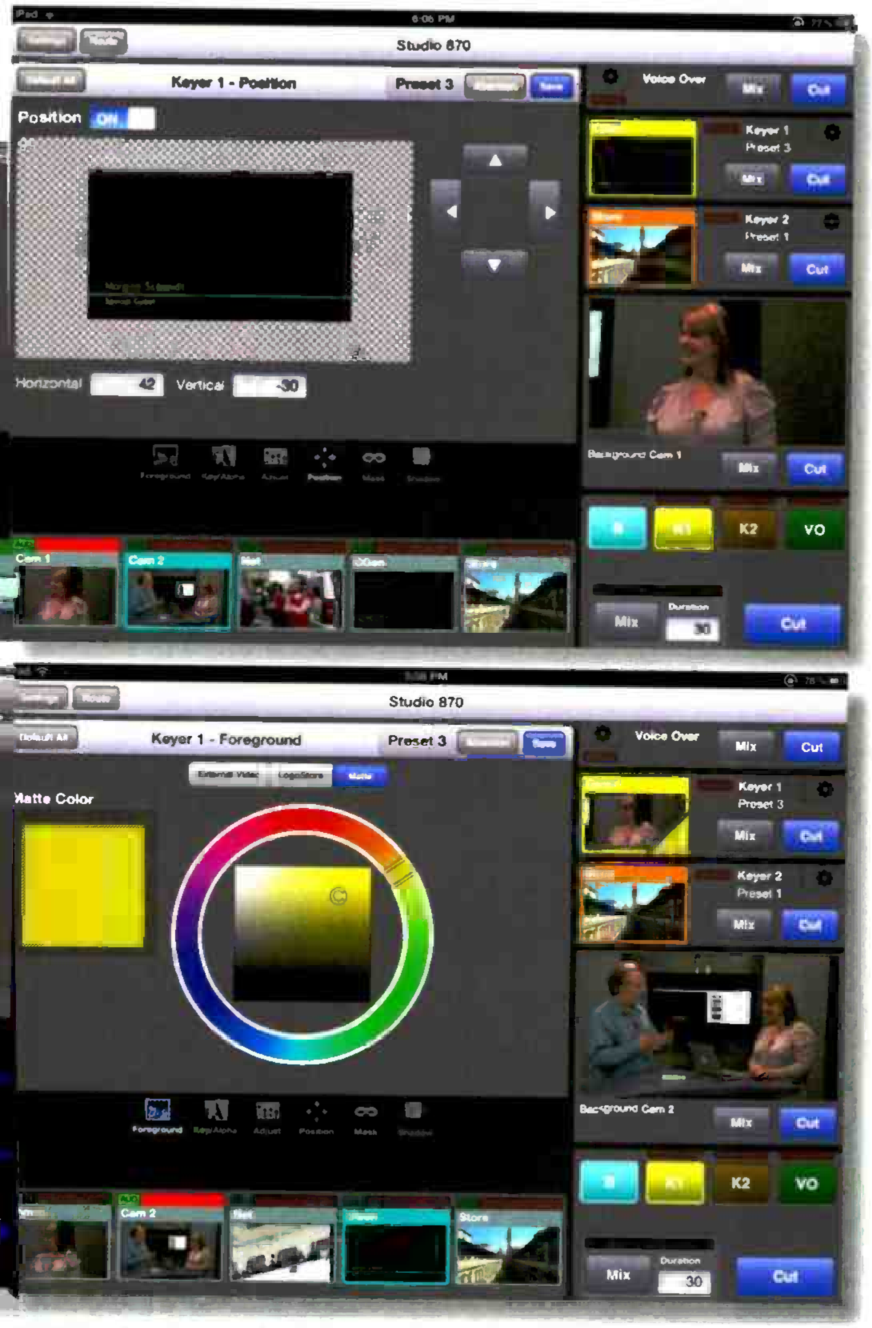
Some servers known as Recursive DNS servers will return an answer to a query even if they are not authoritative for the domain in question. They do this by making a quick look-up for the domain on another DNS server and then delivering the response back to the requestor. Unfortunately, I had misconfigured my DNS server to be recursive — a major mistake. (More on that later.)

If a user tries to view a website and the name server is slow to respond, then the end user perceives that the website is slow, even if the web server is functioning perfectly normally. For this reason, DNS severs tend to be fast servers connected to large pipes.

So, the question was: Why were bad guys out there directing a lot of traffic at my DNS server? If an attacker can figure out how to efficiently use DNS servers to direct a lot of traffic at a target, then they have an effective weapon in the cyber war. This is exactly what a DNS amplification

I do not know how many packets were handled successfully by my router during the last week, but that number is probably hundreds of millions.

Keying Is Believing



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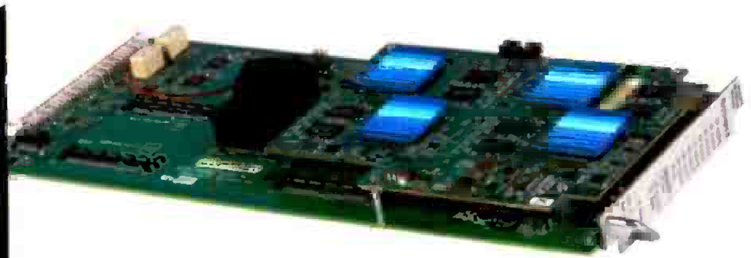

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attack does. By making a small query, an attacker can get a DNS server to respond with a large reply. This is called an amplification attack. To give you an idea of the amount of amplification that is possible, a 60B Extended DNS (EDNS) query can yield a response of more than 4000B — an amplification factor of 66.

But, if an attacker makes a small query and the DNS server responds to him or her with a 66X reply, that is not very useful. The final part of the attack is that the attacker spoofs the source address so that it looks like it is the victim. Now that all the pieces are in place, let's look at how the attack using my server worked.

As Figure 2 shows, an attacker sends an EDNS query to my server, but he or she spoofs the source address of the message so that it looks as if the query is originating from the victim. My server dutifully responds to the query, but instead of sending the reply to the attacker, my server sends it to the victim since my server thinks that it is the victim who is asking for the information. My DNS response shows up at the victim's IP address unsolicited. That really is all there is to it. Act like you are someone else, ask a small question, and watch them receive a huge reply.

My server was hit with similar requests from many different attackers. Someone operating a bot-net had instructed the computers to all attack the same victim.

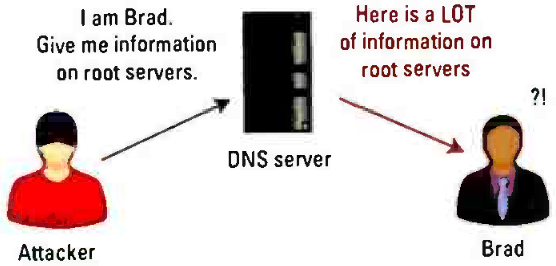

Figure 2. An attacker pretends to be a victim asking for a response. The DNS server then floods the real victim with a huge, unsolicited reply.

However, here is the rub: It is not a single attacker. My server was hit with requests from many different attackers. Someone operating a bot-net had instructed the computers to all attack the same victim. A bot-net is a federation of compromised computers, all commanded to execute commands remotely by people who control the bot-net. Bot-nets are comprised of many thousands of laptops, desktop systems and even computers at businesses. The one thing these computers have in common is that, at some point, people have executed programs on these computers that compromised their security, allowing the computer to be remotely controlled without the owner's knowledge. Analysis of my DNS logs showed that hundreds of computers were being used to generate thousands of requests per minute, all directed at the same target.

> **The DNS amplification attack is only one tool in the attacker's tool box. Attacks exist for every kind of server.**

What can a media company do to guard against having its name servers coopted into participating in a DNS amplification attack? The first thing is, if you operate your own DNS servers, ensure that your servers are not recursive, meaning that they will only answer for the domains you control. Second, configure the DNS server's firewall using the RATE command to ensure that if multiple requests come in from the same IP address in short order, then those IPs are automatically black-listed. Third, if you are using a Cisco router to connect to the Internet, consider enabling Unicast Reverse Source Path Forwarding or Unicast RPF. RPF limits attacks by verifying that the requestor is not spoofing the IP address.

I realize that there may not be even one reader who is operating his or her own DNS servers on the Internet. However, I expect that there are a number of media companies operating Web servers, e-mail servers and other systems that rely on Internet connectivity. The DNS amplification attack is only one tool in the attacker's tool box. Attacks exist for every kind of server. So, my hope is not that you will secure your DNS servers to keep from being an unwitting agent in an attack on a third party. It is to tell you about my real-world experience, to let you know that attacks are happening and to tell you to be vigilant. **BE**

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

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

ADDITIONAL RESOURCES

The following are available on the *Broadcast Engineering* website:

- Building IP-centric media data centers
- A tutorial on IP network addressing
- Network addressing

Future-proofing plants and trucks

3Gb/s is a great step for improving image quality.

BY STAN MOOTE AND RANDY CONROD

After many years, the transition to HDTV continues to roll out both domestically and worldwide. This major step in technology was the first wherein consumer industry products were capable of delivering higher-quality video than broadcasters were typically sending into the home.

Many broadcasters simply up-converted SD to get on-air for HD once digital transmission standards were settled for OTA, cable and satellite. Shooting in 16:9 fooled many viewers into thinking they were seeing HD. Certainly a full-digital 16:9 SD plant with a high-quality up-converter to HD creates stunning results, mainly due to never having encoded the video into NTSC or PAL analog domains. The switchover to digital bought broadcasters several years of avoiding expensive HD equipment upgrades.

