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PRODUCTION ROOM

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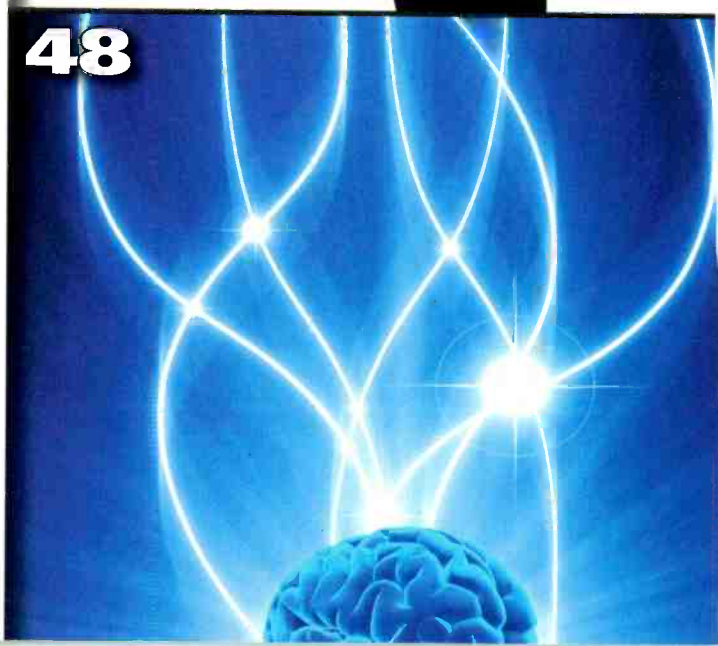
ON THE COVER:
The battle for spectrum continues unabated, but how did auctions become the focal point, and are there any alternatives to them?



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JUST THE FACTS!

Connected CE devices in the home will account for 27 percent of all OTT video transactions in 2016, up from 6 percent last year, according to a new study from IMS Research. The study finds that a key driver in this growth is the geographic expansion of OTT services, such as those from Netflix and Amazon. IMS Research forecasts that by the end of 2016, more than 133 million TV households worldwide will be accessing OTT content via their pay-TV STBs.

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Ignore the obvious

The report's executive summary begins, "Every day, more and more Americans begin using Smartphones, tablets and wireless modems to access new mobile applications and services ... Some have argued that without a fundamental shift of spectrum from broadcasters to commercial wireless operators, the nation will soon face a massive 'mobile traffic jam,' and that auctioning broadcast spectrum will deliver a revenue windfall to the U.S. Treasury."

This report titled, "The Economic Value of Broadcast Innovation — Impact on the U.S. Treasury," was prepared for the Sinclair Broadcast Group by Business Analytix.

It presents a plan that takes advantage of broadcaster's efficient one-to-many distribution, but adds a new layer of "converged ... point-to-point (unicast) data/services provided by other wireless operators."

Under the proposal, OTA broadcast could work with wireless services to distribute video and IP-based content. Mark Aitken, Vice President of Advanced Technology for Sinclair Broadcast Group, calls the solution a "WIN-WIN-WIN" for the U.S. Treasury, consumers and broadcasters.

The study suggests the best way to meet projected growth for mobile IP is to allow broadcasters to deliver point-to-multipoint *Broadcast Overlay* technology that would create, in the report's words, "the most efficient possible delivery of high bandwidth data to mobile users."

Certainly, the report states well the case for TV stations being allowed to deliver IP services. No matter if one focuses on total revenue generated to the treasury, numbers of channels of data delivered or benefits to consumers and broadcasters, this solution seems attractive.

I admit to looking first at the needs of American viewers when it comes to video and suggest that broadcasters are best qualified to meet them. Several key data points from the survey similarly conclude that Sinclair has a good idea. The following seem pertinent:

The FCC's National Broadband Plan targeted 120MHz of TV spectrum for reclamation and its predicted revenue generation. Yet, some experts say only 84MHz may be usable because of interference and border issues. If so, the amount of net spectrum available for mobile broadband might only increase by about 15 percent.

The need to serve an ever-increasing audience of new mobile users with data and video will not go away. In mid-November, Amazon announced it will begin providing Hulu Plus on its upcoming Kindle Fire tablet. Does anyone think other tablet manufacturers' vendors won't do likewise?

The Pew Excellence in Journalism has a new report titled "The Tablet Revolution and the future of news." The report claims that 77 percent of tablet owners use them daily. More than 53 percent use them to view news daily. And, they spend 95 minutes daily on those devices. While many of these viewers are connected to WiFi, others rely on 3G and higher services — the type of spectrum FCC Chairman Julius Genachowski wants to take from broadcasters.

The Business Analytix report summarizes the dilemma, "... even if the total available spectrum is nearly doubled, and even if improvements in technology multiply the capacity of that spectrum fourfold, the eightfold increase in supply over the next 15 years would be dwarfed by the growth in demand: consumer mobile data traffic alone is projected to increase almost seventy-fold by 2026."

In layman's terms, the report is saying regulators can play spectrum grab all day, and it still won't be enough to meet the growing demand.

Chairman Genachowski's argument for reclaiming TV spectrum and selling it to the highest bidder reminds me of Netflix commercials. "What is two plus orange? Uh, twelve point three. Correct! What is the sixth Monday in December? Friday. Correct! How much money will Uncle Sam get from auctioning off television spectrum? A zillion dollars. Correct!" BE

Brad Dick

EDITORIAL DIRECTOR

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Dual-polarization weather radar

Is your station prepared?

BY MICHAEL RICHARDSON

In the decades since World War II radar operators in search of enemy aircraft inadvertently discovered precipitation returns on their scopes, weather radars have used horizontal scanning techniques to identify the location and intensity of rainfall in the atmosphere. Now, with meteorology's move into dual-polarization radar technology — which employs both horizontally and vertically polarized signals to detect weather targets — things are changing.

Dual-polarization has been an emerging weather capability in the broadcast industry for a few years now, with several stations across the U.S. already employing advanced dual-polarimetric radar systems. As the U.S. National Weather Service's entire NEXRAD radar fleet is upgraded to dual-pol by the end of 2013, however, this new technology is quickly becoming a relevant matter to every broadcaster in the country. So what's dual-pol all about?

Radar meteorology

When it comes to conventional weather detection, this much is universal: Radars operate by transmitting horizontally polarized RF energy pulses, which are reflected back by precipitation (anything from raindrops and hailstones to sleet and snow) suspended in the atmosphere. The drops and particles that make up precipitation are known meteorologically as hydrometeors. Using the properties of the returned signal as a basis for calculation, conventional Doppler radar systems produce two data products of extreme value: reflectivity and velocity, which depict the patterns and intensity of precipitation and wind, respectively.

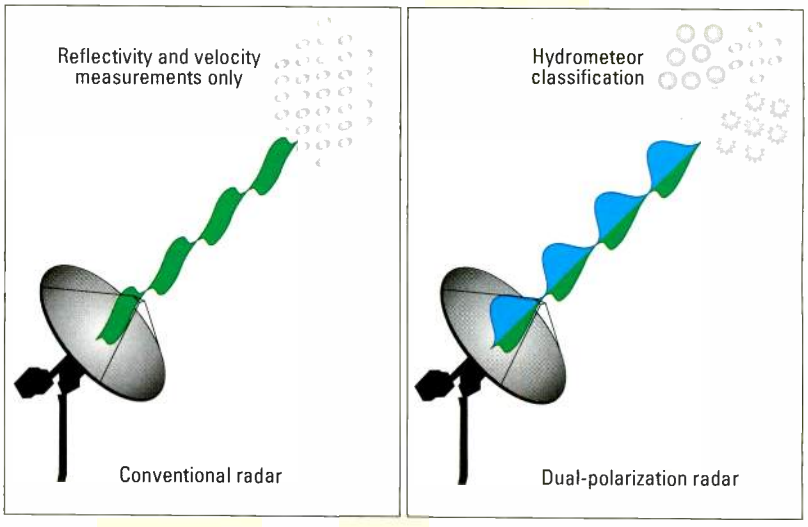

Figure 1. With dual-polarization, radar is able to measure the direct size, shape and moisture content of hydrometers.

In dual-polarimetric applications, the radar transmits simultaneously in two polarizations, horizontal and vertical, allowing the radar's signal processor to make direct measurements of the size, shape and moisture content of hydrometeors, as shown in Figure 1. (Frozen hydrometeors have less water content than rain.)

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

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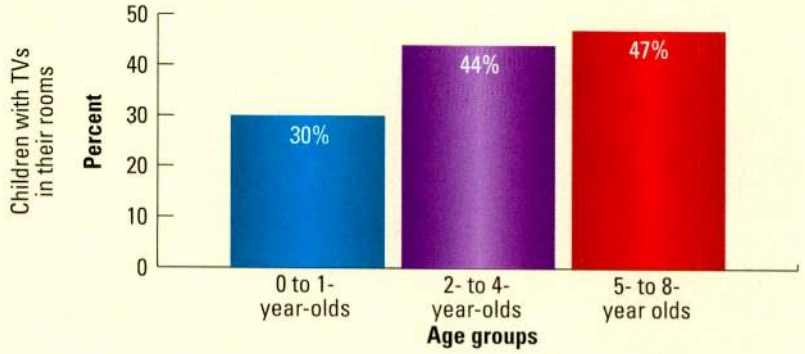
As many as three out of 10 kids age one or younger have a TV in their rooms. By age five, the number is nearly half.



Source: Common Sense Media

http://www.commonsensemedia.org/sites/default/files/research/zerotoeightfinal2011.pdf

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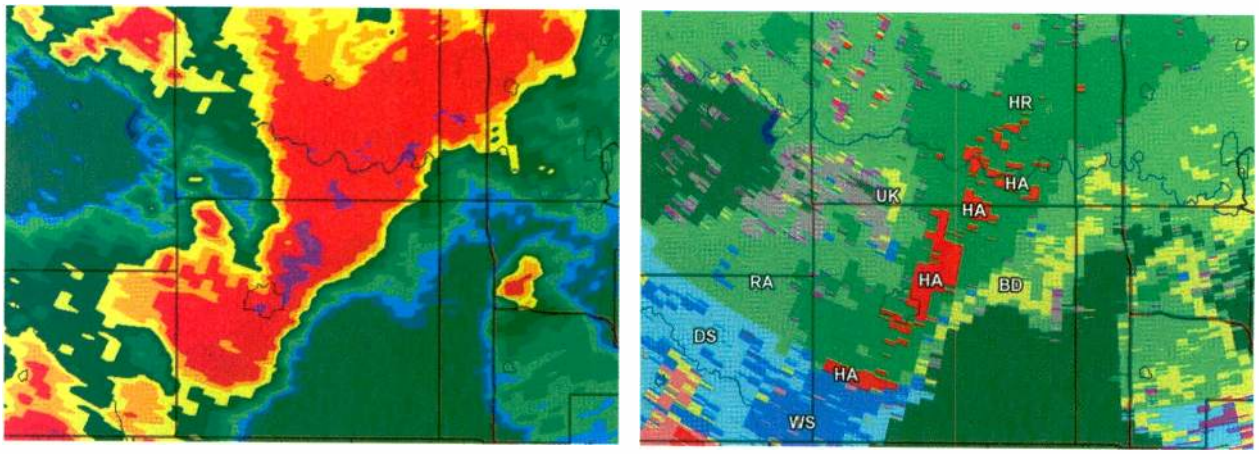
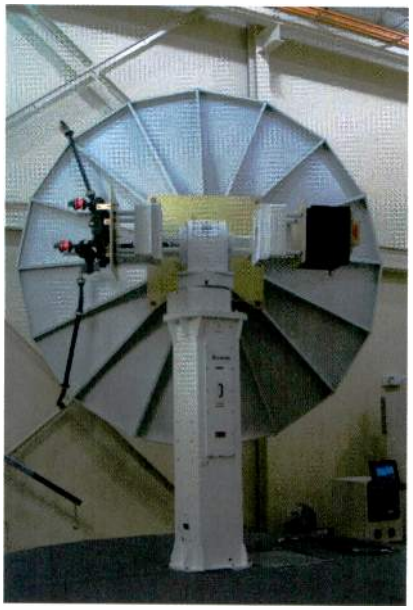


At top left, an image shows NEXRAD Level III Reflectivity. The above image on the right shows Hydrometeor Classification data from the same scan. Here, very high reflectivity levels (in red) have been revealed as hail instead of merely heavy rain.



A waveguide splitter (middle) is shown mounted with an adjoining waveguide on the left in the bottom image.

Since the radar processor can now measure the shape of any hydrometeors the signal has encountered, it can calculate the type of precipitation your viewers may expect. In this way, the guesswork needed for the meteorologist to accurately distinguish between, for example, hail and heavy rain, or snow and freezing rain, is eliminated. Dual-polarimetric radars can more accurately determine instantaneous rainfall rates, too, so flooding can be more accurately forecasted. And, there's lot more to come from dual-pol advances in the future.

Choosing dual-polarization

Television stations have two options when it comes to securing a dual-polarimetric live radar of their own: implement a new installation, or upgrade legacy radar hardware with the new capability. From a budgetary standpoint, maximizing current hardware is always the preferred method, but it's important to note that due to increased signal processing demand and other requirements, not every radar currently in use will be up to the task of handling dual-pol operations.

Peak transmitting power is an area of serious consideration. To achieve simultaneous horizontal and vertical transmission, a dual-pol radar's RF pulses are physically split between the two polarizations, effectively halving transmission strength per channel.

The risk in using lower powered radars for dual-polarimetric applications is attenuation, caused when the transmitted beam is scattered and absorbed as it travels through storm cells. The weaker the signal as it reaches a target, the lower the resolution of the returned measurements. It's really this simple: Brute force equals better punching power and higher data resolution, and that's important when it comes to dual-pol radar.

In many instances, the most immediately visible modification to a radar is the addition of an RF palette behind the antenna, mounted to one of the pedestal's swing arms. The palette contains a waveguide splitter that divides the RF signal emanating from the radar's klystron or coaxial magnetron transmitter into separate channels. As the newly separated pulses travel through the remaining waveguide, one channel is physically converted into a vertical polarity before the signal is dispatched through the feed horn.

On the other side, the opposite swing arm hosts, in this example, an antenna-mounted electronics module — a climate-controlled box housing receiver components, as well as low noise amplifiers (LNAs) that convert the received transmission into an electrical signal the Doppler signal processor can decipher. This configuration also allows the radar to be more easily calibrated by directly injecting a test signal into an LNA without the attenuation or loss associated with directional couplers. The solid-state climate control system maintains an interior module temperature of 20°C to 30°C throughout the year to ensure reliability and signal stability.

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Inside the radar shelter on the ground, additional modifications are made to the radar equipment cabinet; for example, any new transmitting equipment would be installed during the upgrade. To support the increased processing requirements, a higher-spec Doppler processor will typically be retrofitted to the legacy hardware stack. The processor contains a suite of components, including built-in test equipment (BITE).