As the technology shift continued, broadcast equipment manufacturers observed that camera sensors were being built for 1080p as a simpler method of making them selectable between 480i/576i SD and 720p/1080i HD resolutions through the use of internal processing algorithms. This foresight then drove the push toward building distribution and routing products to handle 1080p signals, as the feeling was that 1080p would ultimately become a driving force for display technology, too.

Today, 1080p is the norm for video quality in consumer products, with 3-D TV also in the mix. 4K sets are coming, but remain too far off for broadcasters to transmit anything beyond a few boutique channels — so let's hold this thought for right now and focus on HD.

1.5Gb/s infrastructure

HDTV infrastructures that operate at 1.5Gb/s support 480i/576i SD and 720p/1080i HD resolutions. To get the best quality for the 1080 lines of resolution, progressive scanning and two SDI connections are required. This dual-link connection — basically two HD 1.5Gb/s streams — has been extensively used in small, high-quality production environments for 4:4:4, fill and key, and most recently for left- and right-eye channels. Broadcast system designers prefer a simpler, more cost-effective single connection, so until this was a possibility, higher-quality production for broadcasters was considered cost-prohibitive and too complex to implement.

To better support 1080p, broadcast equipment manufacturers collaborated with SMPTE to upgrade HD-SDI from 1.5Gb/s to 3Gb/s. By agreeing to move exclusively to 3Gb/s infrastructure products, equipment manufacturers were able to push integrated circuit manufacturers to supply 3Gb/s parts at the same price as 1.5Gb/s. This set the stage for future-proofing plants for 1080p (and also for 3-D TV), but has this small step brought home viewers any better quality than they have seen before? Well, not yet. The reason is that current conversion, bandwidth compression and display techniques use deinterlacing and scaling technologies that affect the end video quality.

So how do we improve quality? The infrastructure exists today to eliminate the need for deinterlacing and scalers, so why not just start with 1080p?

Interlace vs. progressive

There were two choices when HDTV infrastructures at 1.5Gb/s were built: 720p and 1080i. The two formats generated a huge debate and almost religious wars.

Interlace was certainly great back in the CRT days, but we have moved well beyond this. The benefits of progressive scan — whether 720p or 1080p — are huge when it comes to production, processing and compression. To keep within 1.5Gb/s, we were clipped at 720p for HD; however, with 3Gb/s, we can easily jump to 1080p. Flat-screen TV sets are all progressive scan on the display side. When the input is interlaced, the TV sets convert the signal into the set's native display format with complex algorithms. This conversion causes artifacts because of the deinterlacing step required for progressive internal processing.

Level A	Direct mapping of an uncompressed 1080p video into the 3Gb/s serial digital interface
Level B-DL	Dual-link mapping of a 1080p video into the 3Gb/s serial digital interface
Level B-DS	Dual-stream mapping of two independent 720p or 1080i (or 1080p/≤30) video into the 3Gb/s serial digital interface

Table 1. 3Gb/s has three different mapping schemes.


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As the advent of 4K/Quad HD/UHDTV-1 leads us into the future, ATSC and DVB standards continue to evolve, incorporating 1080p and higher resolutions to keep pace with home display devices. However, unless a higher-quality video resolution becomes proven across the entire workflow, moving to 1080p over 3Gb/s infrastructures is the easiest and quickest step to improve broadcast video quality today.

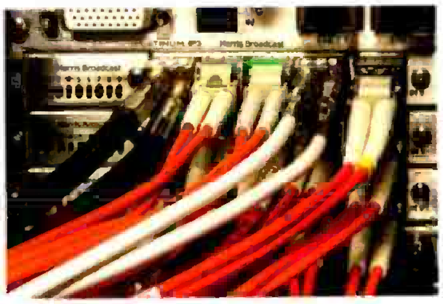


Figure 1. SFP technology allows for mixed-mode operation of both coax and optical in large 3Gb/s routing switchers.

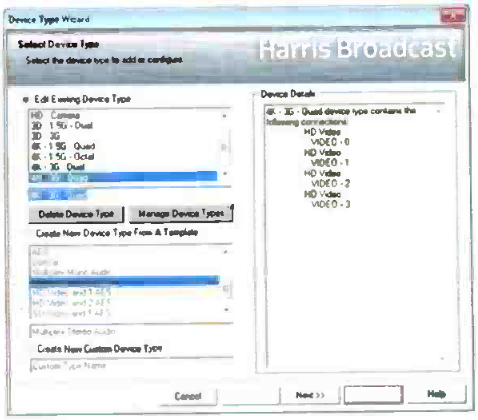


Figure 2. New 3Gb/s routers are future-proofed for new standards such as 1080p and 4K with drop-down configuration menus.

3Gb/s infrastructure

With the birth of 3Gb/s, various technical issues arose that would take advantage of the extra bandwidth, yet still be compatible with systems limited to 1.5Gb/s. SMPTE standards were developed, describing three different mapping schemes for transporting uncompressed video including ancillary data such as the audio data, the audio control packets, the payload ID, the time code, etc., into this new SDI interface running at 3Gb/s. These are defined as Level A, Level B Dual Link (B-DL) and Level B Dual Stream (B-DS). (See Table 1 on page 20.)

Level A carries one 1080p video signal. Level B-DL is formatted in the same manner as described above for building larger, more cost-effective, high-quality production systems. Level B-DS is able to carry either two different 720p or 1080i signals, or one left and right frame-aligned pair of 3-D TV signals running at 720p or 1080i.

Although these mapping schemes appear straightforward, it is important to ensure the streams are properly tagged, as many devices are not compatible with all three levels. Additionally, we can't forget about the embedded audio streams, especially in Level B modes. Be sure you know which streams you are actually using and modifying.

Cabling

Cabling is also an important consideration. In SD infrastructures, cable lengths over 1300ft are typical. 1.5Gb/s infrastructures have a shorter length of typically 500ft, with the latest technology providing up to almost 1000ft. For 3Gb/s, the length is typically 250ft, with a maximum 600ft made possible by using the latest technology. These cable lengths are dependent on the cable type and equalizer technology.

Fiber-optic technology is used when longer cable runs are required in a 1080p plant. Fiber is often thought to be highly complex, but this is far from the truth. IT usage of fiber has advanced the technology, and broadcast can tag on these improvements.

Additionally, a technology called small form-factor pluggable (SFP) now allows for deciding on the fly whether ports will use fiber or coax. In this mixed-mode environment, both optical fiber and coaxial type interfaces are used depending on the system design, which is typically decided on cable length requirements. (See Figure 1.)

For future-proofing plants, 3Gb/s certainly does the trick, and many infrastructure products are 3Gb/s-ready now. Some simply need software upgrades and have device control parameters set for various uses. (See Figure 2.) Notice for 3-D TV there are a couple of options to bind inputs and outputs together depending if running dual stream or combined. For future 4K considerations, different options are available for binding together two (dual) or four (quad) ports for different 4K frame rate options.

In summary, moving to higher quality across the baseband workflow is possible today by using image formats such as 1080p. Building a plant based on 3Gb/s infrastructure products is a cost-effective way to keep your facility up to date. By eliminating the video scaling and deinterlacing technologies that cause artifacts in the video image before distribution into the home environment, broadcasters can follow the price curves of IT fiber-optical technologies, future-proofing their facilities with 3Gb/s and bringing higher quality into the home. **BE**

Stan Moote is VP Business Development, Harris Broadcast, and Randy Conrod is Product Manager — Digital Products, Harris Broadcast.

Send questions and comments to:
editor@broadcastengineering.com

ADDITIONAL RESOURCES

The following are available on the *Broadcast Engineering* website:

- Future-Proofing Your Routing Requirements
- Building a 3Gb/s infrastructure
- Are 3-D and 3Gb/s the future of TV?

Broadcast DTV

The future is spectrally efficient, graceful degradation and higher payload receivable by hand-held devices up to the radio horizon.

BY ODED BENDOV

To begin, one should wonder whether the headline scenario is possible. Should the industry even look into it? The answer is yes, it is possible.[1]

Why is the DTV Transmitter-Receiver link model, made up of a rooftop antenna connected to an ideal receiver, a path without multipath that ignores diffraction loss at the radio horizon and ground clutter loss all around? The simple answer is that this model, a relic of 1950s analog television, was the only way to satisfy (only on paper) the demand from some broadcasters that digital HDTV reception be extended to the then analog Grade B contour. I can make this observation because I participated in the ACATS proceedings. The objective was clear: We needed an American DTV standard, fast. Broadcasters, not in a position to analyze true limits of the ATSC 8-VSB system, got the promised "coverage area" assurance they sought, and a new standard was off and running.

It didn't take long to realize, experimentally and theoretically,[2] that the ATSC standard was unsuitable for reliable reception by consumer devices with a rooftop antenna or even aided by DTS.

We now have the opportunity to do it in a way that will promote the growth of free OTA DTV before it succumbs to other wireless competitors with advanced capabilities.

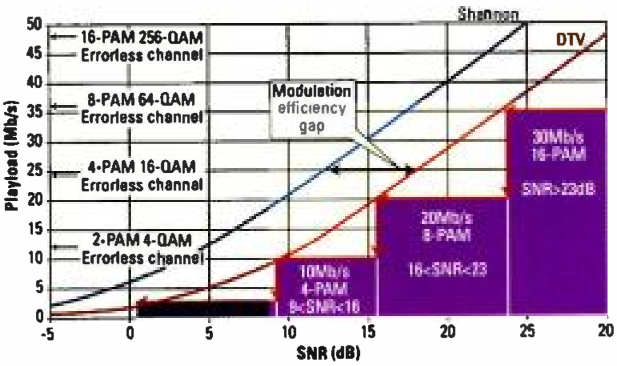


Figure 1. This shows what can be done, in principle, trading payload for SNR.