The BITE is a multi-purpose and essential modification. In addition to performing continuous system checks, it allows radar technicians to, with a station's permission, remotely dial into the radar system. Troubleshooting, calibration and other system checks can then be performed without waiting for the vendor to arrive on-site, or taking the radar system offline.

The NEXRAD factor

Dual-polarization is not functionality limited to privately owned radars. In fact, the NEXRAD radar network for the National Weather Service will soon be upgraded as well. As the upgrade program moves into nationwide deployment, NEXRAD will become even more relevant to your station as dual-polarimetric data products become available. To find out when your local NEXRAD site will receive the dual-pol upgrade, log on to http://www.roc.noaa.gov/WSR88D/DualPol/Default.aspx, and click the "Deploy Schedule" link.

Conclusion

The future of broadcast weather radar is in dual-polarization, but as with any transition, there are sure to be challenges. One of these is preparing the broadcast meteorology community for the influx of new data it will soon have, whether through a local NEXRAD upgrade, or a privately owned weather radar. Knowledge is power, so encourage your station's weather team to attend seminars on the topic. Both the National Weather Service and at least one vendor have begun their own education efforts, ensuring broadcast meteorologists have the tools to understand dual-polarimetric data products, and how the data can be used to their stations' advantage.

By anticipating the role dual-polarimetric radar will soon play in your market, your station can provide even better local radar information, and harness the potential of this new technology. BE

Michael Richardson is marketing communications manager, Baron Services.

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Station files may move

The FCC proposes to host public files on its website.

BY HARRY C. MARTIN

Under a proposal released in October, the FCC plans to host on its website all television station public files.

The proposed plan

Licensees would have to compile most of the same materials currently required to be maintained in the public file. But for the first time, the public file would include sponsorship identification information for furnished programming, in addition to agreements about shared services among licensees. All such materials would have to be scanned and submitted to the commission, which would then post them on the FCC's own website.

The online public file would not include correspondence from the public; that would have to be maintained in a correspondence file at the station, available for public review. All political advertising information would have to be submitted to the FCC, however.

Despite the volume of such information and the practical difficulty of keeping up with the flow of political buys in the midst of an election season, the FCC proposes that all political files be uploaded "immediately absent unusual circumstances."

The commission is proposing to eliminate the need for TV licensees to include a copy of their contour maps in their public files, but they would have to include express identification of their main studio locations. The FCC also proposes to require TV stations to air announcements of the existence, location and accessibility of their online public files at least three times per week as part of their station identifications.

This initiative [FCC Form 355] was broadly opposed by the television industry.

FCC Form 355

In 2007, the FCC proposed that TV licensees be subject to "enhanced disclosure" of their public service programming efforts using a new FCC Form 355. The form, which never went into effect, sought detailed information about a wide range of program categories, e.g., national news, local news, local civic affairs, local electoral affairs, local programming, paid and unpaid PSAs, underserved communities programming, religious programming, and independently produced programming. This initiative was broadly opposed by the television industry.

The proposed changes to the public file rule vacate the 2007 order creating Form 355. But the commission indicates that it is seriously considering an alternate reporting requirement that substantially streamlines and revises Form 355. According to the FCC, the industry can expect to see a notice of inquiry seeking comments on that alternate approach.

Formatting and uploading

As the commission envisions the transition to an FCC-maintained online public file, each licensee would be required to upload into its online FCC file location all materials already in its public file. The commission has delegated to the Media Bureau the task of determining how, when and in what format the contents of several thousand public files are to be uploaded.

Public comments invited

This public file initiative is merely a collection of proposals. The commission takes pains to solicit comments on the wide variety of questions that these proposals raise. A separate section of the notice of rulemaking solicits cost/benefit analyses relative to the various proposals. Television licensees should review the proposals carefully with an eye toward providing the commission as much detailed information as possible, particularly with respect to any burdens the proposed system is likely to impose. It is clear from the text of the proposal that this item was drafted with the preconceived notion that any such burdens would be minimal and easily absorbed. BE

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

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

Dateline

- On or before Feb. 1, 2012, noncommercial TV and Class A stations in Kansas, Nebraska and Oklahoma must file their biennial ownership reports.
- Television stations in Washington, D.C.; Maryland; Virginia; and West Virginia must begin their renewal pre-filing announcements on April 1, 2012.
- By Feb. 1, 2012, TV and Class A TV stations in the following locations must place their 2012 EEO reports in their public files and post them on their websites: Arkansas, Delaware, Kansas, Louisiana, Mississippi, Nebraska, Oklahoma, New Jersey and New York.

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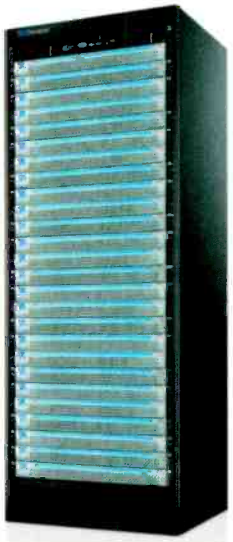

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Facility A/V timing

Managing A/V sync remains challenging for broadcasters.

BY ALDO CUGNINI

Although content distributors have recently gotten the message on audio operations — in the form of federally mandated requirements on commercial and program loudness — the issue of well-managed A/V sync remains unresolved. Despite awareness by program distributors, this problem has persisted, with digital technology both exacerbating it and providing solutions for it.

Causes and solutions known

The causes of poor A/V sync are by now well known, as are the limits of acceptable performance. An understanding of the perceptibility of sync errors goes back to various studies and recommendations, including those of ITU, the film industry and ATSC. ITU found that errors could be detected at +45ms and -125ms for timing of sound relative to vision. The asymmetry is a property of human perception, naturally acclimated to the slower transit speed of sound. They also described an acceptability range of +90ms to -185ms. ATSC tightened the numbers for acceptability with a recommendation of +15ms to -45ms (as shown in Figure 1), and the film industry has come to adopt a tolerance for what it calls "lip flap" of ±22ms, i.e. ±½ frame at 24fps.

Managing A/V sync consists of four basic elements: specification and design of equipment and systems, synchronization measurement, correction, and operational diligence. Specification requires a mind-set to plan and manage the issue in new and existing infrastructures. Equipment is available that can measure A/V sync, either out-of-service (using flash-and-beep or similar technologies), or in-service, using watermarking or fingerprinting.

Watermarking is a technology that inserts a digital signature into the video and audio programs. Although it is a goal that such a process must not perceptibly affect the program content, programmers in general have not accepted that on face value, and the technology has thus met with some resistance as a universal solution. Fingerprinting appears to be a more acceptable solution, wherein the video and audio are sampled, typically frame-by-frame, and a unique non-invasive identification signature for each frame is produced. (See Figure 2 on page 22.) Audio-video fingerprint pairs, generated at a point of known A/V sync, can thus be relayed in their own, out-of-band stream, and used to check A/V sync at other parts of the program chain.

Once the signal has been fingerprinted, improper A/V sync can be corrected at other points by re-measuring the audio-video pair, generating

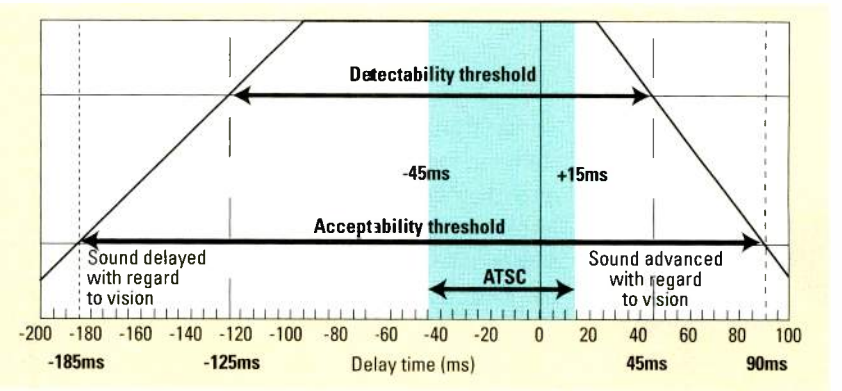
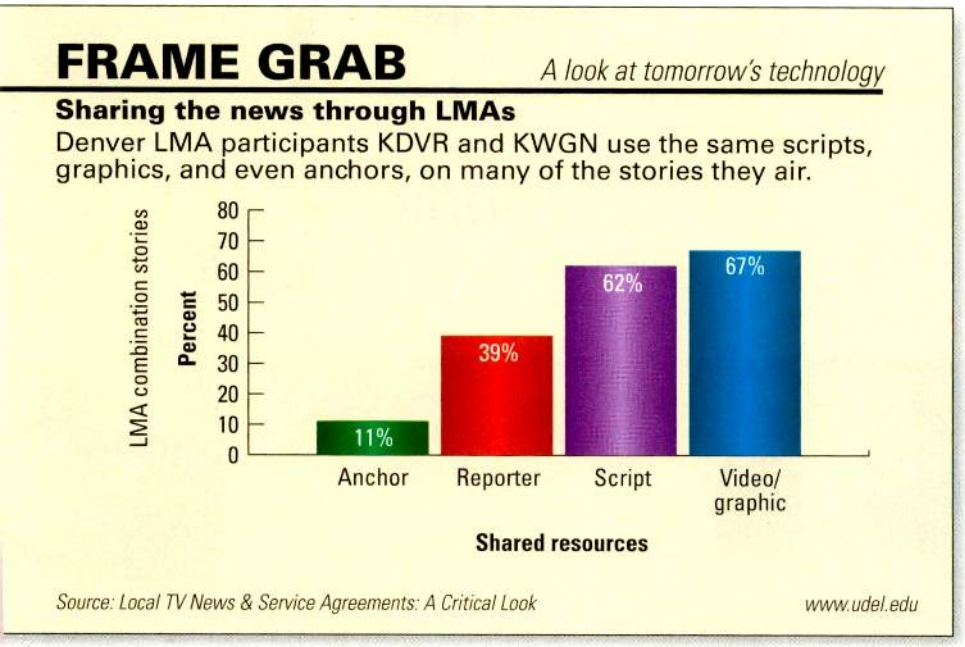


Figure 1. ATSC tightened the numbers for acceptability with a recommendation of +15ms to -45ms.



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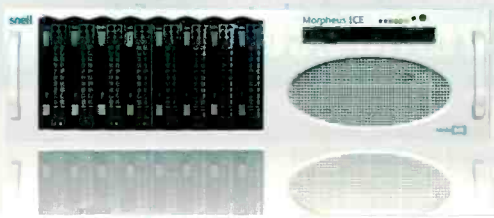

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a new fingerprint and comparing with the reference. Correction involves delaying the audio or video a commensurate amount. This usually requires a static (manual) correction, (i.e., a one-time, infrequent correction), assuming changes in equipment or equipment behavior may have occurred. So that the system can operate continuously, this correlation function needs to operate over a moving window; studies suggest a 10-second buffer with a lock time of about 30 seconds.

Although in principle a dynamic (automatic) correction might be desirable and could be designed into a system or component, conservative engineering practice advocates staying away from such a solution, which could be susceptible to instability. This is especially true for systems with wandering A/V sync: it is better to find the cause of the problem and rectify it, than to slap a bandage on an ongoing unidentified issue.

Current fingerprinting technology can provide an accuracy of better than 1ms, with a high degree of content-identification confidence. A growing number of audio and video processors are now incorporating fingerprint generators and detectors, making system planning and control much more attractive. Current equipment can provide manual audio delay, line equalization and automatic frequency response control using OTA training. GPS synchronization can also provide another point of reference for geographically distributed systems. Many of these modules are already part of the signal path, and with a separate fingerprint stream relayed over an SNMP/Ethernet signal-management network, content can be monitored and corrected as a part of normal system operations. The VANC and MPEG streams can carry sync information, too, but such use may be precluded by incompatible equipment, or even by content agreements.

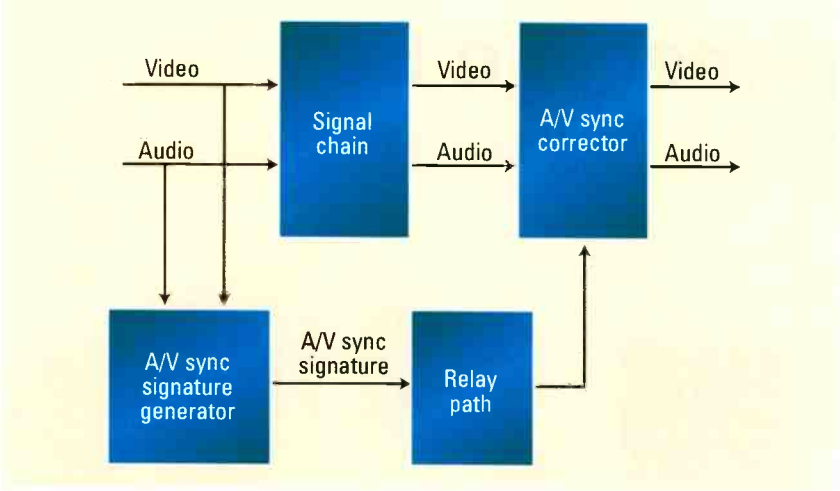

Figure 2. Fingerprinting allows correction of A/V sync error.

Importance of standardization

AES, SMPTE and IEEE have all formed study groups and committees to investigate various standards for lip-sync error-detection and evaluation systems. Of these, the SMPTE 22TV Lip Sync Ad Hoc Group (AHG) has been working to develop an open standard for in-service audio-video timing error measurement. The group is considering a number of requirements for such a system,

including a specification for fingerprinting that has low complexity and operational robustness. Overall, the AHG aims to specify a system that enables automatic detection and measurement of A/V sync errors, works through complex distribution systems, is resilient to signal processing including up- and downconversion, and enables detection of errors at multiple points in the chain and over multiple distribution paths. Systems and technologies have been presented to the group by Mirandah and Zeitera, demonstrating the feasibility of a universal method for generating fingerprints and handling them in the plant.

The SMPTE work is aimed at ensuring that such a system be interoperable across multiple vendors of fingerprint generators and detectors. The group also is examining the requirements for the data paths and protocols needed to relay fingerprint data, including content delivery and transmission. At this point in time, a candidate technology has been identified, and initial drafting of the core documents is underway. A prototype of the system has been realized in both the hardware and software domains, and is undergoing end-user field testing to characterize its behavior and identify opportunities for optimization.

As a result of recent SMPTE committee restructuring, this work is now proceeding in the 24TB-01 Ad-Hoc Group – Lip Sync. The chairmanship has transitioned from Graham Jones (who has retired) to Paul Briscoe. The committee welcomes additional participation, as work is now reaching a mature stage; interested parties should contact the chair at pbriscoe@harris.com.

What else can be done?

Because the causes of poor A/V sync extend over the entire signal chain, solutions need to be implemented in a wide-reaching campaign. All parts of the contribution side need scrutiny, including trucks and other sources. It should become standard practice to conduct an out-of-service flash and beep of all signal-handling components. Content distributors should acquire reference decoders, and sample CE devices on an ongoing basis through appropriate test arrangements.

Encoder and signal-processing equipment manufacturers have a competitive interest in testing their product technology both in development as well as in and out of service. If there is a design problem in the equipment, new products can be developed, and users must consider replacement or upgrades if possible. A standard under development makes a strong case for FPGAs, offering a faster design-to-market cycle when a known specification is finally released.

On the consumer side, many TV receivers and set-top boxes still do not manage A/V sync properly. Lab experiments show that decoders can have differing amounts of A/V sync error on startup, and can drift, too. Unfortunately, equipment replacement may be the only solution there, which is a slow function of time. And with content increasingly being mastered in 5.1 channels, consumers will be expecting a better viewing and listening experience.

The interest of content distributors in solving this problem is hard to gauge; lacking a clear financial incentive, and reluctant to deploy a technology that may not interoperate with other systems, they may be adopting a wait-and-see attitude for the SMPTE standardization process. Fingerprinting technology shows great promise for A/V sync management, but the work of industry committees must have a quick and profitable path to market, as uncertainty can delay implementation. BE

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JPEG 2000

It has benefits over IP networks, but some issues exist.

BY BRAD GILMER

JPEG 2000 has caught the attention of the professional media world for good reason. First, it closely matches some workflows, where the production process operates on each frame of a video stream as a discrete unit. This is different from MPEG-2 and MPEG-4 AVC, where, during the reconstruction process, algorithms reference frames before and after the frame being reconstructed. The ability to compress each frame as a free-standing unit has made it popular in the digital intermediate space in Hollywood. JPEG 2000 is also of interest to those who want lossless compression. It can provide a bit-perfect reconstruction of the original compressed image, although at a cost in terms of bandwidth. Also, the wavelet compression used in JPEG 2000 provides some unique opportunities that are not available in other compression methods.

The wavelet transform separates the image into four sub-bands. The first sub-band is a lowpass horizontal and lowpass vertical (LL). Images that have gone through this separation are basically lower-resolution images of the original. The other sub-bands are as follows: lowpass horizontal and highpass vertical (LH); highpass horizontal and lowpass vertical (HL); and highpass horizontal and highpass vertical (HH). Using wavelet transforms and some clever thinking, implementers can do some interesting things. For example, they can send only the LL image, if they know that they are feeding a low-resolution display. Or they can send the LL sub-band in a highly-protected stream, in order to ensure the original image arrives intact. That said, they can then send the higher-resolution sub-bands unprotected since a momentary loss of these sub-bands is not likely to be noticed.

Given JPEG 2000's popularity, it is not surprising there have been some developments that make it particularly interesting for professional applications. First, the ITU has created an amendment[1] that outlines specific configurations for broadcast contribution applications. These configurations are intended to establish interoperability points for those implementing JPEG 2000 in professional applications. This is important because, until the amendment was released, there were so many variables in the compression tool set that interoperability was unlikely. The second important development, Amendment 5 to the MPEG 2 standard[2], provides a mapping of the JPEG 2000 Program Elementary Stream (PES) onto the MPEG-2 Transport Stream (TS).

JPEG 2000's ability to compress each frame as a free-standing unit has made it popular in the Digital Intermediate space in Hollywood and to those who want lossless compression.

Finally, some time ago, the Pro-MPEG Forum started to develop

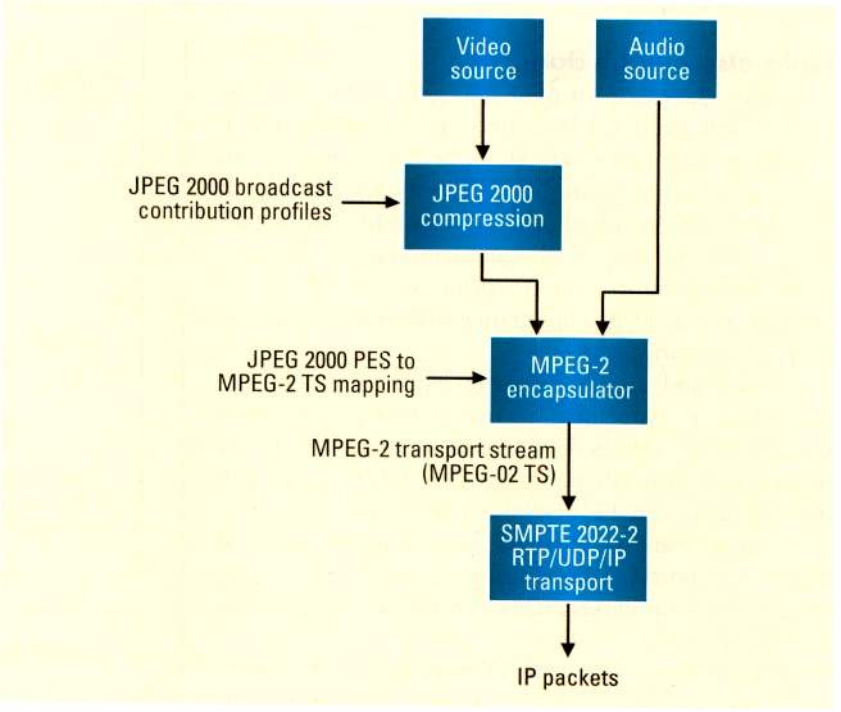

Figure 1. JPEG 2000 over IP relies on three critical developments: broadcast contribution profiles, JPEG 2000 PES to MPEG-2 mapping, and SMPTE 2022-2 for MPEG-2 transport over IP networks.

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a standardized way to transport MPEG-2 TS over IP networks. The Video Services Forum picked up on this work and continued to develop it, finally submitting a draft for standardization within the SMPTE. This standard, SMPTE 2022-2[3], describes a method for mapping MPEG-2 Transport Streams onto IP networks using RTP and UDP. The document was approved in 2007 and is the most common standard deployed today for professional video transport applications.

So these three developments — development of broadcast profiles; a mapping of JPEG 2000 Program Elementary Streams to MPEG 2 Transport Streams; and wide availability of MPEG-2 TS over IP transport equipment — mean now it is possible to transport JPEG 2000 over IP networks. Figure 1 on page 24 shows how these developments work together.

Starting with a video source, the image is compressed using a compression engine. This engine is configured to one of the Broadcast Contribution profiles in ITU-T Amendment 3. The compression engine produces a JPEG 2000 PES. This stream is then fed to an MPEG-2 encapsulator. The encapsulator uses the mapping rules established in the MPEG-2 specification, Amendment 5, to map the PES onto an MPEG-2 TS. This MPEG-2 TS is fully compliant with MPEG-2 specifications because, from the outside, it looks just like a normal MPEG-2 transport stream. As such, the output of the MPEG-2 encapsulator can be fed into a SMPTE 2022-2 compliant video transport device. This device encapsulates the MPEG-2 TS in standard RTP and UDP packets, and then those packets are wrapped in IP packets. These IP packets can now be fed into an IP network.

You might wonder why we take a relatively new compression algorithm such as JPEG 2000 and encapsulate it in MPEG-2. There are several reasons for this. First and foremost, there are already a number of specifications for how to encapsulate a number of different audio formats into MPEG-2 transport streams. Remember: JPEG 2000 says nothing about audio. Using MPEG-2 TS allows us to transport and present the audio alongside the JPEG 2000 compressed video using well-known audio standards. Also, this approach allows us to leverage the existing SMPTE 2022-2 MPEG-2 TS over IP standard. Finally, there are no technical issues in MPEG-2 TS that need to be fixed in this application space, so re-use of transport streams rather than inventing something entirely new seems like a good solution.

So, the good news is that the time is ripe for development of an interoperable, open solution for the transport of JPEG 2000 video and audio over IP networks. The standards exist, and there is a clear path forward. But, there are a few issues that need addressed.

JPEG 2000 has been around for quite some time. As such, some proprietary JPEG 2000 over IP transport solutions have already been created. Of course, these were developed in response to customer demand, so existing implementations may need to be changed. Another issue is that while the broadcast contribution profiles in Amendment 3 go a long way toward interoperability in the JPEG 2000 PES space, recent analysis suggests, without further definition, implementations based upon these profiles will not be interoperable. Finally, until the industry actually tries to connect devices from different manufacturers together, interoperability cannot be assured.

Recent analysis suggests, without further definition, implementations based upon broadcast contribution profiles in Amendment 3 will not be interoperable in the JPEG 2000 PES space.

Fortunately, the industry is becoming aware of these issues, and steps are being taken to begin work in earnest on interoperable, open transport of professional JPEG 2000 images over IP networks. I would expect to see some developments around this in the first half of the coming year. BE

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

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Footnotes:

1. "Profiles for Broadcast Applications" ISO/IEC 15444-1:2004 Amd.3-2010 (ISO/IEC, Geneva, Switzerland: 2010) |Rec. ITU-T T.800 Amd.3 (06/2010) (ITU, Geneva, Switzerland:2010)
2. Amendment 5: Transport of JPEG 2000 Part 1 (ITU-T Rec T.800 | ISO/IEC 15444-1) video over ITU-T Rec H.222.0| ISO/IEC 13818-1
3. SMPTE ST20 22-2:2007 "Unidirectional Transport of Constant Bit Rate MPEG-2 Transport Streams on IP Networks

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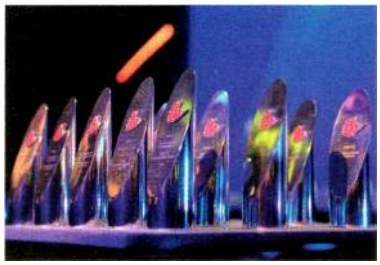

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4K2K

The format offers an intermediate step on the way to Ultra High HD.

BY STEVE MULLEN

If you are in London during the 2012 Olympics without a ticket, there is an alternate way for you to "be present" at certain events. The BBC plans to broadcast part of the games in Ultra High HD (UHD) in select locations. UHD, which has been under development by NHK for years, delivers an "8K4K" (7680 x 4320) pixel image. With a planned commercial introduction in five years, an intermediate production step is necessary. This step, to be generally introduced at CES 2012, is "4K2K."

For many in the broadcast industry, 4K2K will be a surprise — likely an unwanted surprise. For those in the film world, 4K2K is not new at all. Film is routinely telecined to 4K2K files for digital intermediate (DI) processing, and features are shot with 4K2K cameras.

For many in the broadcast industry, 4K2K will be a surprise — likely an unwanted surprise. For those in the film world, 4K2K is not new at all.

In this first of a two-part series, we will begin our exploration of 4K2K by examining several current 4K2K cameras. Doing so will introduce the many challenges involved in this technology.

Beyond pixel count

Amazingly, unlike a decade ago when 2-megapixel CCDs were exotic, most camcorders now employ CMOS sensors, and 8-megapixel sensors are so common that many smartphones feature them.

Issues beyond pixel count are present with both full HD and 4K2K video cameras. First, how is information read from a CMOS sensor? The greater the number of photosites, the higher the frame rate and the larger the frame size, the more demanding the read-out process. Unless implemented well, a sensor's clock rate will be so high that the power it consumes will create more heat than can be dissipated, leading to limited shooting durations, especially in high ambient temperatures.

Second, many full HD, and most 4K2K cameras, have only a single sensor and thus use a Bayer RGB filter. To obtain an RGB image, sensor data must be de-Bayered. Camera engineers have a choice: Design a camera that delivers equal, or less, RGB resolution than does a three-chip camera.

Third, is the camera targeted to a cinema or video shooter? If the former, then the sensor will be large, Super 35 (23.60mm x 13.25mm), APS-C (23.6mm x 15.7mm), or Micro Four Thirds (M43) (21.6mm x 17.3mm) size, to support obtaining a shallow depth of field (DOF). A videographer may, however, require only the high resolution of 4K2K, thus allowing the use of a small 1/2in (6.4mm x 4.8mm) chip or 1/2.3in (6.16mm x 4.92mm) chip.

Consumer 4K2K cameras — yes, there will be consumer 4K2K cameras — will likely have small chips. Prosumer 4K2K cameras may use small M43, APS-C, or Super 35 chips. The use of M43 and APS sensors is natural because DSLR development is the parent of many of today's single-sensor full HD cameras and camcorders. This technology transfer will continue for 4K2K.

Red Digital Cinema's RED ONE

The Red Digital Cinema RED ONE is the 4K2K camera that most in the broadcast industry are familiar with. Equipped with the newer MYSTERIUM-X sensor, the ONE has a 5120 x 2700 photosite, Super 35, 14-megapixel CMOS chip. The sensor can be "windowed" during read-out to provide four 4K2K frame-sizes.

RED Digital Cinema RED ONE

The largest 4K2K frame size, called "4K 16:9," has a 4096 x 2304-pixel frame. The second frame size, called "4K 2:1" and "4K anamorphic 2:1," has a 4096 x 2048 frame. The third frame size, called "4K HD," has 3840 x 2160 pixels and can be used when shooting HD and 4K2K video productions. (I expect professional, prosumer and consumer 4K2K cameras will use a 3840 x 2160 frame. Projectors and monitors will likely support both 3840 x 2160 and 4096 x 2160.)

The RED ONE can shoot a range of frame rates. However, a trade-off must be made between frame rate and frame size. To shoot at high rates, read-out line width can be set to "3K" or "2K" pixels.

Once a RED ONE captures a frame, it is read out as sequential RGB. The

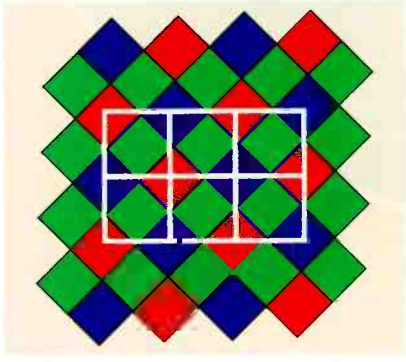
sRGB data then take two different paths. RAW sensor data are wavelet compressed (12-bit REDCODE RAW codec) and output for recording. Data are also sent through the second path to an on-location monitor. While watching the image, a DP can adjust it to create a desired look. Settings, however, do not alter data that are recorded. Rather, the settings become metadata that are recorded with image data. During post, a colorist can use the on-location settings as well as make their own adjustments.

To obtain an RGB image, after decompressing REDCODE data, they are de-Bayered within RED applications. Until this point, frames are defined only in terms of photosite count. Camera resolution cannot be measured. Because there are many de-Bayering algorithms, the process is a critical aspect of single-sensor cameras. See the "Understanding de-Bayering" sidebar.

RED ONE, with the original 4520 x 2540 MYSTERIUM sensor, has a horizontal resolution measured at almost 3100 TVL (1550 line pairs), which means de-Bayer "efficiency" is about 78 percent. The goal of obtaining 4000 TVL resolution is brought closer by the RED EPIC, which has a 5K (5120 x 2700) sensor that, after de-Bayering, should provide about 3874 TVL (1937 line pairs).

Sony's F65

At the opposite end of the price range, Sony offers its F65. The F65 has a CMOS sensor that Sony markets as delivering "true" 4K.



Sony F65 "true" 4K CMOS sensor

Understanding de-Bayering

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. (See Figure A.)