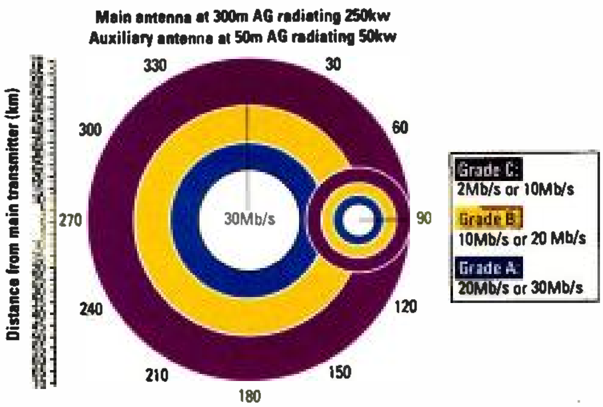


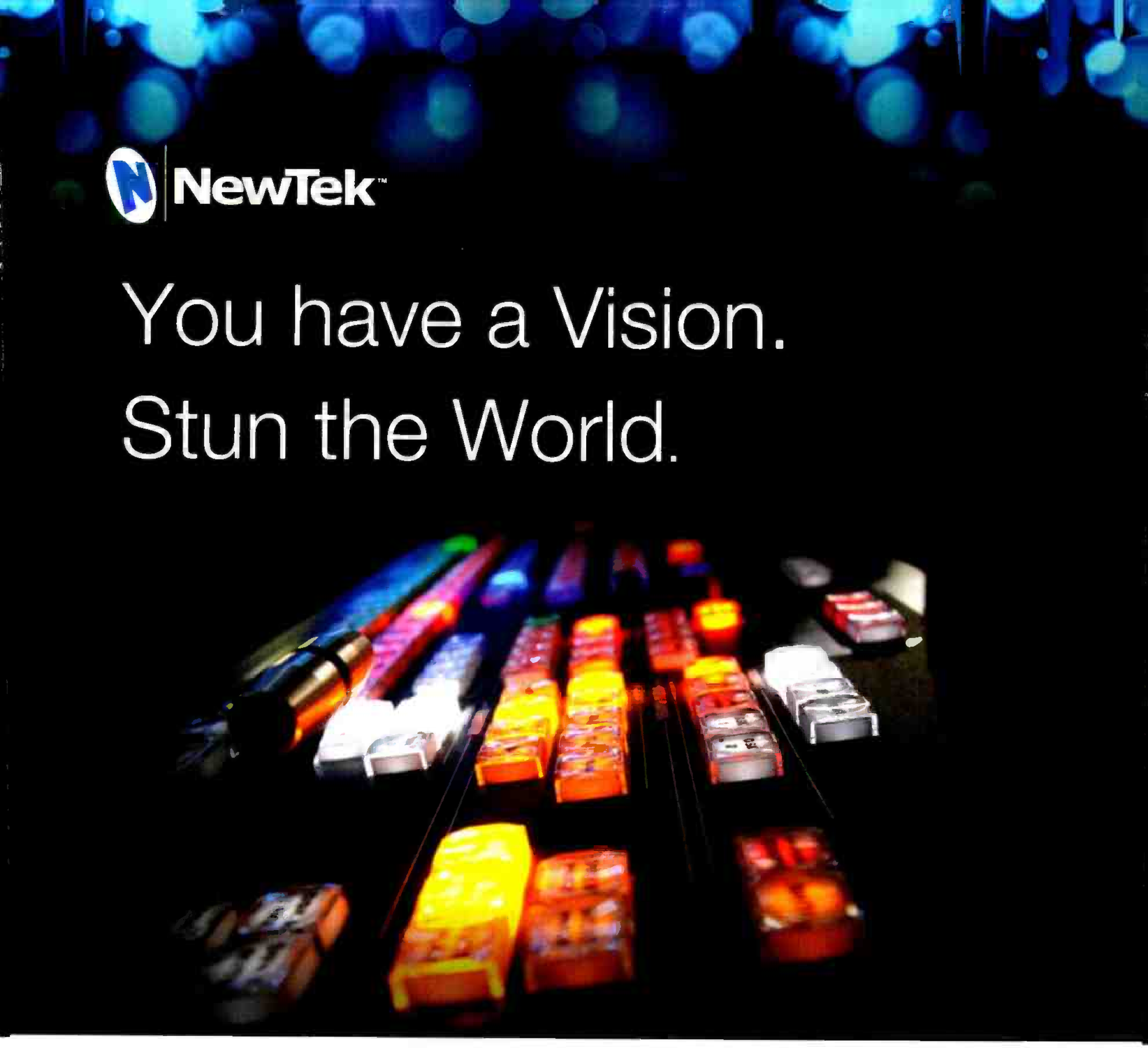
Figure 2. Higher payload up to the radio horizon is possible through low-power auxiliary transmitters on adjacent channels, each serving two main stations at half bit-rate.

Service or coverage

The service area is not the thermal-noise-limited contour used by the FCC to predict "coverage area" to well beyond the radio horizon, at which diffraction loss predominates and where solid reception by typical consumer installations was unlikely even in the analog-TV era. For DTV, service is important, not coverage. The decodable payload in the presence of multipath and interference quantifies the service, whereas coverage simply quantifies the incident signal without multipath and without interference. That was OK in the analog era because video and audio were never lost, just gracefully degraded. But, for DTV, service rather than coverage is of value, and the real service area is clearly limited by the radio horizon. The residual signal beyond the horizon may be a minor interference to the few who insist on reception in that area, but that should be of secondary interest to broadcasters. So, before we continue, we must accept this technical reality.

Who wouldn't want graceful degradation of DTV to replace the black screen? That would be one of several possibilities with a new standard. Look at Figure 1 for what can be done in principle[3], trading payload (Mb/s) for SNR (dB). Note how the capacity decreases with SNR, which in turn decreases with distance from the tower. The ATSC system was designed for SNR = ~15dB at the noise-limited contour. So, the maximum payload was set to ~20Mb/s, exhibiting a "cliff-edge" for lower SNR. But, as experience has shown, ATSC service is greatly impacted by real-world multipath. That's why it is not unusual for many consumer receivers within the coverage area to display pixellation or frozen video. With multicarrier (COFDM) hierarchical modulation, graceful degradation from high to low payload is one of several possibilities.

Better yet, how about higher payload up to the radio horizon? That too would be possible by adding low-power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auxiliary transmitters on adjacent channels, each serving two main stations at half bit-rate. In effect, each broadcaster would be getting 9MHz of bandwidth. This is not an SFN, and no synchronization of transmitters is required. (See Figure 2 on page 24.) There could be several auxiliaries on the same adjacent channels so long as they are shielded from each other by their radio horizons. Figure 2 was computed just to explain the ideal Quality-of-Service (QoS) contours using F(50,90) without interference and multipath.[4]

The DTV channels are now sparsely spaced, and OET-69 applies to only one interferor, the first adjacent channel. For packed channels, OET-69 is useless as it cannot be "fixed" for multiple interferors emanating from different antennas on different towers. To achieve spectral efficiency through closely packed channels, the FCC will have to mandate minimal specification on the linearity and dynamic range of the receiver, the weakest link between the broadcaster and the consumer, and also mandate SNR-controlled AGC.

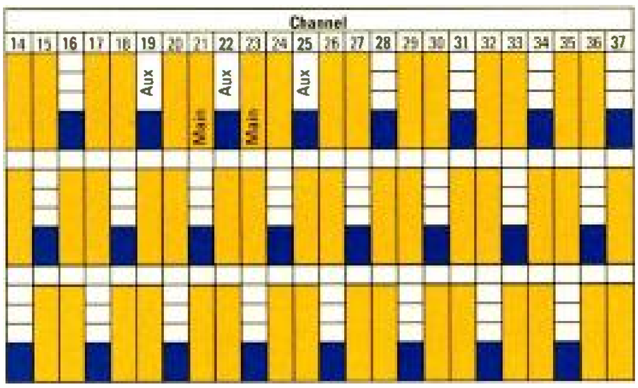

Figure 3. In some situations, a market may require 16 or more stations. This is an example involving 16 main and eight auxiliary low-power stations.

Channel repacking example

Most broadcast television markets can accommodate up to 12 full-power stations. However, a market may require 16 or more stations. One possible example of allocating 16 main and eight auxiliary low-power stations occupying 144MHz is shown in Figure 3. The main channels are grouped in pairs, in part because the popular and effective slotted-pipe antenna can accommodate two UHF channels. In the depicted allocation, Channels 23 and 26 receive the worst interference, mostly generated by the receiver's non-linearity.

There are seven interference components that must be accounted for in state-of-the-art receivers where the tuner is on a silicon chip and without inductive elements. These components include those from certain pairs and triplets of channels. The QoS contour map of Channel 23, including multipath and six of the seven sources of interference generated by the main and auxiliary transmissions,[5] is shown in Figure 4. (See page 28.) The receiver's linearity used for these results is comparable to that of a "good" existing DTV converter box.

Toward the East, Channel 23's SNR is degraded by Channel 22. In that area, the receiver can switch to Channel 22 at half rate and high SNR, which extends to the radio horizon.