Figure A: 16-pixel Bayer filter

For example, a 1000 x 1000 sensor can provide only 500 x 500 green samples. 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." Published values vary widely, but range from 70 percent to 80 percent per axis.

A software de-Bayer can be adjusted so it recovers more fine detail at the expense of artifacts or deliver a smooth, very clean image. Likewise, a camera designer can choose the desired value. A working value for a high-quality process is 78 percent.

Our example sensor should have at least 1282 x 1282 pixels, 1.64 megapixels, to enable de-Bayering to recover 1000 x 1000 green pixels (1/0.78 x 1000). The increase in pixels is 1.64 times. Therefore, a single-sensor full HD camera should have a 3.4-megapixel sensor, while a 4K2K camera should have a 13.6-megapixel sensor. (Both sensors have a 16:9 aspect ratio.)

Sequential RGB (sRGB) data are de-Bayered to create an RGB image that inherently has 4:2:2 color sampling. The de-Bayer process can be nearest neighbor, linear, cubic, cubic spline, etc. What follows is a simplified description of nearest neighbor de-Bayering.

Figure B shows an interpolated green value where there is only a red sample. Depending on the higher correlation, adjacent vertical or adjacent horizontal pairs of green samples are used.

Figure C shows an interpolated green value where there is only a blue sample. Depending on the higher correlation, adjacent vertical or adjacent horizontal pairs of green samples are used.

Missing red values are obtained by interpolating them from nearest neighbor red samples that are horizontally adjacent to a green pixel that has no red sample. (See Figure D.)

Missing red values are also obtained by interpolating them from nearest neighbor red samples that are diagonally adjacent to a blue pixel that has no red sample. (See Figure E.)

Missing blue values are obtained by interpolating them from nearest neighbor blue samples that are vertically adjacent to a green pixel that has no blue sample. (See Figure F.)

Missing blue values are also obtained by interpolating them from nearest neighbor blue samples that are diagonally adjacent to a red pixel that has no blue sample. (See Figure G.)

Figure B: Interpolated green value where there is only a red sample

Figure C: Interpolated green value where there is only a blue sample

Figure D: Interpolated red value where there is only a green sample

Figure E: Interpolated red value where there is only a blue sample

Figure F: Interpolated blue value where there is only a green sample

Figure G: Interpolated blue value where there is only a red sample

After de-Bayering a frame of sRGB data, the result is an equal size RGB frame.

Sony's first 250,000-pixel CCD camera

The 20-million photosite sensor, which has a diagonally oriented Bayer pattern, provides a green sample for every pixel in a 4K2K RGB image. Sony claims the chip's unique design provides full horizontal, vertical and even diagonal resolution on the green channel, plus full horizontal and vertical resolution on the blue and red channels. (This chip would have been unbelievable in 1985, when I bought Sony's first 250,000-pixel 2/3in CCD camera.)

Although different in price, the Sony and RED cameras both have a single Super 35-size CMOS sensor that can be read out fully for each capture.

Canon's EOS C300

The announced Canon EOS C300 also has a Super 35-sized sensor. It has a 3840 x 2160-photosite Bayer-pattern sensor. However, the sensor operates in unusual manner: Two rows are read out simultaneously. Thus, an "upper" and "lower" photosite pair are available at the same time. When each photosite pair from two rows is combined with another pair, delayed by one pixel-time, from the previous column, signals from four photosites are available. Each 2 x 2 photosite group (RGBG) is combined into a single RGB pixel. This process yields a 1920 x 1080-pixel frame that has, by definition, 4:4:4 color sampling. Each full HD frame of 8-bit data is then compressed using 50Mb/s, 4:2:2 long-GOP MPEG-2.

Canon EOS C300

Canon has already announced that it is developing a full-frame DSLR that will have a 3840 x 2160-photosite sensor that will record 4K2K. BE

Steve Mullen is the owner of Digital Video Consulting.

Real loudness control

Does a real answer exist amid theories and frustration?

BY RANDY CONROD AND STEPHANE GAUTHIER

Loudness, if you will, increasingly has been making noise in the broadcast industry. Standards organizations have been working long and hard to publish recommendations, best practices and specifications to guide the industry and ensure consistent measurements.

Governments are introducing legislation to promote and enforce better regulation. Equipment vendors are writing articles to discuss the situation. Experts have penned books on the subject. Yet, despite all the available information, there remains a great deal of uncertainty as to how to best deal with the issue.

The loudness paradox lies at the heart of the matter. On one side, there is a desire to maintain the artistic integrity of the original program (translation: don't modify audio). On the other, there is a need to minimize viewer frustration with regard to loudness inconsistencies across different content and channels. (See Figure 1.) This often requires some level of audio processing.

The paradox is this: How can loudness be kept consistent if the audio is not modified?

Before we discuss possible solutions, it's important to define a few basic terms:

- *Artistic integrity*: Original dynamic range + original spectral density.
- *Long-term loudness*: Loudness of the clip averaged over a relatively long period of time (usually the duration of the entire clip).
- *Short-term loudness*: Loudness of the clip measured over a very short period of time (measured in milliseconds or seconds).
- *Dialnorm*: Metadata value used to indicate the long-term loudness of a clip.

Loudness control on ingest

Careful audio management on ingest will go a long way toward providing consistent loudness. Tools are available now that allow broadcasters to measure the loudness of an entire clip, and then adjust the gain of the clip to ensure that the overall long-term loudness is at the desired level. That way, regardless of what content is played, each clip will share the same long-term loudness, thereby minimizing loudness inconsistencies.

A single gain value is applied across the clip, ensuring the dynamic range (the difference between the softest and loudest audio) is perfectly preserved. (See Figure 2 on page 32.) This satisfies the first half of the artistic integrity formula: *artistic integrity = dynamic range + spectral density*. Since the gain is applied equally across the frequency spectrum, the spectral content of the audio is also preserved, fully satisfying the artistic integrity formula: *artistic integrity = dynamic range + spectral density.*

However, there are a few places where this approach is problematic:

- Silence — Long periods of silence contribute to average loudness,

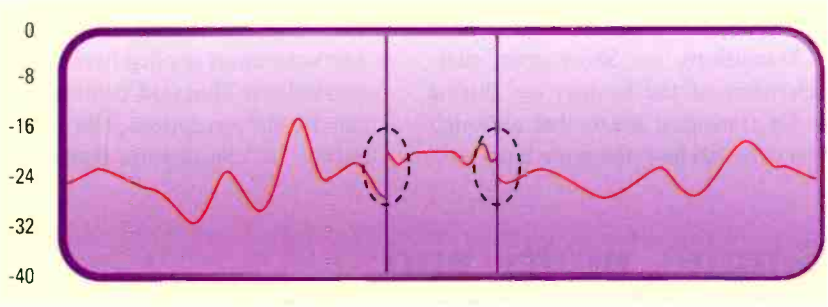


Figure 1. This image shows a clip prior to any gain adjustment, highlighting the disparity between loudness levels.

ITU-R BS.1770 adoption

The measurement algorithm must come close to mimicking the human perception of loudness in order to be useful. The accuracy of an algorithm is determined by how close it comes. Any difference between the two essentially leads to incorrect audio gain adjustments, and therefore unnecessary audio modifications and an incorrect overall loudness.

The ITU-R BS.1770 algorithm was developed to identify a means of measuring loudness by splitting the signal into five frequency bands and applying a weighting filter. This solution is simple and cost-effective for equipment manufacturers to implement, and results in a reasonably good approximation.

More complex techniques (such as critical-band analysis) are available with better accuracy. These techniques require more hardware/software processing power, and the expertise is limited to very few companies worldwide. Such complex technology would severely restrict wide adoption of the standard. ITU-R BS.1770 represents a good balance between accuracy and simplicity, enabling widespread adoption. With everyone using the same technique, content across providers will be more consistent.

For more information on measurement techniques, refer to "Perceptual Loudness Management for Broadcast Applications" by DTS.

lowering the measured result. The gain applied must, therefore, be increased such that the long-term loudness of the clip reaches the desired level. This impacts the dialog level of the clip and can lead to dialog levels that are slightly different between clips. Dialog is considered a key "anchor" point in human loudness perception. Gating algorithms have been developed to suppress periods of silence from contributing to the measured result. Some mild, short-term loudness control processing will help reduce differences in perceived dialog levels, while having little impact on the overall dynamic range.

- *Trade-off decision*: With a proper gating algorithm, differences in dialog levels should be very small. Any short-term correction should be very light.

- Transitions — Short-term characteristics of the human ear during a clip transition mean that although two clips can have the same long-term loudness, the switch point from one clip to the next could cause the ear to perceive a sudden jump in loudness. Again, mild, short-term loudness control will help to reduce the jumps.

  - *Trade-off decision*: The jumps in loudness perception will not always happen. When they do, however, they are usually short lived. Any correction applied here should also be light. That said, commercials can be the exception. The largest source of complaints, transitioning to a commercial often results in a sudden increase in loudness. This is partly due to the severely restricted dynamic range of most commercials, which translates to a high average loudness value.

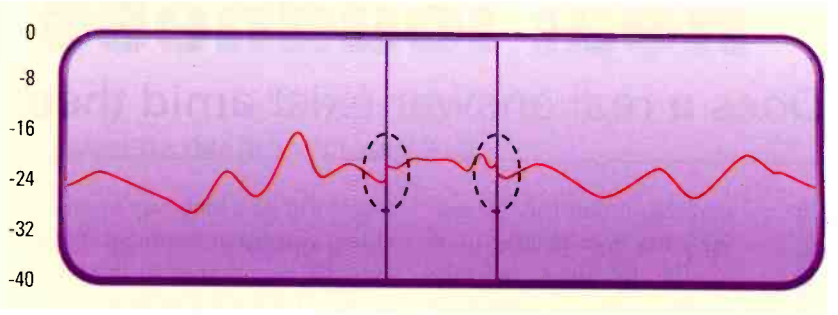


Figure 2. This image shows the same clip from Figure 1 after a single gain value has been applied across the entire spetral content. The spectral density has been preserved, satisfying the artistic integrity formula.

- Live audio — Live material and material received too late to be processed before going to air cannot have its long-term loudness measured. It is necessary to apply some level of short-term, real-time control to keep the loudness reasonably close to the desired level. The level of the anchor point, in this case, will depend on the person mixing the audio or the absolute gain value of the incoming audio. It is, therefore, subject to more unpredictability. Generally speaking, this scenario requires more aggressive loudness control to ensure the anchor point is close to the desired target level.

  - *Trade-off decision*: In this case, the variations in perceived loudness could be substantial, and the loss of artistic integrity is overshadowed in cases where the audio level becomes annoying to the listener. More aggressive loudness control is recommended.

Single-, multi- and critical-band techniques

Manufacturers of multiband compressors often provide content-based profiles, in addition to controlling the amount of loudness control. This is useful for choosing profiles that match the type of content going through, so that the multiband compressor can adapt to different audio characteristics (for example, news, sports, drama, jazz music, rock music, etc.). This helps to compensate for the differences between how a multiband compressor measures loudness and how the ear perceives loudness. It also helps to compensate for the changes to spectral density that multiband compressors, by definition, impose on the audio.

Loudness controllers that use critical-band analysis, however, do not need to offer such profiles. The increased computational algorithm delivers a loudness measurement that is mathematically much closer to how the ear perceives loudness and is a single result for the entire audible range. This means that a loudness controller that uses critical band loudness measure can apply a single gain to the entire signal (known as "wideband") and, therefore, does not change the spectral density of the signal in any way.

This is not to be confused with single-band compressors (also known as wideband) that only look at the intensity of the signal to apply gain correction. These original wideband compressors create significant, audible artifacts and are not suitable for modern broadcast loudness control.

For more information on single-band, multi-band and critical-band techniques, refer to "Perceptual Loudness Management for Broadcast Applications" by DTS.

Dynamic correction profiles

With many different profiles, it becomes necessary to adapt to the content. This translates into providing the least possible amount of real-time correction for the situation at hand.

Automation can be of great service to a network or station. Known good content can have mild processing only. Enhanced processing can be enabled for live or unknown/unprocessed

content. It is important for real-time loudness controllers to be able to respond to automation triggers.

A benefit of leaving some mild processing for all content is it helps when known good content is not at the correct loudness. This can happen when the ingest control process is applied incorrectly or inconsistently, or when dialnorm metadata is either incorrect or missing.

In addition to mild processing, some loudness controllers provide more advanced features such as intelligent metadata handling of missing/incorrect dialnorm, and input loudness measurement alarms to warn of very hot or very quiet content.

Cascaded processing

One of the simplest approaches is a "set and forget" control profile. The controller will be configured to apply mild processing, providing an excellent trade-off between artistic integrity and consistent loudness level. That said, someone upstream or downstream may also apply loudness correction. Imagine where a feed, with mild loudness correction is sent to a local station, which then also applies mild correction. The effect is an ever-increasing reduction in the signal's dynamic range.

Everyone in the audio chain must understand sources and destination, and have flexible enough systems to dynamically make changes as required.

Tailored solutions

There are many unique applications and situations, with different characteristics and requirements for each. There is no "one size fits all," and engineers must tailor solutions to the situation at hand.

Good ingest loudness management is one of the most important steps in ensuring consistent levels. However, processing the audio is inevitable in some scenarios. Therefore, quality of the real-time loudness control processor is key when choosing a real-time solution.

To provide a solution that minimizes processing, real-time controllers must apply the most appropriate correction profile. The goal is a system that preserves artistic integrity of the audio wherever possible, while applying only enough processing to ensure compliance. Spending time up front to configure such a system will result in an enhanced listening experience. **BE**

Randy Conrod is product manager, digital products, Harris Broadcast Communications. Stephane Gauthier is senior account manager, strategic sales, Altera.

SYSTEM DESIGN SHOWCASE

WOWT: The foundation for the Gray Model

A new station design concept removes master control from the workflow equation.

BY JIM OCON, VIC RICHARDS AND MIKE FASS

The transition to a digital and HD workflow represents a cultural shift for the broadcaster. That shift can take many forms, from basic playout automation to full-fledged centralcasting. Regardless of the chosen path, the workflow transition forever alters the way stations and network facilities operate.

Gray Television has been on record talking about the Gray Model, its unique twist on workflow integration at the station level. The concept goes far deeper than the obvious transitional points: The company characterizes it as a full heart, lung and brain transplant as opposed to a simple strategic shift.

WOWT in Omaha, NE, is the blueprint for this redesign concept, and the first reference point for all Gray stations in transition. The station's deep pool of in-house resources was ideal for the initial project. It also had a well-oiled plant infrastructure that remained efficient but was ripe for an upgrade.

In the new station design, automation replaces the traditional function of the MCR, and multiple station processes are handled from the station's Media Control Center, which features Harris ADC automation and an HView multiviewer, as well as Ross Video OverDrive control. Pictured: Mike Fass, media production manager at WOWT.

Workflow accommodation

Facility staff implemented the new model as opposed to working with an outside systems integrator, learning the equipment inside-out. That upfront knowledge became valuable for future troubleshooting purposes.

The initial stages focused on clearing space to accommodate the new workflow. The station design involves removing the traditional MCR and merging production,

ingest, playout and other operations into a principal area called the Media Control Center.

Master control elimination is perhaps the boldest characteristic of Gray Television's new integration concept. Automation becomes the pulse of the entire ecosystem with master control's absence. Harris ADC automation acts as the force multiplier in the station group's model, merging business and technical operations from traffic and billing through to the transmission point.

The centralized operation removes the need to babysit machines in different spaces and promotes a scalable environment in which adding an automated ingest feed or playout channel is headache-free. The redesign plan essentially supports technical expansion through an open and flexible environment.

Throughout the redesign, the station has downsized to fewer than five racks, each deeper to accommodate more servers. However, as router size decreases and file-based workflows become more common, there may be less need for rack space.

Flexibility in blueprint

It also provides plenty of wiggle room in the blueprint to accommodate subtle differences among stations.

Automated ingest is one glaring difference. WOWT records little syndicated content, which minimizes auto-ingest needs. The majority of the content records automatically, with technical media producers manually segmenting the feeds in ADC.

The entire process ties back to the elimination of master control. The absence of a master control switcher means that ADC is switching destinations on its house router. This transitions the true master control operation to ADC and a NEXIO AMP transmission server, which removes manual switching processes.

This change forces additional QC up front, however. The role of the traffic operator evolves from basic commercial copy assignments to media ingest. This means ingesting commercials, promos and other copy into ADC and analyzing video and audio levels. The media production department subsequently verifies that the material is present, in order and playing back as intended.

ADC automation also generates all as-run files, and imports the files into OSi-Traffic media software. The as-run files become the official station logs as bills are generated and distributed. (Sayonara, paper logs.)

The Nexio AMP server also ties to the newsroom workflow. Raw video is stored on a Facilis Technology TerraBlock SAN, edited on Grass Valley EDIUS machines, and transferred via fiber to NEXIO AMP for play-to-air.

In the core

The broadcast plant infrastructure continues to shrink, its compression almost analogous to the digital signal. This is most obvious in the rack room when studying the integration model.

The station has downsized to fewer than five racks, housing KVM switches; signal-processing equipment; and electronics for the router, Vizrt graphics, and other systems. The racks are deeper to accommodate more servers, but real estate requirements diminish as routers get smaller and file-based workflows take shape.

The engineering staff cleaned up facility power and ensured adequate cooling prior to building out the new racks. Multiple HVAC loops cool the room to ensure that the servers and computer equipment remain operable. The station plans to extend the rack room cooling concept to the computer-rich newsroom and studio areas.

The facility has transitioned to an all-embedded scenario, which makes signal processing fundamentally easier. Following the station group's model, it has replaced outdated satellite receivers, removing the need to populate rack space with multiple audio embedders

WOWT's newly redesigned newsroom features workstations equipped with dual networks that enable newsroom staff to access the Internet and the station's video network.

and de-embedders. These have been replaced with satellite receivers that spit out embedded SDI signals, even if they take analog signals in. This minimizes lip sync issues and makes the overall signal processing much cleaner.

The station has added Harris X50 frame synchronizers and format converters, along with AJA FS1 synchronizers. The X50 offers significantly better technical capability, while the FS1 offers a quick learning curve. Both have their benefits in the station group's redesign model.

At press time, the station is testing audio legalizers from Harris, Linear Acoustic and TC Electronic to please viewers as well as the FCC. Videotek VTM4100 rasterizers handle test and measurement in the infrastructure.

Production and playout

ADC automation and the NEXIO AMP server also connect to a Ross Video OverDrive automated production control system. The Media Client server can cue breaking news clips for playout, and the OverDrive operator can take content to air once quality and duration is confirmed. Other production tools include a Vision switcher — part of the OverDrive system — a Yamaha DM1000 audio mixer, Sony EX3 cameras, and Cambotics robotic camera control systems.

The move to the automated production environment was perhaps the most challenging learning curve, especially in terms of audio. OverDrive rundowns require operators to code audio with video sources at each encoding step. For example, the microphone disappears if the operator fails to code the mic audio with a piece of video.

HView SX Hybrid multiviewers are used in production and traffic. Multiviewers are of increasing significance today: The monitor walls of yesteryear are disappearing as the number of bodies in the facility decreases. It is almost impossible for one or two operators to track everything along a wall of separate monitors.

The multiviewer allows one pair of eyes to monitor a single screen — big enough to accommodate every important element but compact enough to not overwhelm the operator. The multiviewer's ergonomic workflow provides a clear sightline into what is important, with a simple means of interpreting key information. The signals being monitored remain mostly static, with a strong focus on news and other play-to-air sources including camera, server and automation feeds.

The traffic multiviewer is helpful to media specialists for monitoring ingest and record feeds, while providing a second monitoring point for other operators.

Solid backbone

The backbone is central to everything in TV facility operations today, and the station's network topology reflects this reality.

The first goal was to ensure that the station's video network co-existed with the newsroom network. The industry has transitioned to an era where the same workstations are used to access the internet, and send and receive video.

The station has implemented dual networks on each workstation to separate the two processes for maximum protection without handcuffing the staff. Newsroom personnel have access to social media and video networking applications, for example, without requiring separate computers.

The station uses a Cisco Layer III backbone, but it is planning a migration to HP ProCurve, which is easier to configure and requires fewer service plans. The station has implemented ProCurve for asset sharing, as opposed to using islands of KVM switches. The result is a single network for sharing all available assets at multiple locations around the facility. Future plans include upgrading more switches and other network elements to facilitate faster media transfer.

And onto transmission

It would appear on paper that transmission is a separate animal from the type of station redesign described here. The truth is that transmission is the result of all the hard work to this point.

The station transmits four streams: two terrestrial and two mobile. It was among the first stations to launch ATSC Mobile DTV, using the Harris MPH system with integrated encoding, network adaption and amplification via the Apex M2X exciter. The system also includes Roundbox software for electronic program guides and other data services.

The station's workflow DNA remains relevant as the transmission process publishes content to TV sets and mobile devices. Automation and playlists drive the station content that moves over the air. Fewer conversions in the plant — an increasing trend as stations move away from baseband and toward all-IP — make the last mile easier, from stat-muxing through to transmission. Eventually, the transmitter will be the only baseband imprint in the entire chain.

The project has been an ideal proof of concept for the Gray Model as it rolls out to other stations in the station group. With plenty of technical challenges met and learned from, the WOWT team has laid a roadmap that the remaining stations can follow to the next level of broadcasting. BE

Jim Ocon is VP-technology, Vic Richards is director of promotion and media production, and Mike Fass is media production manager at WOWT, Gray Television.

Project team

WOWT:
Vic Richards, director of promotion and media production
Mike Fass, media production manager
Rick Klutts, chief engineer
Amy Adams, news director
Dennis Wilden, executive producer
Mike Plews, chief photographer
WOWT/Gray Television: Charlie Effinger
Gray Television: Jim Ocon, VP-technology, Lisa Guill

Technology at work

AJA FS1 synchronizers
Autoscript teleprompter
Cambotics camera robotics
ENPS newsroom system
Facilis Technology TerraBlock SAN
Grass Valley EDIUS editor
Harris Broadcast
- ADC-100 automation systems
- Apex M2X exciter
- AutoSat automation systems
- HView Predator multiviewers
- MPH Mobile DTV system
- NEXIO AMP servers
- Videotek VTM4100 rasterizers
- X50 frame synchronizer/converters

Ross Video
- CrossOver switcher
- OverDrive automated production control system
- Vision production switcher

Roundbox mobile broadcast software
Sony EX3 HD cameras
Utah Scientific
- SC-4 control system
- UTAH-100/X HD/SD video distribution amplifiers
- UTAH-400/64 router switcher

Vizrt graphics
Yamaha DM1000 audio console

XF305 XF105 XA10

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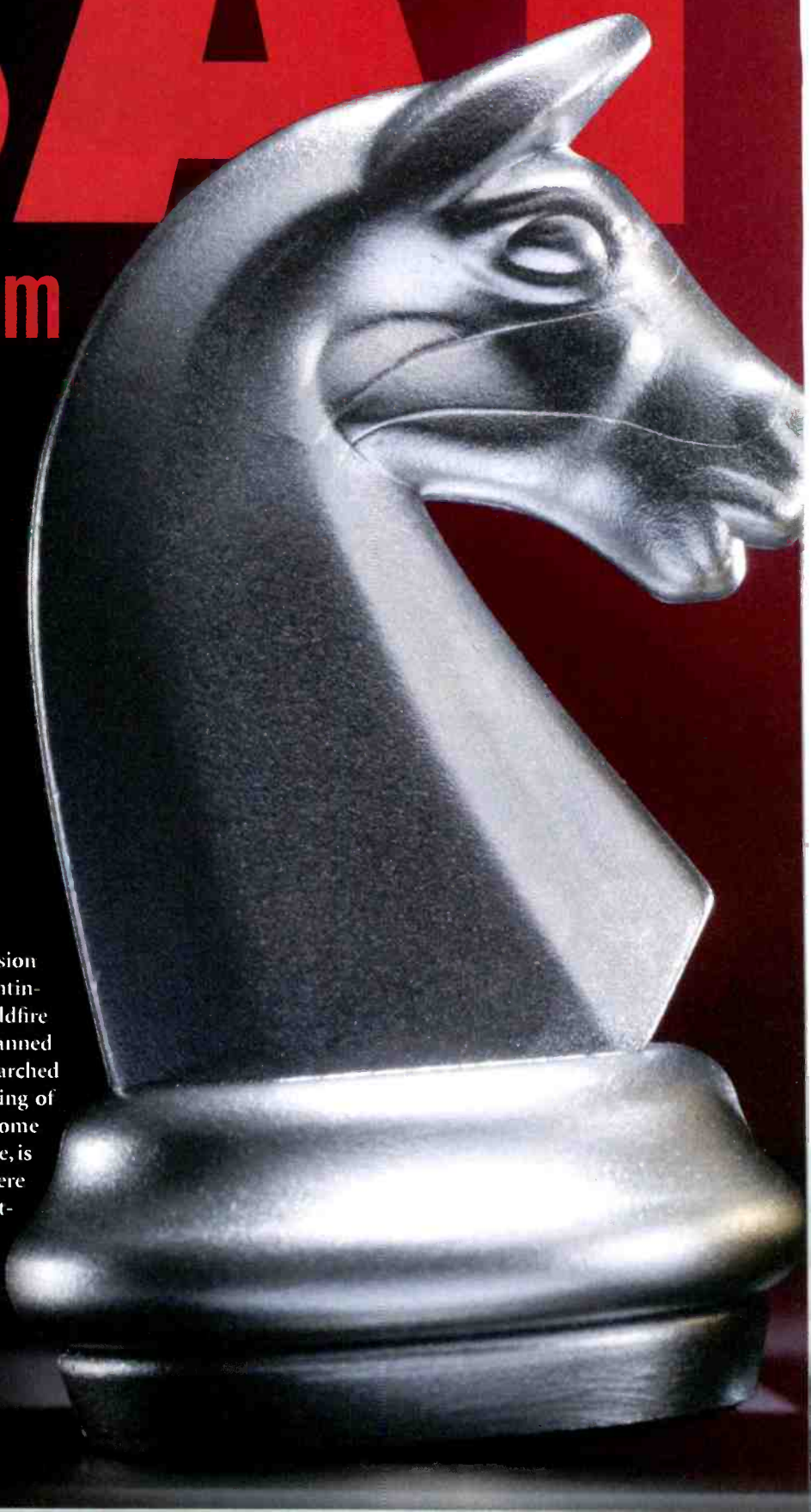
THE BATTLE for spectrum

Here's how we got to where we are today.



BY MARK A. AITKEN

The battle for television broadcast spectrum continues to rage much like a wildfire out of control, being fanned by the hot winds of the CTIA and a parched Congress willing to sell almost anything of monetary value. At the same time, some Americans are asking, "If there is smoke, is there really a fire?" Depending on where one sits, and as time progresses, the battle lines seem to be less and less clear as the smoke spreads. So, let's wind back the clock to see how we got to where we are (or are not), and better understand what was the genesis of the debate unfolding before us.

TLE

"In the beginning, God created the heavens and the earth," and from all accounts by the FCC, CTIA, CEA and others, not enough spectrum. (It is nice being better informed than the almighty.) In an address at a CTIA meeting on Oct. 5, 2009, FCC Chairman Julius Genachowski said, "I believe that the biggest threat to the future of mobile in America is the looming spectrum crisis." From that date forward, this crisis, unknown and unnamed by anyone before then, has taken on a life of its own.

In March 2010, the FCC announced its controversial National Broadband Plan (NBP). This aggressive plan promised to transform the nature of broadband and shape an understanding of a new American policy initiative. I found a well-articulated summary (sort of a "Readers Digest" version of the plan) written by Rob Frieden, a professor of telecommunications and law at Penn State University. Frieden writes on his blog, regarding the NBP:

> "In a nutshell, I see much to like about the Plan, but doubt whether many of the 'should' language will get done. More broadly, the Plan does not provide much insight on what the authors think the Commission can do, on its own accord, versus the need for new statutory authorization."

Background

The drive for statutory authorization has been the focus of the FCC from virtually day one. Let's try to navigate what has transpired.

On June 28, 2010, the White House endorsed the FCC's proposal to free up 500MHz of spectrum from government and commercial users for wireless broadband and other uses with the avid support of the CTIA, CEA and others. The alignment of parties and issues speaking to "the looming spectrum crisis" are perhaps best characterized as the haves and the have-nots.

The NBP has all the twists and unexpected turns that one would expect to thrill most every daredevil, and the promised excitement can be felt, but are the wheels for the ride attached in a safe and meaningful way? There is a whole lot more in the NBP than the discussion of spectrum, but it is the spectrum policy issues and their characterization that have been driving the discussion.

From the executive summary of the NBP we find:

- Spectrum is a major input for providers of broadband service. Currently, the FCC has only 50MHz in inventory, just a fraction of the amount that will be necessary to match growing demand. More efficient allocation and assignment of spectrum will reduce deployment costs, drive investment and benefit consumers through better performance and lower prices. The recommendations on spectrum policy include the following:
- Make 500MHz of spectrum newly available for broadband within 10 years, of which 300MHz should be made available for mobile use within five years.
- Enable incentives and mechanisms to repurpose spectrum to more flexible uses. Mechanisms include incentive auctions, which allow auction proceeds to be shared in an equitable manner with current licensees as market demands change. These would benefit both spectrum holders and the American public. The public could benefit from additional spectrum for high-demand uses and from new auction revenues. Incumbents, meanwhile, could recognize a portion of the value of enabling new uses of spectrum. For example, this would allow the FCC to share auction proceeds with broadcasters who voluntarily agree to use technology to continue traditional broadcast services with less spectrum.
- Ensure greater transparency of spectrum allocation, assignment and use through an FCC-created spectrum dashboard to foster an efficient secondary market.
- Expand opportunities for innovative spectrum access models by creating new avenues for opportunistic and unlicensed use of spectrum and increasing research into new spectrum technologies.