One can add more interference or change the locations of the various towers and the transmitting antenna's patterns. These changes may shrink the high SNR contour and move the operating point on the SNR plot. But, as long as the carrier's pilots are detected, the SNR-controlled AGC then moves the operating point toward the area of maximum SNR. For a known modulation, the SNR contours are interchangeable with payload contours, and, for a given ERP and propagation algorithm, the X-axis can be

converted to distance away from the tower. Thus, a complete prediction of service in the presence of multipath and interference is possible. **BE**

Oded Bendov is president, TV Transmission Antenna Group.

FOOTNOTES:

1 You can read more about it in my filing with the FCC, docket 12-268: *http://apps.fcc.gov/ecfs/document/view?id=7022117651*

2 "Why are the ATSC-8VSB and M/H Standards Fundamentally Unsuitable for Next Generation Television Broadcasting and How to Painlessly Transit to ATSC/OFDM Network." Available at *http://www.tvantenna.tv/papers.asp*

3 I. Eizmendi et.al., "CNR requirements for DVB-T2 fixed reception based on field trial results," Electronics Letters, Vol 47, Issue 1, 6 January 2011. Data scaled to 6MHz channel.

4 A paper titled "Spectrally Efficient DTV System: A step-by-step Design of 1MW UHF System for Reception by Hand-held Devices up to the Radio Horizon," is in progress.

5 The seventh, triple beats, requires statistical approximation and is under review.

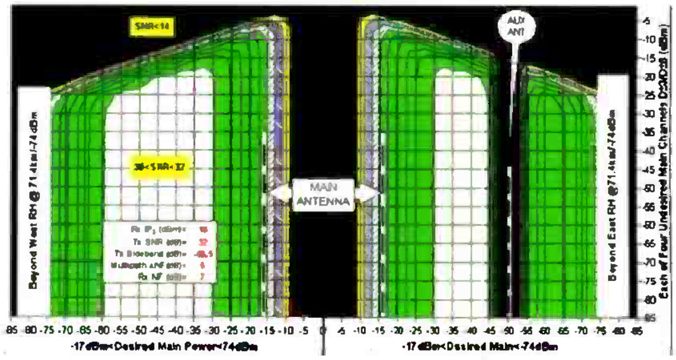

Figure 4. This shows the QoS contour map of Channel 23, including multipath and six out of seven sources of interference generated by main and auxiliary transmissions.

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ADDITIONAL RESOURCES

The following are available on the *Broadcast Engineering* website:

- Will LPTV survive after spectrum auctions?
- Will stations sell spectrum at auction?
- Major-market stations join to sell spectrum at FCC auction

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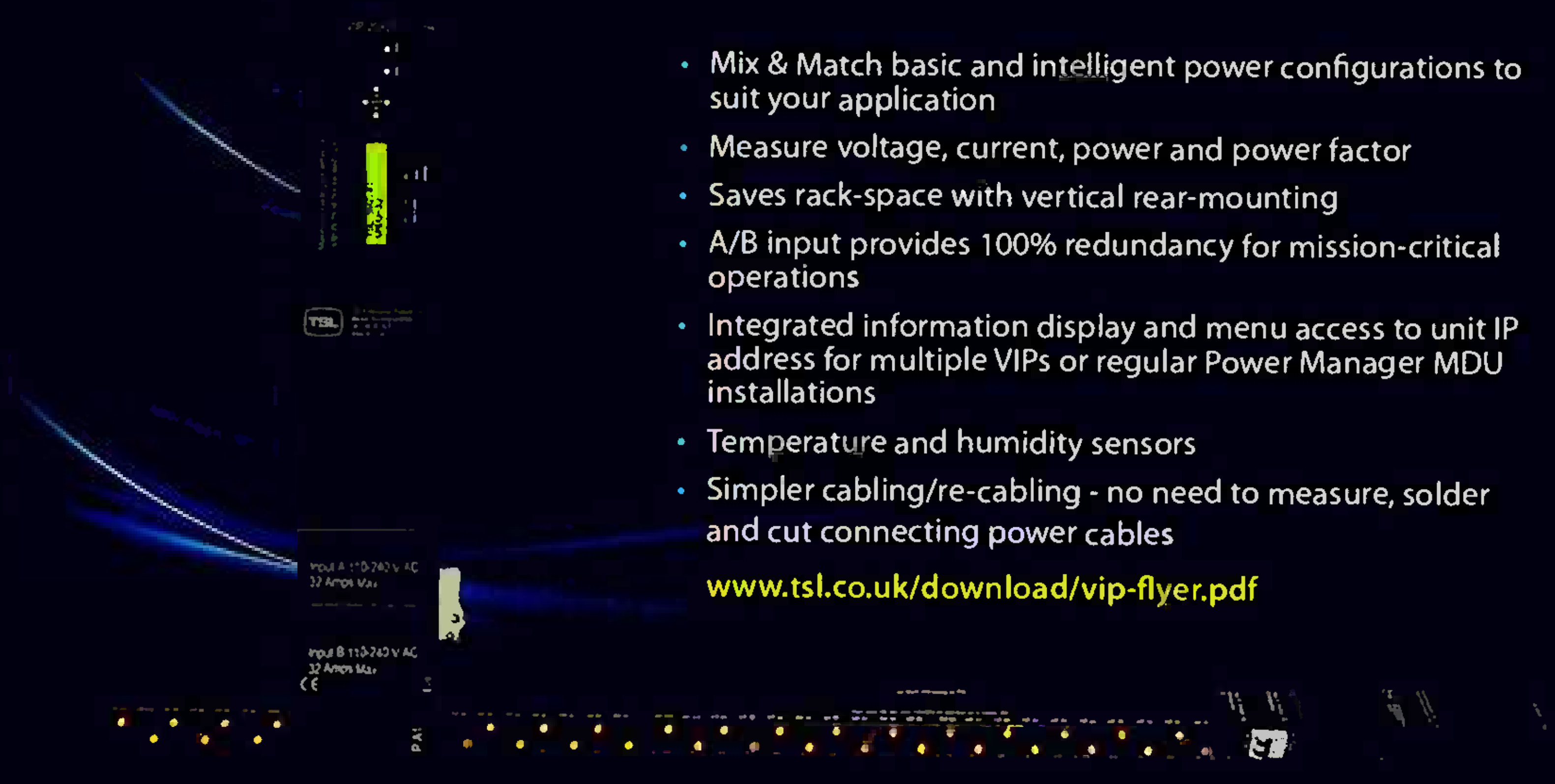

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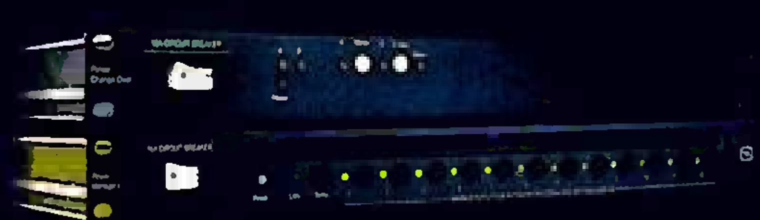

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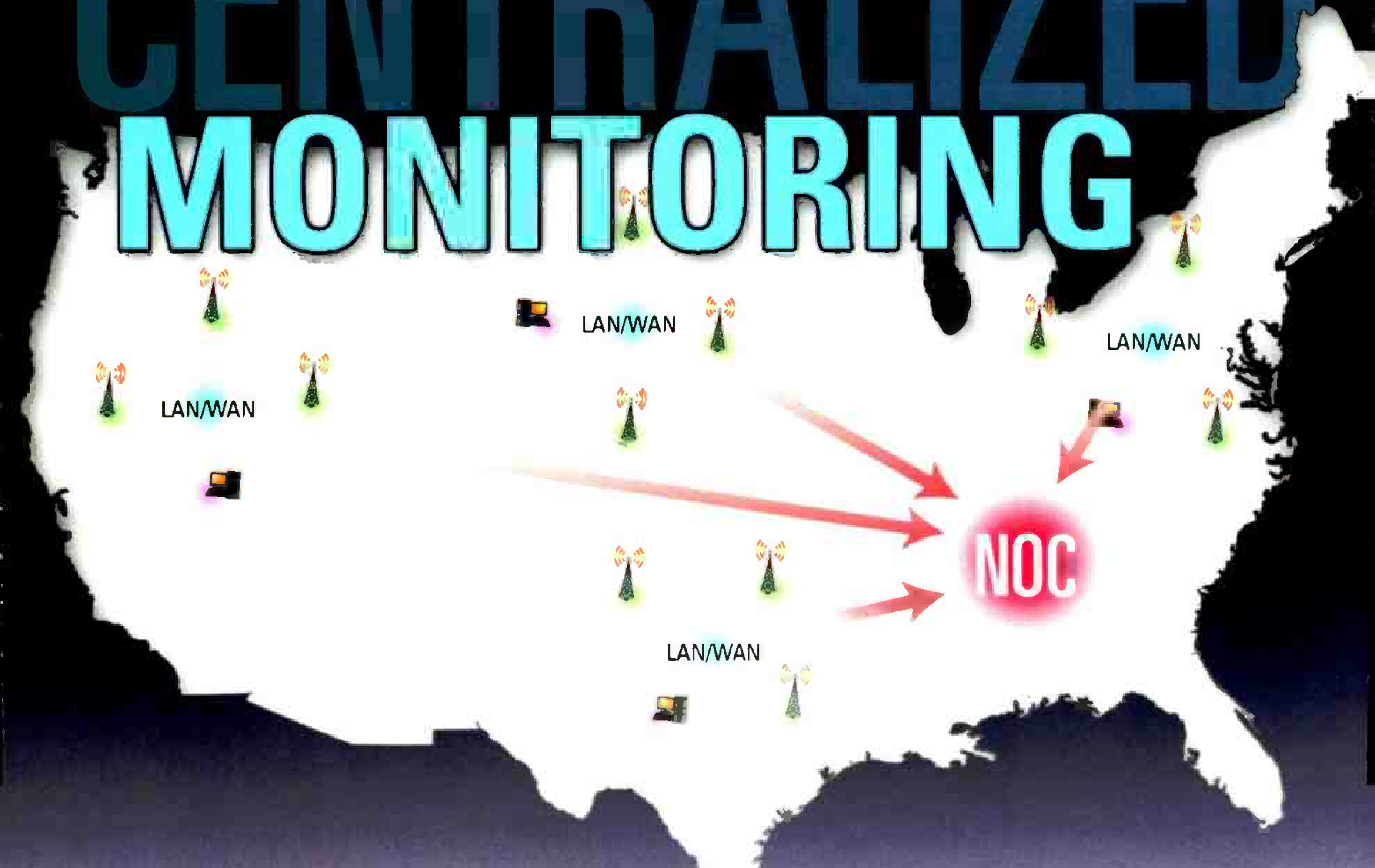