It would certainly seem that several ways might exist that could lead to a vigorous industry discussion about one or another course that could affect such a bold plan. One might also think (or at least hope) that such an open discussion of spectrum would lead to a multiplicity of ideas regarding policies that might yield such spectrum. But alas, this is Washington, and easy things than can be resolved by being candid rarely if ever follow such a dignified course.

In Chapter 5 of the NBP — "SPECTRUM" — the plan states, "The FCC should initiate a rule making proceeding to reallocate 120MHz from the broadcast television (TV) bands." Where did that come from? The FCC has identified 225MHz through 3.7GHz as "prime wireless spectrum." If television broadcasters occupy only 5.18 percent of this wide swath of frequencies exclusively (another 3.65 percent is shared with land-mobile and BAS), why is the FCC so intent on confiscating 24 percent of "needed spectrum" (120MHz of the stated 500MHz) from television broadcasters up front?

Without even so much as a hint as to how such a swath of spectrum is to be made available, how it might affect the present occupants (television broadcasters, us), and without any stated critical analysis as to the specific necessity of the upper UHF, the "broadcast television spectrum debate" has churned on this narrow issue. The rest of the NBP seems to have escaped the attention of everyone.

There has been some flexibility exhibited in discussions and offers of various small segments of the "prime spectrum" by NTIA, from some government assets with an offer of 115MHz. But on the broader discussion of what amount of what spectrum from whom might be made available at what cost and by which means to answer the stated "need" of 500MHz, well, there has been little flexibility (as in none) about the 120MHz that broadcasters occupy and the means by which it should be taken away.

No alternative to auctions?

There exists a lack of diversity and dialog, and everyone has settled on the two ends of the only plan: auction spectrum. Are you for or against? With no other options having been put on the table, parts of the television broadcast industry have offered support to the idea of a "truly voluntary incentive auction," and given the nod to giving up spectrum. (I, for one, have not embraced such a position.) Everyone except perhaps the FCC and those wireless carriers coveting the television broadcast UHF spectrum seem to understand the meaning of "voluntary." But how did we get to here (auctions of television broadcast spectrum) from there (we need 500MHz of wireless spectrum)?

The FCC, which is held accountable by Congress as the expert agency on spectrum matters, has yet to make good on what would seem to be the required first step of devising and executing a plan. What spectrum do we have, how is it being used, by whom, and what is the impact of reallocating it to address the needs of the NBP would seem to be some initial steps.

There have been frequent calls from the likes of Rep. John Dingell (D-MI) to make good on the various

request for a spectrum inventory and an understanding of the repacking plan (allotment optimization model [AOM]), but little want on the part of this FCC's chairman to suitably answer the request. Genachowski is quoted as saying AOM "remains very much a work in progress," adding that he was "deeply concerned that disclosure of predecisional information would potentially damage the commission's deliberative process, as well as result in needless public confusion about the status of the Commission's work on the voluntary incentive auction concept."

Before Sept. 28, 2011, the discussion was largely about an auction for television broadcast spectrum, but the new call (chanted for by Steve Largent of the CTIA and others) is for a series of auctions. This idea was first delineated in a paper prepared for the 39th Research Conference on Communication, Information and Internet Policy. One position taken in the paper hypothesized increased revenues brought by a series of auctions for 120MHz of television broadcast UHF spectrum.

One thing is evident: Before the end of October, no one had offered an alternative plan to auctions. In conversations with FCC staff, when asked, "Why only auctions?" the answer was a simple one. They would consider other options, but none had been offered. As a result, you have both the House and the Senate with draft language to authorize the FCC and auctions. Some thought that the "Supercommittee" would include spectrum auction language. Everything there was DOA. Rep. Greg Walden (R-OR), chairman of the House Communications Subcommittee has submitted a bill including spectrum incentive auctions for mark up, and, if all goes as expected, it could get voted out of the subcommittee. Again, auctions were the only option that had been on the table from the beginning, and the focus on the part of the haves and the have-nots has been specific language. Broadcasters — high-power, low-power, class A and translator operators — are looking for protection.

One might ask a simple question, "Is there an option beyond auctions?" Starting in late October, some may have seen reports of a Broadcast Overlay plan put forward by The Coalition For Free TV and Broadband. They state "... broadcasters have better ideas, more potential to create jobs and revenue that will benefit the federal government, and ways in which they can help alleviate the spectrum crunch." They appear intent on making sure Class A TVs, LPTVs and TV translators are not lost in the spectrum auction discussion. Rep. Gene Green (D-TX) said some low-power TV spectrum plans may make sense. At a meeting with LPTV executives, "we discussed how the Dingell/Green bill protects Americans' access to free OTA television," he said. "They also highlighted an idea of theirs that would raise $100 billion over 15 years, which is far more than any of the current spectrum proposals raise," Green said of the coalition. "Their proposal agrees with the Dingell/Green bill, to ensure that broadcasters that wish to stay in the market are not forced out. This idea deserves scrutiny, and I look forward to working on it," he said. Their plan would be an alternative to auctions.

This 112th Congress has before it numerous spectrum-related bills, including the president's jobs bill. The group Public Knowledge has a list and searchable copies of the legislation as well as an "informational chart comparing the bills to help you navigate the spectrum bill tsunami." It may take a tsunami to put out this raging spectrum wildfire. It may also make sense to put on the hip waders. BE

Mark A. Aitken is vice president of advanced technology, Sinclair Broadcast Group.

Taming the 2.4GHz band

Plug-and-play devices need coordination to avoid interference.

BY LARRY ESTRIN

In recent years, there has been an explosion in license-free devices using the Wi-Fi 2.4GHz spectrum. These devices have been billed as "plug-and-play," resulting in a serious misconception about the need for frequency coordination throughout the production industry. That misconception hinges on the flawed belief that the absence of a license means interference is impossible. Simply put, that belief is dead-wrong!

While it is true that a specific license to use the product is not required, there are a significant and growing number of instances where there may be upward of 50-plus 2.4GHz devices operating in relatively close proximity to one another. These locations include almost all motion picture, television production and news studios, college and professional sporting venues, as well as live performance theaters. One of the best ways to combat this issue isn't through a technical solution. It is communication between all parties involved in the broadcast or event that ensures frequency channels do not interfere with one another.

Rampant devices

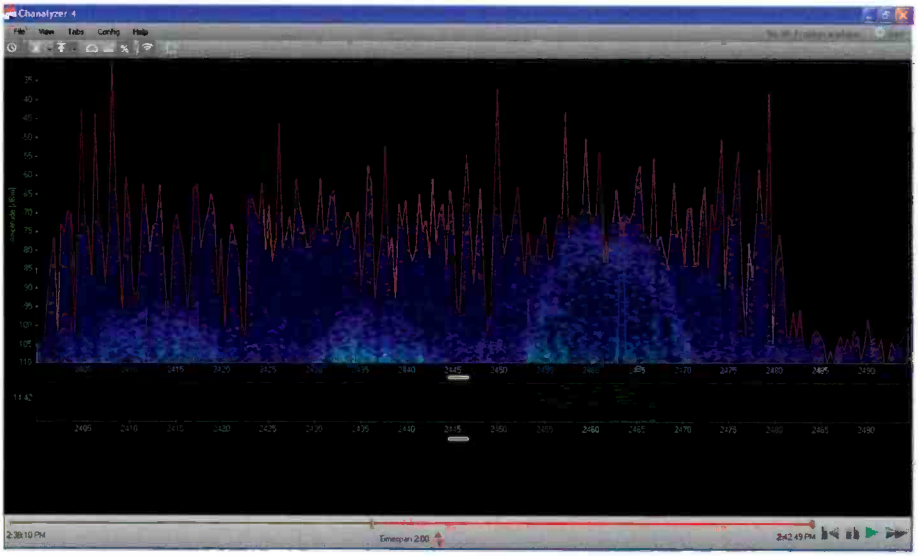
The 2.4GHz spectrum is used for hundreds of devices, including portable billing devices, surveillance systems, restaurant and service facilities, and more. Of course, every user believes he or she has the most optimal use of the spectrum. A primary purpose of coordination is to allow the maximum use of as

many devices as possible without interference. Most of these devices have multiple channel settings within the 2.4GHz spectrum. Coordination in advance allows for all the devices to work without conflict or disruption.

That said, no production is immune to interference. Sometimes, however, it is at larger events where frequency coordination is paramount. An example of this came when technicians were coordinating wireless devices for the most recent telecast of the NFL draft.

"At the NFL draft at Radio City Music Hall, a 2.4GHz wireless intercom system was fired up," said Ralph Beaver, manager of the NFL game day coordinators. "Immediately, the NFL IT people were trying to find out why more than half of their many, many laptops in use in the hall had slowed or stopped. CP Communications technicians on-site immediately recognized the problem and very quickly changed the settings on the wireless intercom system so as not to occupy that much of the Wi-Fi band.

"At the same event, a 2.5GHz wireless camera was turned on in the theater. The camera wreaked havoc with the other wireless devices until it was adjusted so that it would not conflict with the 2.4GHz devices."



This image illustrates a reading received from a Wi-Fi analyzer dectecting different Wi-Fi devices within a venue. The spikes in the reading indicate a device operating in the 2.4GHz band.

Human element is key

Michael Mason, president of CP Communications, believes that one of the best ways to work through this issue is simple communication.

"The fundamental principles of coordination are cooperation and the sharing of information," Mason said. "There is no difference if you are using 500MHz or 2.4GHz. All parties using RF need to communicate with each other so a plan can be put together to ensure a successful show.

"The challenge with the 2.4GHz band, as well as all other license-free bands, is the lack of understanding that license-free does not mean coordination free. In large venue events, such as NFL's Super Bowl or the MLB All-Star Game, great expense (both time and money) is put forth on frequency coordination. Unfortunately, tens of thousands of handheld

devices and/or smartphones come into these venues that we have no control over. These can and will adversely affect the spectrum.

"While they may not be permitted to access the Internet through the Wi-Fi systems in the venues, they are constantly pinging them, looking for access. This constant chatter alone raises the noise floor tremendously. Taking this into consideration, it is critical that the users who do have control over their equipment coordinate with each other by sharing information and steering their equipment toward usable parts of the spectrum."

Henry Cohen, of Production Radio Rentals — a supplier and integrator of communication devices for special events, believes that along with communication, preplanning needs to be a part of frequency coordination.

"Coordinating the unlicensed bands (generally 900MHz to 928MHz in the United States, 1.92GHz to 1.93GHz, 2.405GHz to 2.485GHz, and the 5GHz U-NII sub-bands) have become an absolute requirement in most special and high profile events," Cohen said. "Many bad experiences have managed to get the attention of management. A significant element of coordination is to clearly communicate the policies governing equipment operations to all event vendors, participants, venue administration and, in particular, IT departments during the planning phase(s).

"As this remains a somewhat new concept to most entities involved in productions, time is generally required to find and contact the appropriate technical individuals and educate them so they can acquire the proper equipment needed to manage spectrum coordination."

Most IT department technicians have little concept of, or experience with, the production world and the dynamically growing requirement for RF communications to support ever-increasing levels of production. IT technicians' training and experience rarely goes beyond the plug-and-play concept, or the use of non-overlapping channels and possibly transmission power levels. They generally believe that latency is not a problem; *just send the information packet again and again.*

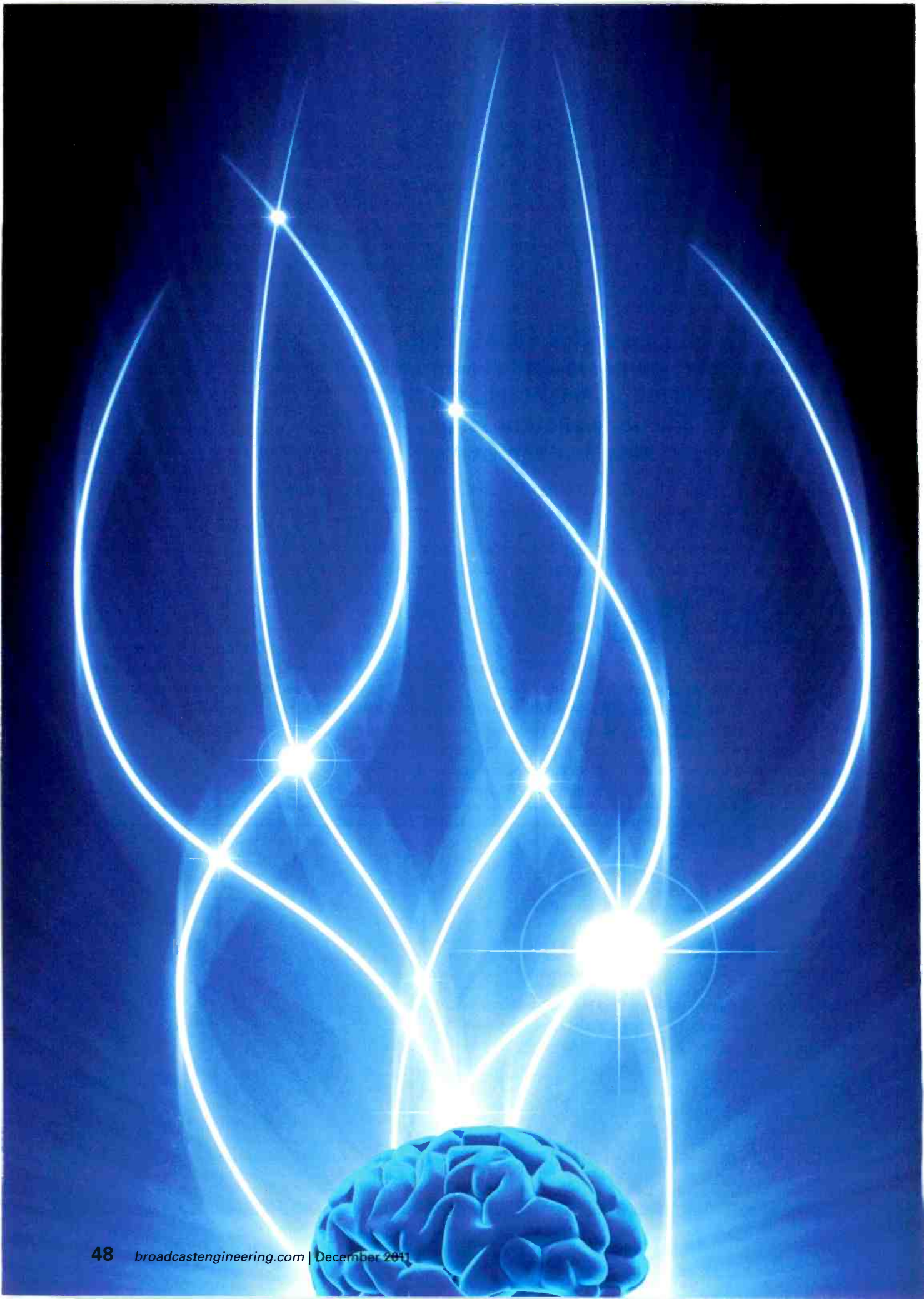
Aid from technological advances

In addition to resolving this issue via communication, manufacturers are developing products to help with frequency coordination. Many companies have built in various channel configurations in their 2.4GHz products. One company, for example, has reached out to some of the wireless DMX receiver/transmitter manufacturers in order to coordinate the channel configuration schemes between manufacturers.