Identifying and resolving DTV transport stream issues centrally can streamline workflows.

BY RICHARD CHERNOCK

As consumer demand for more sophisticated and personalized viewer experiences continues to grow, broadcasters are increasingly offering a multitude of innovative services, including those on mobile devices. Whether a broadcaster is operating a single station, is part of a duopoly or a member of a multistation group, chances are the broadcaster is in charge of managing more than just one transmission. Consequently, as the transmission count increases, so does the likelihood of managing additional transport stream errors — some of which can greatly impair quality of service, leading to viewer complaints.

Deploying a unified test and monitoring system is the most effective method for ensuring the integrity of multiple broadcast services. By having all transport stream information in a centralized location, engineers are able to quickly detect and resolve errors so that they can focus on other important day-to-day operations. Additionally, a centralized DTV monitoring system is a great tool for pinpointing critical audio loudness issues, given the recent audio loudness legislation, including the Commercial Audio Loudness Mitigation (CALM) Act.

This article will provide a hands-on approach to reliably detecting and quickly resolving transport stream issues in multiple networks, while discussing the advantages of deploying a centralized digital transport stream monitoring solution for delivering a higher quality of service.

Step 1: Identifying transport stream errors

What matters most to broadcast viewers is being able to watch their preferred programming without any glitches, no matter how it gets to them. However, DTV systems are complex, with many different interacting components. This complexity can cause problems in the broadcast transmission and result in viewer dissatisfaction. Common issues that may be visible to viewers


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include video tiling, lip-sync errors, intermittent tuning, inconsistent loudness levels and missing components. Being able to identify these errors and act upon them in a timely manner is, therefore, critical for retaining viewers.

So how does a broadcaster mitigate these issues? The first step is identifying that a serious error exists. By using an advanced DTV transport stream monitoring system that provides a centralized view of the entire broadcast operation, engineers can more quickly determine which system is causing the issue.

Deploying a centralized DTV monitoring system is an effective method for both single stations and centralized station groups. A single-station broadcast operation can use the monitoring system to analyze strategic points within the broadcast transmission. (See Figure 1.) By monitoring transport streams at these points, a broadcaster can quickly determine whether problems arise from inside the station or from the content source. For a regionalized station group, the monitoring system can help further streamline operations by sending transport stream metrics from all of the stations to a centralized office location for troubleshooting. (See Figure 2 on page 34.) On

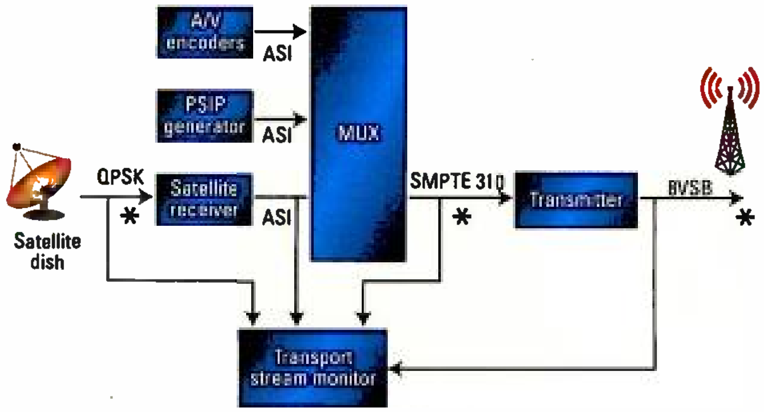

Figure 1. Using a centralized DTV transport streaming monitoring system, broadcasters can monitor multiple points in the broadcast transmission chain.

Deploying a centralized DTV monitoring system is an effective method for both single stations and centralized station groups.

an even larger scale, a national broadcast group that operates regionalized station groups all reporting to the same network operations center (NOC) may find a centralized monitoring system to be an extremely efficient tool. (See Figure 3 on page 36.)

Centralized monitoring enables broadcasters to maximize efficiencies by taking advantage of different levels of engineering expertise at various stations across the country. For example, while an engineer at one station may not know how to repair a transport stream issue, one at another site may have the solution. A national broadcast group can count on regional experts to troubleshoot certain errors, while employing a master expert at the NOC for more critical issues or those that may be affecting all of the stations.

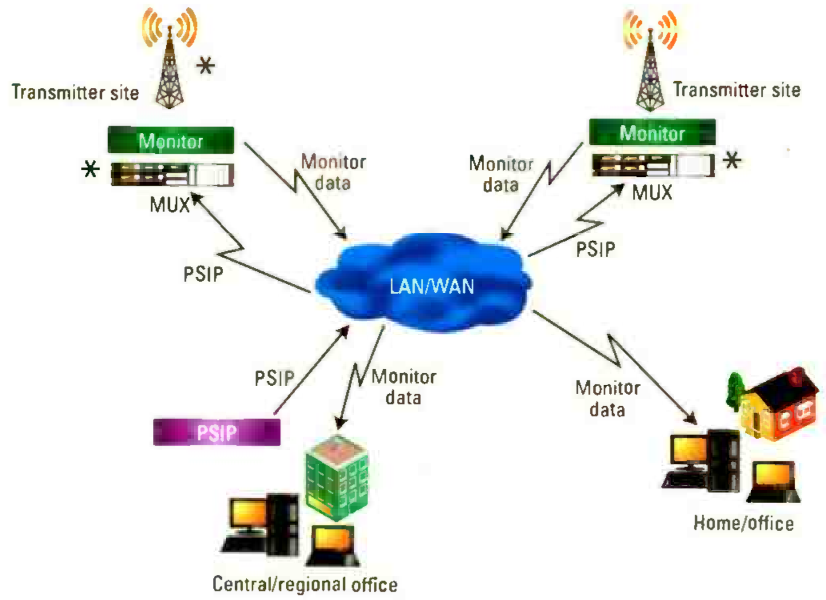

Figure 2. Within a regionalized station group environment, a centralized DTV transport stream monitoring system can provide engineers in a central office with valuable information about all of the stations.

Second, a centralized monitoring system is cost-effective because it allows an expert engineer to monitor multiple stations from a remote location, and then pass on his knowledge to other engineers at those locations.

Third, it dramatically reduces the time involved with resolving certain errors that may be occurring simultaneously across multiple stations. Rather than all of the stations needing to resolve this issue, it can be detected and taken care of all at once from a single platform.

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Finally, by enabling stations to monitor both terrestrial and mobile DTV transport streams from a unified platform, it reduces the complexity involved with ensuring high-quality content is being delivered to a variety of viewer devices, increasing viewer satisfaction and extending the broadcaster's revenue stream.

Step 2: Classifying errors

The second step in effectively resolving DTV transport stream errors involves classification. As was mentioned earlier, DTV systems are incredibly complex. At any given time, it's likely that at least one error is occurring in the broadcast transmission. For example, a multiplexer can only emit one transport stream packet at a time; however, there are multiple timing cycles involved. If two transport stream packets are queued for emission at the same time — one carrying a system table (such as the Program Association Table (PAT)) and another carrying the PCR for one of the video streams — then the mux will correctly choose to send the transport stream packet carrying the PCR, leading to a minor error in PAT table timing. The majority of errors are insignificant; however, a critical error could affect viewers' quality of service. How can an engineer determine which error is causing a serious

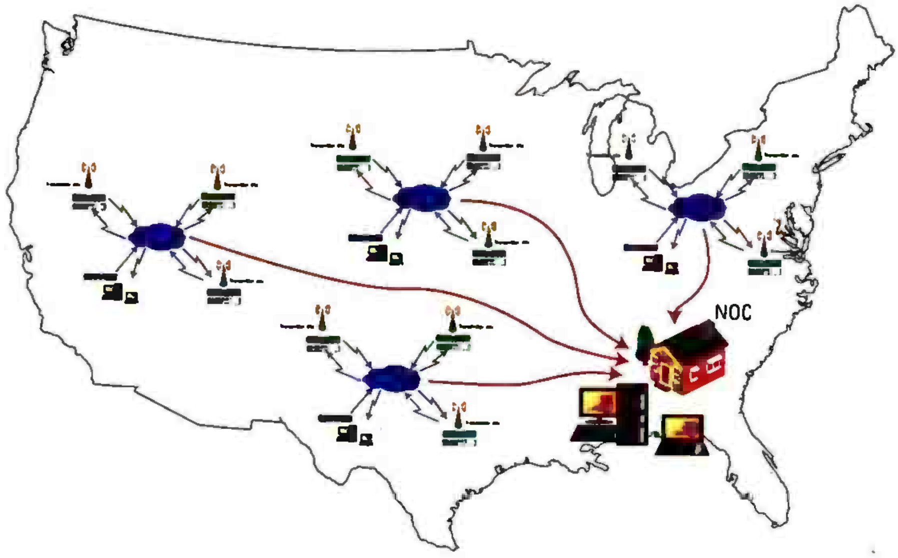

Figure 3. Using an advanced DTV transport stream monitoring system that provides a centralized view of transport stream data, a national broadcast group can remotely troubleshoot issues arising from regions and local stations at the network operations center.

quality of service issue if there are multiple errors?