It is also appropriate to mention that other spectrums that are license-free, such as Digital Enhanced Cordless Telecommunications (DECT) wireless telephone systems, can and will interfere with each other as well as other services. Some production communications manufacturers have designed wireless stage management systems using the DECT platform, further exacerbating the problem of license-free without frequency coordination.

Frequency coordination is the most effective way to guarantee the proper operation of all devices at a particular event, whether it is the Super Bowl or a church service. Taking the time to plan the use of the available spectrum will yield positive results for everyone. A good reason to do so is that if everyone coordinates at a particular event, then everyone can be protected by the frequency coordinator. BE

Larry Estrin is strategic technology consultant for Clear-Com.



Intelligent optical networks

BY FADY MASOUD

The technology can increase the survivability and efficiency of video distribution networks.

Broadcasters, as well as film and television producers, face the common challenge of efficiently transporting high-bandwidth video content over existing networks while maintaining the highest levels of availability. The smallest downtime while broadcasting a live event has serious consequences on advertising revenue and viewer experience. While availability is of vital importance in the broadcasting industry, the ability to transport high-quality video content efficiently is equally important. Broadcasters are constrained by short-range microwave services and costly satellite services, which offer subpar reliability, latency and service quality, while film and television studios are hampered by terrestrial leased-line services and router-based networks that are not suitable or robust enough for HD video delivery. This article describes how an intelligent optical network increases the survivability of broadcast networks and provides efficient and cost-effective transport of high-quality, advanced video content.

Current challenges

Video content is often carried over private lines, ATM, ring-based SONET/SDH, or router-based networks with some type of path redundancy (link protection) and sub-50ms failover time. Despite this carrier-class guarantee of service, these networks cannot survive multiple or simultaneous failures caused by natural disasters, acts of terrorism or human error. (See Figure 1.)

Meanwhile, the demands for new HD and 3-D video capabilities are growing rapidly, creating additional transport challenges. HD and 3-D video are driving significant increases in bandwidth demand that cannot be mitigated through compression because compressing HD and other high-end video results in a loss of signal quality and adds cost and complexity to the network. Addressing these issues, while minimizing the risk of service disruptions, requires a new network approach: a highly survivable intelligent optical infrastructure.

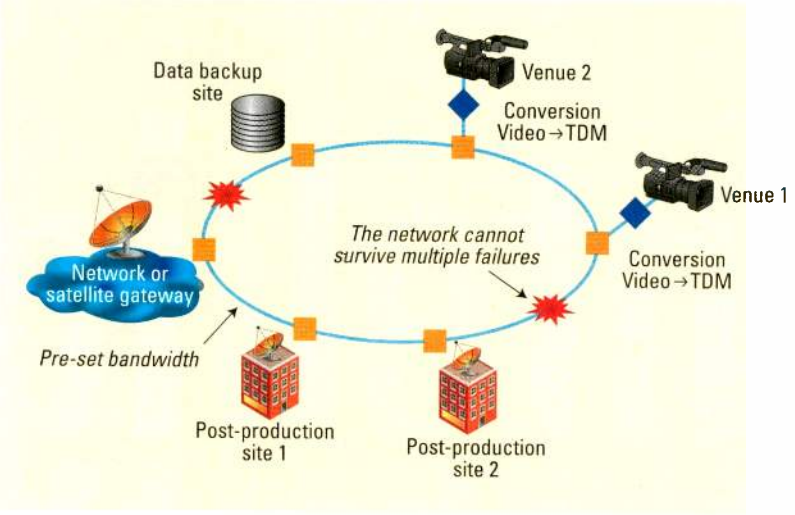


Figure 1. Current deployment for live video broadcast

Conventional leased lines and router-based networks are ill-suited for HD video content. HD video files are too large to transport over copper leased lines, and conventional router networks are incapable of streaming uncompressed HD video signals. Since compression leads to a degradation in video and audio quality, many studios distribute HD video content on tape — a costly and inefficient method.

Those who use conventional satellite services have realized quickly that this medium is expensive and fraught with limitations. Satellite uplink/downlink delays can cause unnatural pauses and "talk-over" that impede

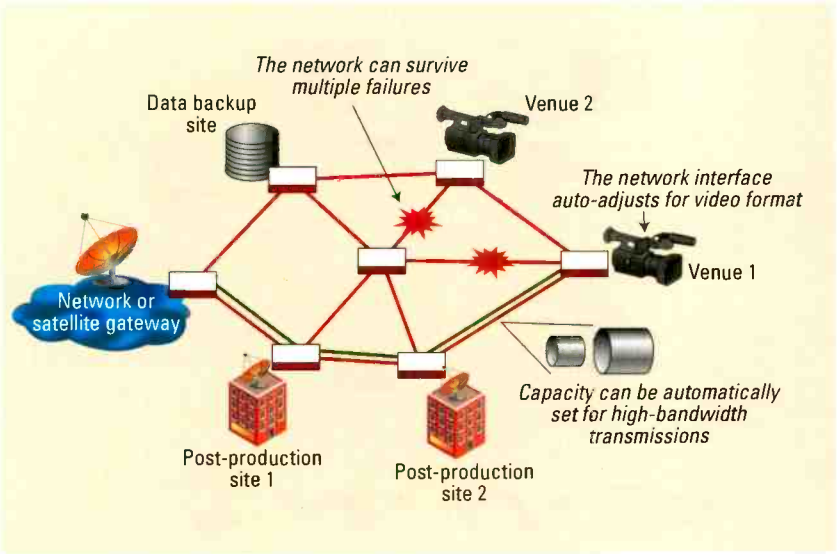


Figure 2. Intelligent optical network for live video broadcast applications

live interviews. Poor weather conditions can impair satellite feeds, and scheduling transponder time is inconvenient and inefficient.

Distance is another challenge for television and film studios because they rely on geographically dispersed teams to assemble and edit content. A team in one facility may specialize in dialogue editing; another in a second location may add music tracks; and a group in a third city may generate visual effects. Sharing HD content securely and efficiently over hundreds or thousands of miles is a challenge video broadcasters and producers have to overcome.

The intelligent optical network

Highly reliable, intelligent optical infrastructure enables uncompressed SD, HD and 3-D digital video signals to be transported efficiently, regardless of distance. Network complexity can be reduced and operations simplified to achieve better video quality compared to alternative compression strategies. While compatibility with video compression requires more complex configuration and testing to ensure interoperability between encoding and decoding devices, uncompressed video formats adhere to universal standards and can be transmitted using less equipment in the end-to-end video transmission path. This makes installation easier, reduces costs and enhances network reliability and survivability.

An intelligent network is made possible with the latest technology breakthroughs in silicon and software that have unlocked the network potential to carry high-bandwidth video content with the highest levels of availability. Some of these technology breakthroughs, and how they solve the latest challenges faced by video broadcasters and producers, are listed below.

- **Capacity:** Intelligence is brought to the network by a breakthrough technology called coherent optical processing, which increases network capacity 10 times or more while preserving the existing fiber plant — no network re-engineering, no forklifting, no massive investment. Coherent optical processing unlocks the network potential to handle the large amount of traffic between venues, such as stadiums, and production sites. The capacity unleashed by coherent optical processing allows the core of the video transport network to scale for emerging video interfaces, such as 3G HD and 3-D.
- **Efficient signal mapping through Ethernet or optical transport network (OTN):** Video signals can be transported over the network efficiently and cost-effectively while preserving their stringent requirements such as synchronization (clocking), low jitter and low latency. Packet technology advancements allow users to map and merge video signals — such as SD-SDI, HD-SDI, 3G-SDI and DVB-ASI — onto Ethernet (GigE or 10GigE), with a complete set of diagnosis and monitoring tools. OTN allows video signals

to be carried transparently over the network, with built-in capabilities such as FEC that increase signal reach and help reduce the number of network elements required between the nodes. The intelligent optical network brings operational simplicity, scalability and efficient bandwidth management (aggregating and switching) capabilities to eliminate bandwidth fragmentation and ensure efficient use of all network assets.

- Intelligent control plane: Downtime in video networks translates to the loss of millions of dollars in advertising revenue and damages the provider's reputation with viewers. An intelligent control plane acts as the brain of the network, reacting to network changes — such as multiple simultaneous failures, changes in network topology or an increase in latency in some of the network's critical spans — in real time, without any human intervention. The control plane handles and executes the bandwidth increase requests, setting up a new connection between two end points (such as a broadcast in HD between two locations, or a need to transfer a large amount of raw video footage between two studios) and many other tasks required in the TV broadcast and movie production industries, without any intervention. The control plane increases network availability and protects it from the various sources of failures, such as

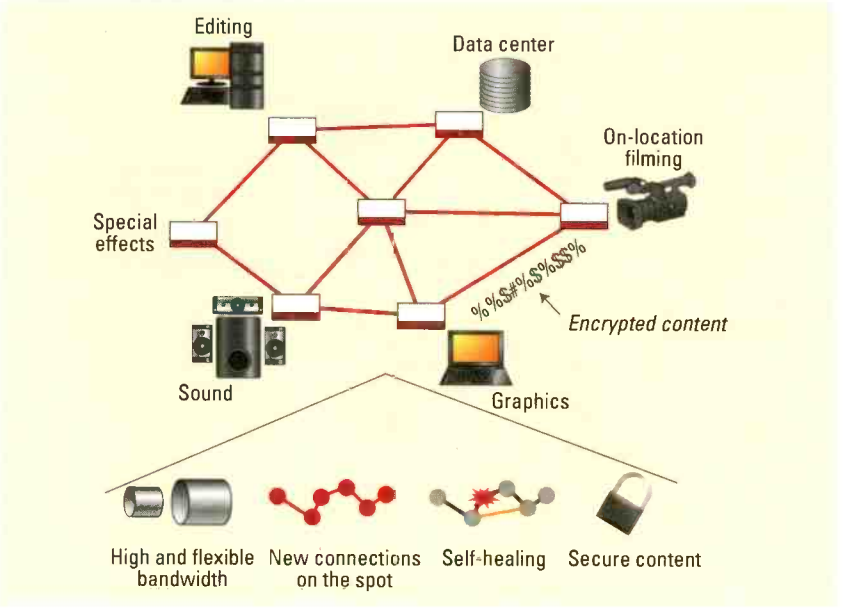


Figure 3. Intelligent optical network in TV and movie production applications

fiber cuts or hardware failures that could affect the services offered to viewers. (See Figure 2 on page 51 and Figure 3 on page 52).

Benefits

An intelligent optical network has a significant positive impact on the video transport network.

- **Enhanced reliability (uptime):** The self-healing capability and the ability to survive multiple failures enabled by an intelligent optical network raise video network availability to a new level. Service providers offering network connectivity to broadcasters and TV production firms can capitalize on the high availability of these services as a competitive differentiator.
- **High performance:** An intelligent optical network provides deterministic, high-performance, scalable, resilient and fully transparent video transport. High-quality video can be delivered with low latency and low jitter. Emerging video signals such as 3G-SDI and 3-D TV can be transported on the network without putting a huge stress on its capacity.
- **Enhanced flexibility:** All the established video interfaces used in the video industry (such as SD-SDI, HD-SDI, DCI [3G-SDI] and DVB-ASI) are supported, allowing content producers to reduce inventory and maintenance costs. Content producers can upgrade to a newer video protocol — such as from HD to 3G HD — in a plug-and-play fashion, without operational churn.
- **Advanced diagnostic features:** The combination of video-specific applications and advanced transport networking features, such as fault detection and state signaling, provide superior diagnostic capabilities. The video engineer can now distinguish between a camera failure and a network fiber failure, with different video patterns being generated in the video stream for each type of failure.
- **Better networking agility:** The intelligent optical network enables better agility through a quick setup or tear-down of new connections (bandwidth on demand) for events where a large amount of bandwidth is needed for a limited period of time, such as broadcasting from football stadiums over a four-hour period.
- **Enhanced security:** In the TV and movie production industries, video content is the most valuable asset to protect from intruders. An intelligent optical network enables wire-speed encryption for any content being transported over the network.
- **Architecture simplification:** An intelligent optical network brings operational simplicity, efficiency and cost savings to venues, production sites and backup sites. Seamless scalability, flexibility, efficient bandwidth management and automated operations drive down operating costs while simplifying the network architecture.

The intelligent optical network allows broadcasters to transmit live content more reliably and economically, with higher service quality. Television and motion picture studios can exploit electronic delivery to improve collaboration among post-production teams, eliminate tape-based distribution methods and reduce costs.

Conclusion

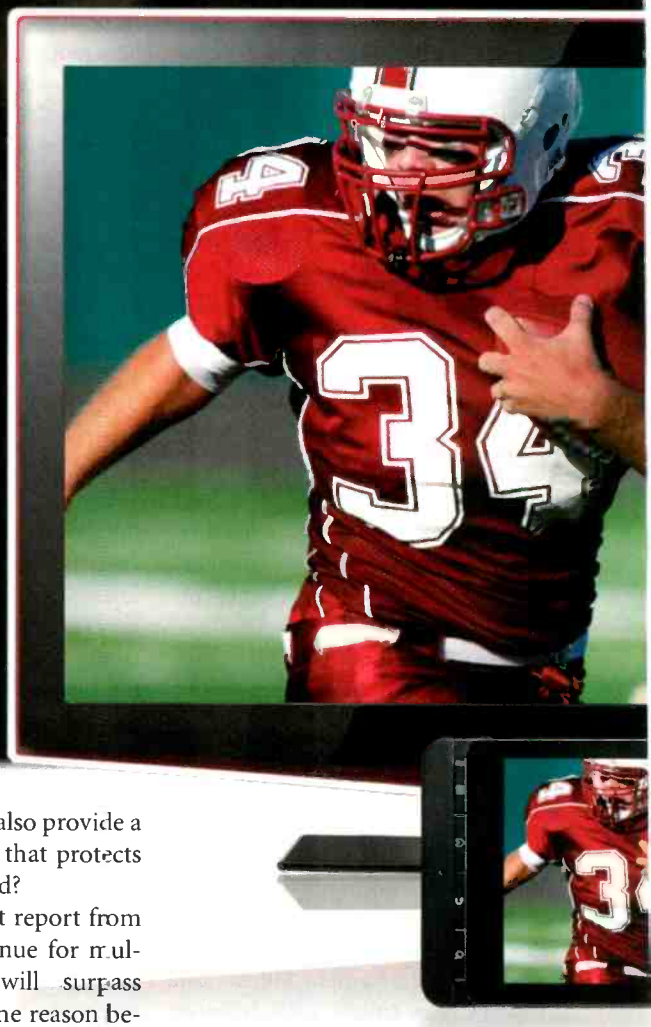
In the video broadcast industry, uptime, video quality and operating costs are among the main business imperatives. Film and television producers are in a constant search for a secure and reliable system to share high-bandwidth, high-quality video between geographically dispersed teams. The intelligent optical network enhances network survivability and protects it from multiple failures — a feature that current networks cannot match. The network infrastructure also allows content providers to deliver video in its highest quality while paving the way for a new generation of protocols, and leads to network simplification and cost reduction that set a new economic benchmark for video production and distribution. BE

Fady Masoud, M. Eng., is an advisor at Ciena's Portfolio Solutions Group — Montreal, Canada.