In an effort to help broadcasters minimize transport stream issues, the ATSC published a Recommended Practice for Transport Stream Verification, known as ATSC A/78-A. (There's also an equivalent standard from the SCTE known as SCTE -142.) The ATSC's Recommended Practice originated from a request to document all of the necessary components an operator needs to pay attention to during an ATSC broadcast stream in order to eliminate transport stream errors.

Essentially, the document provides broadcasters and other service providers with a methodology for analyzing different transport stream metrics and categorizing errors into various severity levels. By grouping DTV transport stream errors into categories, a centralized monitoring system allows broadcasters to more rapidly uncover the error source so they can quickly address serious problems that are affecting viewers' quality of service and leave less critical errors that viewers are not aware of for later.

This greatly reduces the occurrence of false alarms, ensuring engineers do not ignore those alarms that actually are important. The error severity metrics for the document were derived from multiple participants in the DTV industry, including broadcasters and equipment manufacturers.

Each error type is assigned a set of severity levels based on the measured metric. The five transport stream severity levels within the ATSC's Recommended Practice, listed in order of most critical to least critical, are as follows:

• *Transport Stream Off Air (TOA):* Errors are severe enough that the transport stream is damaged beyond utility; in other words, the television programming is totally unwatchable. Receivers cannot tune and decode the broadcast. This type of error can occur when, for example, there is an absence of sync bytes.

• *Program Off Air (POA):* A virtual channel is flawed to the point where the service is off-air. Receivers in this case cannot tune or decode the content of the virtual channel. This type of error can occur when, for example, there is a missing entry in a PAT for the virtual channel.

• *Component Missing (CM):* An element of the virtual channel is flawed. In this case, the receiver can't find or decode the program element. Mismatches between the video PID signaled in the PMT and the actual PID in the video transport stream packets are a common source of this error.

• *Quality of Service (QOS):* Certain parameters are out of spec by such an amount that a significant number of receivers are expected to produce flawed outputs. The broadcast may still be viewable, but it will exhibit degradation. These errors can cause tuning issues. For example, if a PAT cycle time is somewhat larger than the specification, then the result will be slower than normal tuning.

• *Technically Non-Conformant (TNC):* The error violates the standard, but with little effect on the viewing experience. For example, there are recommended tables for tuning that outline required frequencies. If the standard states that the PAT, which is a primary table, is supposed to be repeated at 100ms intervals and instead it is repeated at 105ms, it technically doesn't meet the standard. However, no one will ever notice that the tuning is 5ms slower. For these types of errors, the system will generally log it, and engineers will take care of it the next time they perform routine facility maintenance.

Step 3: Filter errors

Leveraging the error severity scale defined in the ATSC's recommendation, the monitoring system can be set up to apply filters and rules that the broadcaster wants to simplify the analysis of what would otherwise be an enormous mass of data. Only the most critical errors would be exposed, while less significant errors are logged for analysis at a later time. Setting up the monitoring system in such a way helps broadcasters to be proactive rather than reactive.

Traditional monitoring systems that don't include intelligent filtering tools may simply use a set of red lights to alert the broadcaster that an error has occurred. There would be no differentiation between serious errors and those that are trivial. With numerous errors likely to be occurring at all times, the system would always be flashing red, therefore making it difficult for engineers to determine when an error is actually of serious nature. Overloading an engineer with information may condition him or her to simply ignore all of the errors, thus letting critical errors that affect viewer quality slip through the cracks.

For a single-station broadcaster, many of the transport stream errors that occur fall into the technically non-conformant error severity category, so they don't require immediate attention from the station and can be logged for later attention. Effective filtering becomes even more important for regionalized and national station groups where the number of errors is dramatically multiplied due to the number of transport streams involved.

Using a centralized DTV monitoring system, broadcast facilities can continuously test streams against a set of defined rules and expectations. When rules are violated to a degree requiring action, engineers receive real-time alarms that allow them to take instant remedial action. This type of monitoring approach means problems are likely to be solved before viewers become aware of the issue.

Final step: Address the most critical issues at hand

After errors have been filtered to expose only the most critical infractions, the engineer must determine which error to address first. Sometimes the monitoring system might show that there are multiple critical errors. For example, a particular broadcast transmission may be experiencing PCR errors, buffer errors and continuity count errors. In this case, it would be important to address the continuity count errors first, as they are often the root cause of PCR and buffer errors. The monitoring system's filtering results are designed to point the engineer toward the appropriate order of action, saving them time.

Next, the engineer would examine the monitoring points in his or her transmission chain to determine which unit is faulty. Moving the monitoring point through the system until the problem either goes away or appears can help determine the source of the error. All of this can be done remotely through a Web-based interface, allowing an engineer in any location to validate critical transformations of DTV streams as they move through the equipment chain or from one site to another for distribution. Depending on how the station is set up, many times an engineer can remotely reach into an offending multiplexer or encoder to change the settings.

In conclusion

Continually monitoring across the entire DTV transport stream system will allow the early identification of chronic or networkwide problems so that broadcasters can perform the necessary maintenance, resolve any issues at hand and avoid viewer complaints.

As more and more broadcasters expand into offering different types of services, like data and connected TV, it becomes even more imperative to increase operational efficiencies and reduce engineer workloads. Collecting transport stream information in a centralized place can greatly streamline a broadcaster's monitoring workflow, enabling it to cost-effectively support additional services and deliver a high quality of service to viewers. BE

Richard Chernock is CSO, Triveni Digital.

Send questions and comments to: editor@broadcastengineering.com

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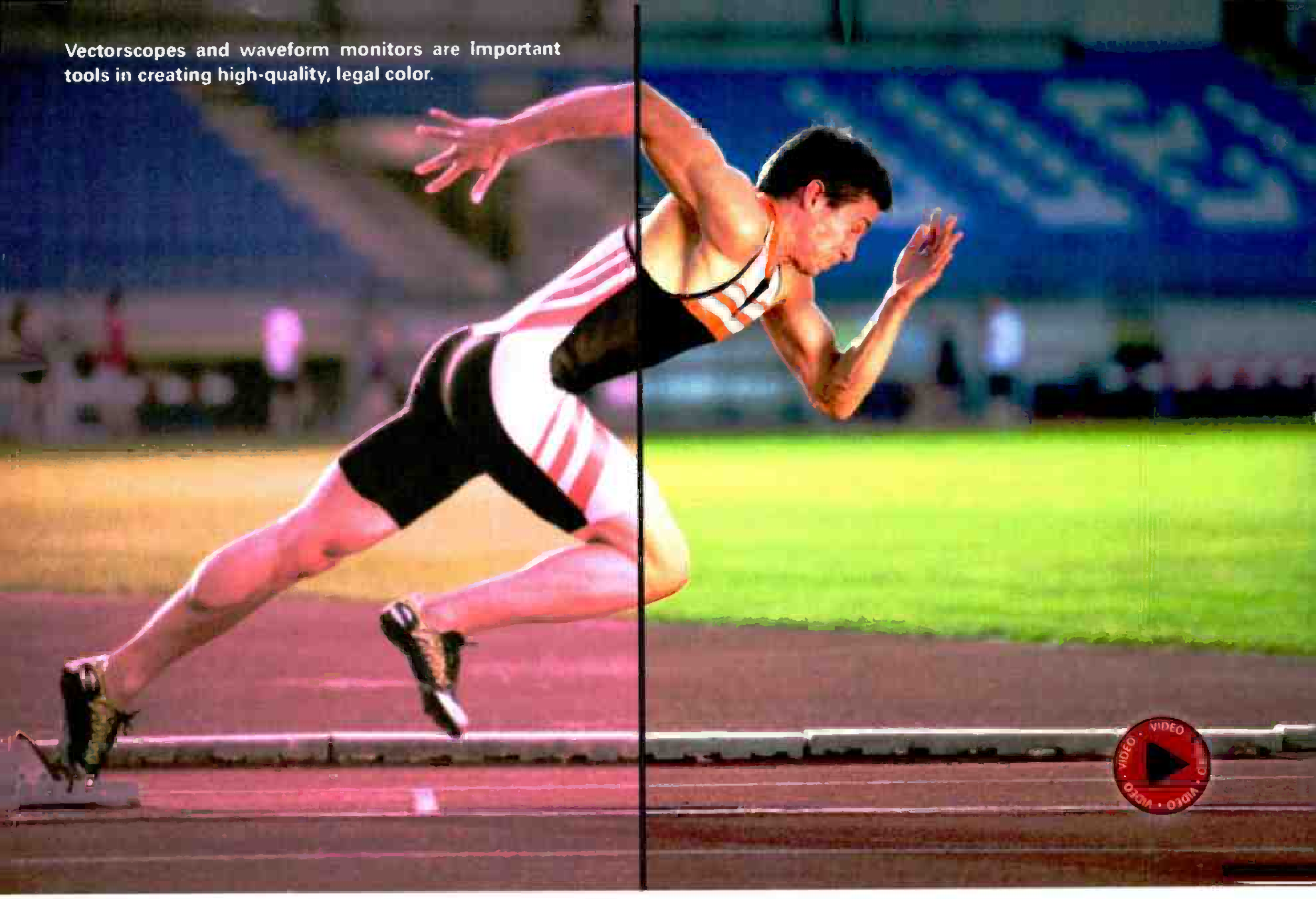

Vectorscopes and waveform monitors are important tools in creating high-quality, legal color.

Color grading

Waveform monitors and vectorscopes are vital tools in colorists' palettes.

BY RICHARD DUVALL

There are two things that are at the core of doing good color grading for video:

- Ensuring that the image on the screen looks great and is graded to best tell the story; and
- Making sure that the image can be properly reproduced and delivered to a variety of media and screens.

This article will focus on the latter. Understanding the importance of legal and valid gamut and determining the color balance are critical to maintaining proper color reproduction across a variety of media and broadcast methods. Before we examine the concepts of color balance, let's quickly review the concepts of color space.

The HSL color space

Video is comprised of three color components: red, green and blue (RGB). Various combinations of these colors make up the colors we see. One way to understand the Hue Saturation and Luma (HSL), or RGB color space, is to imagine it as two cones joined at their widest point, as shown in Figure 1 on page 42).

The waveform monitor

The waveform monitor or rasterizer (scope) is key to providing a legal output of your creative product. Being a brilliant editor and colorist doesn't

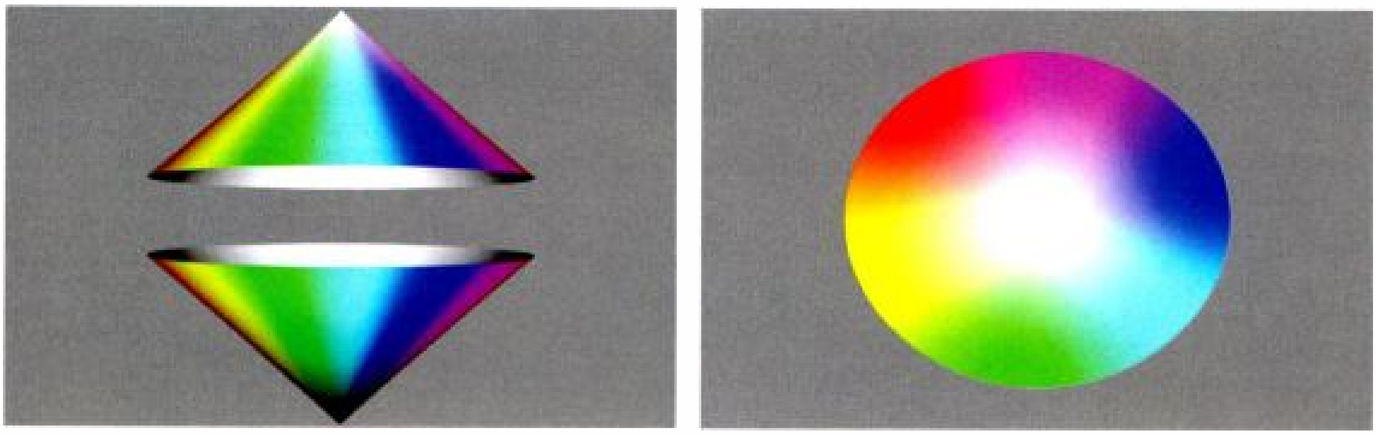

Figure 1. One way to understand the Hue Saturation and Luma (HSL), or RGB color space, is to imagine it as two cones joined at their widest point, as shown on the left. On the right is a top view of color cones.

mean much if no one will air your product. Even if your product isn't being broadcast, legal levels affect the proper duplication of your project and the way it will look on a regular TV monitor.

One of the most basic uses of the waveform monitor is determining whether your luma and setup levels are legal. This means that the brightest part of the luma signal does not extend beyond 100 percent and that the darkest part of the picture does not drop below 0 percent.

Determining color balance

Color balance is indicated by the relative strength of each color channel. With neutral (pure black, white and gray) colors, the strength of each color channel should, technically, be equal. The usual goal of color balancing is to achieve an image where neutral colors are represented with all channels being equal. The most-common reason for unbalanced colors is how the camera is white balanced on location. For example, if a camera is set up to record in tungsten light, when it is actually capturing a scene

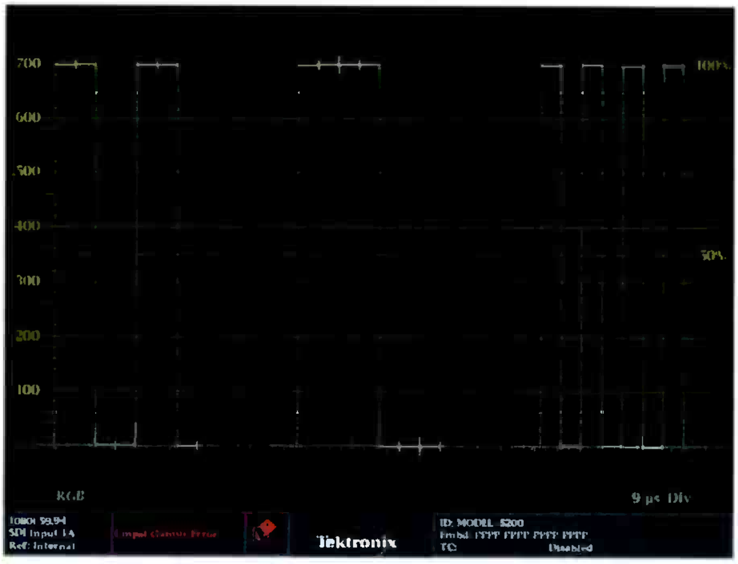

Figure 2. The most common type of parade waveform displays, the RGB Parade, shows the red, green and blue channels of color.

Figure 3. A vectorscope is an XY plot of color (hue) as an angular component of a polar display, much like some familiar color wheels used in color graphics.

lit with daylight, the blue channel will be stronger than the red and green channels. Some camera sensors have a natural tendency to be more sensitive to certain colors in certain tonal ranges. These errors, in sensitivity or white balance, can be corrected by monitoring the image with a waveform monitor and making adjustments to the signal until the signal strength of all three channels is equal when displaying a neutral color.

There are two types of waveform displays colorists consult that are defined as "parade" displays because they show channels of information in a "parade," from left to right.

The most common of these is the RGB Parade shown in Figure 2, which shows the red, green and blue channels of color information horizontally across the display.

The reference marks are referred to as the graticule. On a waveform monitor, these are the horizontal lines describing the millivolts, IRE or percentages from black to full power (white).

Component video levels are represented in terms of millivolts, with black being set at 0mV and white at 700mV. This range of video levels is also represented in terms of a percentage scale with 0 percent equal to 0mV, and 100 percent equal to 700mV.

The vectorscope

Whereas a waveform monitor normally displays a plot of signal vs. time, a vectorscope, shown in Figure 3, is an XY plot of color (hue) as an angular component of a polar display, with the signal amplitude represented by the distance from the center (black). On a vectorscope graticule, there are color targets and other markings that provide a reference as to which vector, or position, a specific color is in.

In color grading applications, the vectorscope helps analyze hue and chroma levels, keeping colors legal and helping to eliminate unwanted color casts. With the gain, setup and gamma corrections done while monitoring primarily the waveform monitor, the colorist's attention focuses more on the vectorscope for the hue and chroma work.

The chroma strength of the signal is indicated by its distance from the center of the vectorscope. The closer the trace is to the outer edge of the vectorscope, the greater the chrominance, or the more vivid the color. The hue of the image is indicated by its rotational position around the circle. An important relationship to understand is the position of the various colors around the periphery of the vectorscope. The targets for red, blue and green form a triangle. In between each of these primary colors are the colors formed by mixing those primaries.

The chroma information presented on the vectorscope is instrumental in trying to eliminate color casts in images. As stated earlier, the chroma strength of a signal is represented by its distance from the center of the vectorscope. Because white, black and pure grays are devoid of chroma information, they all should sit neatly in the center of the vectorscope. Although most video images will have a range of colors, they also usually have some amount of whites, blacks and neutral grays. The key is to be able to see where these parts of the picture sit on the vectorscope and then use the color correction tools at your disposal to move them toward the center of the vectorscope.

For nearly all professional colorists, the various waveform displays — Flat, Low Pass, Luma only, RGB Parade and YCbCr Parade — plus the vectorscope are the main methods for analyzing their image. Although experienced colorists often rely on their eyes, they use these scopes to provide an unchanging reference to guide them as they spend hours color correcting. Without them, their eyes and grades would eventually drift off course. Spend time becoming comfortable with these scopes, and what part of the video image corresponds to the images on the scopes. BE

Richard Duvall is video marketing manager of Tektronix.

Second-screen systems

The path to future revenue goes through new screens and social media.

BY JOHANN SCHREURS

Interactivity across the broadcast spectrum is the new name of the game as broadcasters seek to expand — or, perhaps more accurately, keep — viewers who spend increasingly more time on their connected devices. As laptops, smartphones and tablets become more ubiquitous in the market, viewers are using them not only to facilitate on-the-go lifestyles, but also to engage with social media, as well as other online forms of media and entertainment.

A 2011 Nielsen survey showed that 45 percent of U.S. tablet owners and 41 percent of smartphone owners used devices while watching TV on a daily basis. In sports, the numbers were higher, with an estimated 70 percent of tablet owners watching TV while consulting their Web-connected device. A 2011 Ericsson report found that more than 40 percent of people use social media while watching TV on a weekly basis, and almost one in three chat online. In-depth interviews showed that families combined TV viewing with the use of Twitter, Facebook, texting, voice calls and forum discussions about what they watched.

The silver lining is the new technology that enables broadcasters to take advantage, rather than risk the effects, of social media engagement — providing viewers with more reasons to engage with the content they're consuming. New second-screen systems provide viewers with access to original content not seen anywhere else,

Live sports content owners are among some of the first to implement second-screen systems. The apps can, for example, allow viewers to select different camera positions and view replays of the action.

using otherwise wasted content that often sits on servers. Together, this premium content and increased viewer engagement provides new revenue opportunities.

New, customized content

Technology used by broadcasters and content owners to work alongside, rather than opposed to, forces that threaten to pull away viewers is surprisingly easy. Designed as a suite that can be added on to live multicamera production infrastructure, the technology enables broadcasters and rights owners to output original content — archives, highlights or third-party content — to multiple screens.

New infrastructure isn't needed. The technology is integrated into a seamless file-based workflow either at a broadcast center or on-site production venue. (See Figure 1.) With this capability, broadcasters can provide more ways for viewers to engage with the content they're viewing, including interacting through votes and evaluations, or receiving content customized to their preferences.

Sports — your way

For every sporting event covered, broadcasters are capturing hours of premium content that currently goes unused. For example, in a soccer game with up to 18 cameras, for every 90 minutes of viewed content, another 26.5 hours of content ends up on the cutting room floor — in other words, 90 percent.

Clips or highlights created during live productions and stored on servers can be made available instantly to Web app subscribers. The process begins with the processing and transfer of synchronized live multicamera media recorded on production servers. All metadata associated with event footage are used as keywords, enabling easy content retrieval. Third-party stats are integrated into the database and associated to video clips and highlights, which are made available to the user in near real time. A second-screen timeline of events being produced is created, into which external elements such as ads, stats or surveys can be inserted. Content providers can also add value to media by creating context from live events through multi-angle replays at various speeds, on-the-fly edits, and graphics and statistics insertion.

The aim of the workflow is to enrich the viewer's experience during live sports broadcasts. To do this, the process must be quick and include the following steps in two minutes: clip the action at the venue; transfer the clip (including multiple angles and metadata) from the venue server to a central database; API ingest for third-party items (graphics, statistics) and Web application; on-the-fly video transcoding into required format; and distribute the timeline, content and metadata to connected devices.

The above-stated constraints, minimizing extra resources at the venue and the timely delivery of the content,

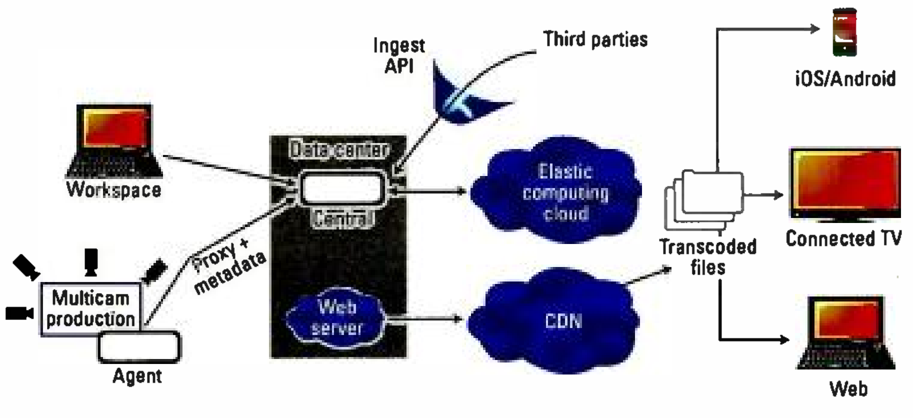

Figure 1. New second-screen systems can interface with multicamera production systems to make content that might otherwise go unwatched available to second-screen devices, providing another potential revenue source for broadcasters.

lead us to move the transcoding service located in the data center. The external transcoding service needs to provide multiple bit rates for each video. This is needed so that the player client can dynamically adjust the chosen video stream as a function of the available bandwidth. Video formats vary as a function of the video capabilities of the smart devices.

A publishing layer communicates with one or multiple standard CDN services to deliver the content to viewers. This distribution policy isolates distribution scalability issues from the central facility scaling. The use of HTTP Live Streaming (HLS) to distribute the content is perfectly compatible with major CDN services.

A new wave of applications

Live sports content owners are among the first to implement large-scale second-screen systems. The technology was recently used by Canal+ Sports, the sports channel of a France-based pay TV broadcaster, to launch its branded second-screen soccer app.

Canal+ Sports recognized that the way fans consume media is rapidly evolving, due both to new smart devices and the spread of fast broadband connectivity. To grow market share, it used a broadcast and media production systems provider to provide the technology for an app providing up-to-the-minute statistics, multicam video clips of all highlights and bonus material such as super-slow-motion action replays in full length. The app also features filmed reactions from commentators and special guests from their live sports programming, as well as the ability to interact via social networks. Available on iOS for iPad users and Android for Samsung Galaxy tablets, the app was easy to create and deploy with the second-screen automated hardware and software system.

While the sports industry may be early adopters, consider the possibilities for reality shows and live variety programming, from interview formats to cooking shows, even dramatic series. Unused content can be made immediately available, both to meet customized tastes and spur social media interaction. The result is more engagement, more viewers and ultimately more revenue. BE

Johann Schreurs is market solution manager, Remote Interface, EVS.

? Send questions and comments to:
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ADDITIONAL RESOURCES

The following are available on the *Broadcast Engineering* website:

- Second-screen magic
- Second-screen apps now key part of TV programming strategies
- Broadcasters experiment with second screen app

The evolution of multiviewers

The devices play important roles in monitoring.

BY GARY OLSON

Multiviewer technology evolved from its origins in signage as video walls and large Jumbotron-style screens used in stadiums and arenas. These early displays typically were CRT video cubes or LCD-based. With the introduction of flat-screen technology, they began to appear as monitors in MCRs and NOCs, and even trucks.

Using multiviewers, the MCR now more resembles a NOC, displaying the screens of playout servers, network traffic and more.

Benefits

There are a number of obvious benefits in using multiviewers, as well as a some not so obvious benefits. Multiviewers reduce the required number of physical monitors, which reduces the power and HVAC requirements.

Multiviewer technology continues to evolve. It is introducing new concepts in monitoring and consolidating many features and functionalities that previously required a lot of outboard gear. The integration of audio metering, under-monitor and clock displays allow each source to have an audio meter if needed, an under-monitor display instead of white tape and multiple clock displays, which are just appearances in the multiview controller. As broadcast and production technologies become more IP-centric, multiviewers take on the additional role of monitoring the network and servers.

Initially, multiviewers were separate devices that required router outputs and separate controllers, which meant additional cost, cabling and infrastructure. Still, there are considerable benefits: Multiviewers occupy less space, require less power and do not generate the heat of CRTs.

Using a multiviewer in a production control room or remote production truck provides the ability to have multiple configurations easily changed using a management dashboard in the image processor. There can be multiple profiles for different productions in a truck serving different production needs for multiple users without having to do major repatching or rerouting.

Multiviewers are powerful tools that are now being fully integrated into routers. They are now cards in the router frame and use the same input cross points. The immediate benefit is that all of the sources on the router are available to the multiviewer without needing additional router outputs. This is a considerable cost savings in equipment and infrastructure.

A recent addition to the feature set in multiviewer technology is the ability to monitor servers and computers. Previously, one had to add a large number of computer monitors or rely on a KVM. Now, a multiviewer using remote monitoring connection tools can display the screen of a server or computer. If the operator sees an issue, the KVM can access that server or computer to resolve the issue.

Monitoring has become significantly more complex. In production, recording to a server requires the server to be monitored the same as the video. Playback means tracking the rundown on the playlist. These are all on server or computer screens.

Multiviewers allow edit and graphic rooms to display on a single screen a lot more things. Multiviewer displays can monitor running processes, without requiring multiple computer screens or multiple windows open on a craft production machine. In an edit room, having the audio meters displayed with each source is helpful as well as the under-monitor displays.

The traditional MCR requires a variety of test monitoring tools. With a multiviwer solution, when problems occur, alerts and status changes become flashing colors on computer screens. Multiviewer technology responds with changed displays, calling the operator's attention to the issue.

Using the power of multiviewers, the MCR now more resembles an NOC, displaying the screens of playout servers, traffic systems, Ethernet network traffic, and other systems and channels. Multiviewers become a multifaceted tool with a considerable amount power to meet both current and future monitoring requirements. BE

Gary Olson is managing director, GHO Group.

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Israel
Asa Talbar
Talbar Media
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talbar@talbar.co.il

Japan
Mashy Yoshikawa
Orient Echo, Inc.
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Asia Pacific
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Wright's Media
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