Mobile video encoding

Encoding specialists can help streamline multiscreen video delivery.

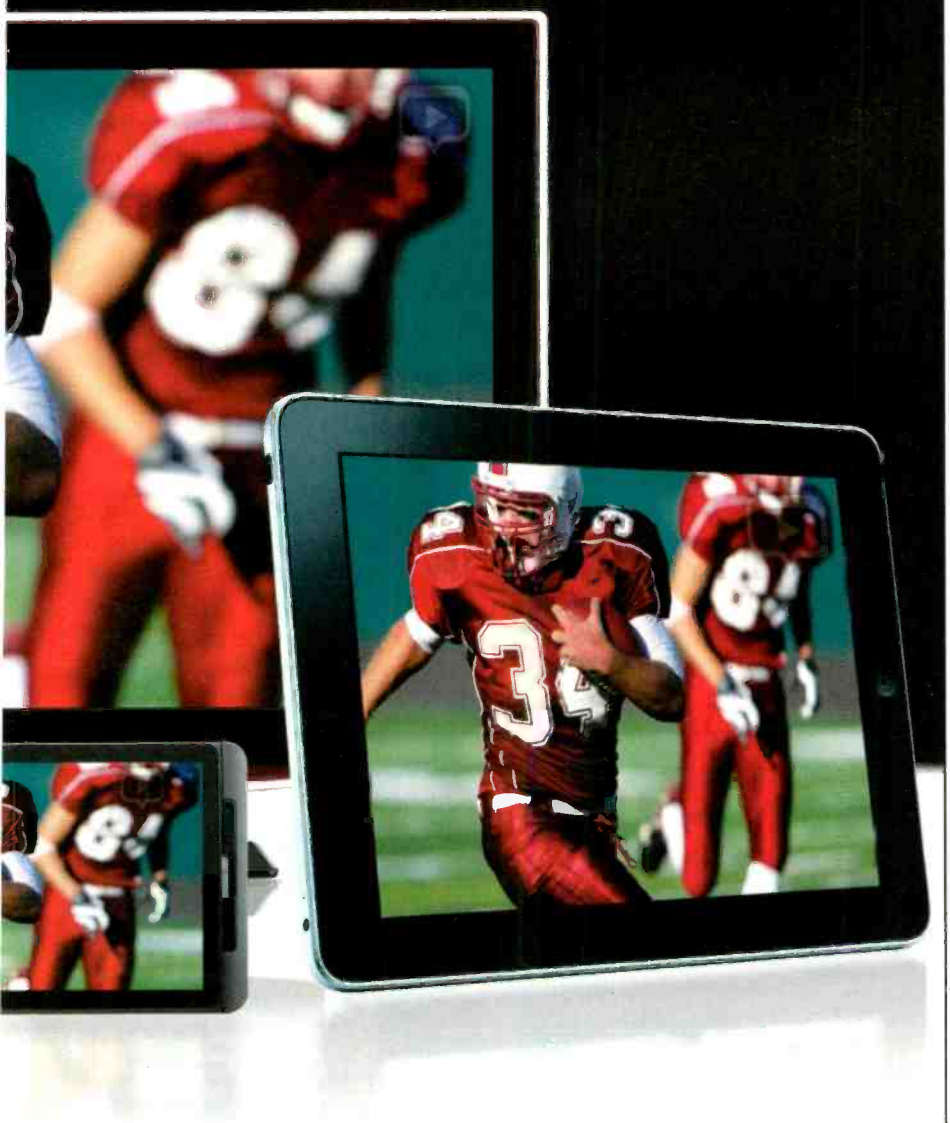
BY DEREK BELL



As TV service providers try to keep up with the surge of mobile video consumption and more connected TVs and tablets coming to market, the need for cost-effective and secure encoding services that provide quality of experience becomes increasingly important. And, although TV service providers understand mobile is important, are they really ready to deliver these services to consumers? Are they prepared to roll out services to stay competitive, but also provide a high-quality experience that protects the quality of their brand?

According to a recent report from In-Stat, worldwide revenue for multiformat transcoders will surpass $460 million in 2015. The reason behind this growth is that due to varying OS and screen size, every new device requires service providers to individually encode video for each model or device family. Furthermore, with the adoption of adaptive streaming, there are now multiple variants of each device. For cable operators, TV service providers and movie studios — or anyone providing premium content to a subscriber base — the need for better encoding

Encoding services can assist content providers to deliver premium video content such as television, movies and even live sports to mobile devices and other connected devices. Images courtesy Quickplay Media.



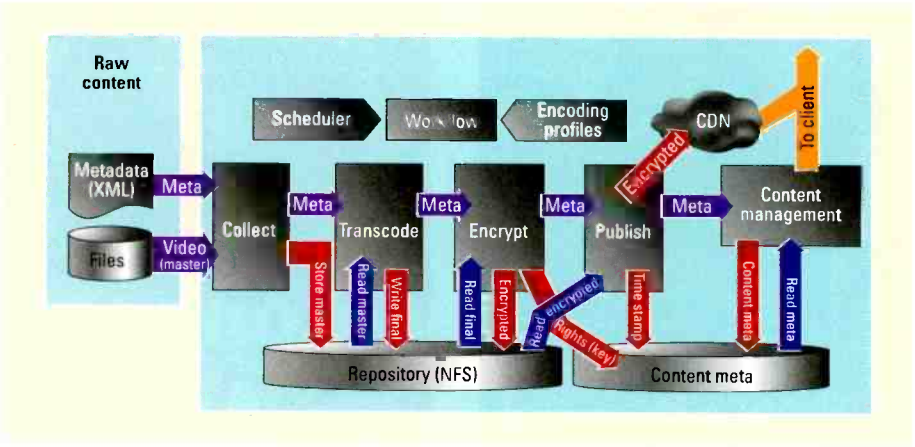


Figure 1. Content providers have many options for the familiar process of collecting, transcoding, encrypting and delivering video. When it comes to premium mobile video, they should remember to include encoding as a step.

is even more critical as the mobile video adoption curve climbs upward and consumers demand a pristine viewing experience on their smartphone and tablet devices. Premium content can be defined as a television show, a movie or a live sporting event — essentially, anything that consumers will pay to watch. Today, the most common means of watching this content is through cable subscriptions. However, as mobile video becomes mainstream, consumers who wish to have access to their cable service across multiple screens will have the choice to either purchase a premium bundle or pay more for a basic package in order to view this same content on a mobile device.

Premium content requires a precise set of specifications, all of which are dependent on factors such as network capacity, carrier requirements, target devices and diversity of source formats. The encoding process follows a four-step process: collect, transcode, encrypt and publish. Although this process is not new, the specifications associated with it continue to evolve due to device capabilities, network evolution, and enhanced compression and delivery technologies. For a bit of perspective, consider this: On average, a 22-minute episode of premium content requires between 20 and 25 output files to accommodate varying devices, screen sizes and (where appropriate) adaptive streams. This is a challenge for content providers across the board. According to an article from Leslie Ellis' "Translation Please" blog, HBO executive Diane Tryneski states, "Since 2006, the number of video assets HBO creates every month went from 500 to 60,000." This story is a familiar one across the industry. As long as new devices are introduced to the market, this number will continue to climb, and content providers will be faced with the challenge of pushing more content in more formats to more devices and increasing network capacity.

As one can imagine, the encoding process can become a time-intensive and costly initiative for content providers to handle on their own. Although many have tried, it requires a lot of resources, which means many service providers are now turning to third-party specialists to help streamline the process and make it more cost-effective, while leveraging economies of scale. Third-party specialists also are better aligned to keep on top

On average, a 22-minute episode of premium content requires between 20 and 25 output files to accommodate varying devices.

of new developments, standards and innovations. In order to provide best-in-class live-TV and VOD services for mobile devices, it's important to consider the points below.

Ensuring high-quality VOD

Aside from the content selection, video playback and quality are the most important parts of the mobile video experience from a consumer's perspective. Thus, it is critical that cable, TV service and content providers have stringent benchmarks in place when testing the quality and delivery of premium content. The first stage of analysis often happens during the ingestion process. When working with a third-party encoding vendor, service providers should make sure that they are receiving optimal source files and accurate metadata for the type of VOD content they are providing. They should understand the preferred levels of interlacing, aspect ratios, resolution, codecs, frame rates and bit rates in order to ensure that they are starting with the best source file. From there, the files should be tested and checked to confirm they meet agreed-upon standards. After the source input is successfully validated, a series of pre-processing steps take place. These steps include video equalization, de-interlacing the file, audio boosting and noise reduction. The encoding process may then begin. If any of these steps are skipped prior to the encoding process, it could severely impact the delivery and quality of the content.

From here, many vendors take a customized approach to the encoding process. The most challenging part of this is determining how many encodes are required to meet the specifications of the overall service. It is important to evaluate key criteria such as network and content types, media player preferences, security, and device capabilities and, in some cases, carrier restrictions. By separating the audio and video layers during performance testing, one can ensure a robust and error-free encode and shape the encoding profile for various device/service combinations. However, it is likely that these encoding profiles

Content providers will be faced with the challenge of pushing more content in more formats to more devices.

will need to be refined as new services and devices come to market.

After each encode is created, each file should be analyzed using automated QC tools to ensure that it meets the quality expectations of the service. If errors are detected during this stage, then manual validation is often required to determine severity levels and next steps. In most cases, a faulty encode will need to be re-encoded from scratch. It should also be standard practice to manually sample video on actual devices to ensure the final product is of the best possible quality and free of any potential errors.

With live TV, there is little opportunity to refine and manipulate the content as it makes its way to IP-connected devices. That does not mean the quality has to suffer.

Live TV — no room for error

It goes without saying that with live TV, there is little opportunity to refine and manipulate the content as it makes its way to a variety of IP-connected devices. That does not mean the quality has to suffer. Content and service providers should feel confident that their services have undergone rigorous testing and monitoring to provide a quality experience for consumers. This includes ensuring that there is a high-quality input feed, that adaptive streaming protocols are supported between various networks, and that the encoding service provider has configured specific profiles for all content. Most importantly, encoding service providers must make sure that any issues in the redundant infrastructure are addressed to avoid the potential of having a negative impact on the service.

The architecture at the core of live TV streaming services should be taken seriously. Whether one is trying to deliver the content via satellite, SDI, ASI or IP speeds, it is important to establish a connection with service provider headends.

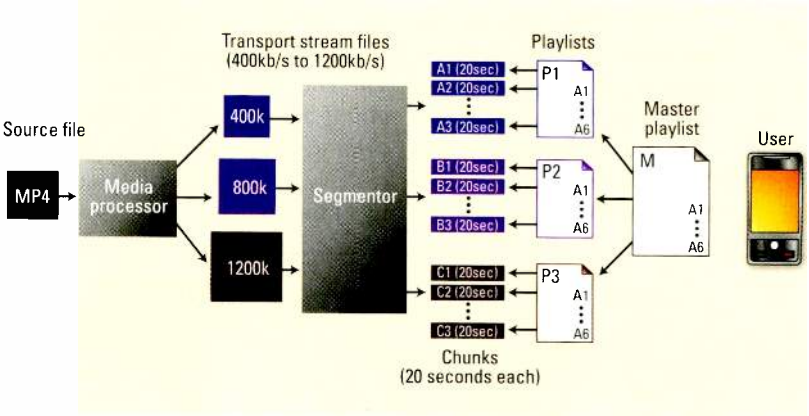


Figure 2. Adaptive streaming has been widely adopted as the trusted model for streaming live video. However, it is important for encoding service providers to offer support for Real Time Streaming Protocol (RTSP).

Adaptive streaming

Due to its consistency and significantly improved quality, adaptive streaming has taken over as the trusted model for streaming live video. However, despite the fact that Real Time Streaming Protocol (RTSP) is no longer the protocol of choice for streaming, it is important that encoding service providers offer support for legacy devices that still use this protocol and maintain capabilities for distributing the content.

Adaptive streaming comes with some challenges: Variables such as bit rate and resolution must be carefully analyzed and tested so that the media player can quickly transition to new versions without compromising the integrity of the picture. Adaptive Streaming now powers many of the early TV Everywhere efforts from cable service providers such as Comcast and Time Warner. These services are helping to drive the adoption and pervasiveness of Adaptive Streaming by making it easier to get various types of content to different devices over several types of network connections. The ability to push higher-quality versions will really come to bear as Long-term Evolution (LTE) networks and devices get rolled out.

A plethora of options exist for determining how to collect, transcode, encrypt and deliver premium mobile video. ... [But] the encoding process is a critical step.

The next encoding frontier

A plethora of options exists for determining how to collect, transcode, encrypt and deliver premium mobile video. One thing remains constant: The encoding process is a critical step in that life cycle. Spending too much on encoding processes or encoding inaccurately can negate a tremendous opportunity to drive additional revenue or value and keep subscribers happy. It is important to find an encoding service provider that will deliver a high-quality finished product and document the process from start to finish in order to establish timeliness in a cost-effective way. BE

Derek Bell is senior director of product management for QuickPlay Media.

"ACL" mixes concert sound with Avid

A duo of S5-BPs simplifies tracking and remix.

BY MEL LAMBERT

For more than 30 years, "Austin City Limits" ("ACL") has brought a wide cross-section of live-music concerts to public-television audiences, in addition to CD and DVD releases from the "Live from Austin" TV series. Since the 1974 "ACL" pilot program, sound engineer David Hough has mixed sound for virtually all of the show's taped live concerts.

Although the initial idea for the series was to showcase the music of Texas, "ACL" now features regional, national and international artists performing a wide range of musical styles.

The show acquired its first S5-BP in 2001, and according to Hough, its combination of fixed and fully assignable controls fit the needs of a live concert where there wasn't the possibility of a second take.

From 1976 through its 2010 season, "ACL" was recorded in Studio 6A located on the University of Texas at Austin campus.

To provide additional audience space for the series' recent tapings, which are recorded live in front of up to 800 patrons, the production recently moved to a new, purpose-built facility at ACL Live at the Moody Theater, sited next to Austin's W Hotel. The theater was equipped with a second S5-BP.

Both the original studio and ACL Live at the Moody Theater are equipped with identical 32-fader Avid S5-BP consoles with the latest V5.0 software, which includes EUCON control. The two consoles need to be fully compatible because, with the exception of other video productions, the original studio now is used pretty much exclusively for reconforming and remixing the audio tracks for concerts recorded at the Moody Theater. Each console features 72 mic/line inputs that route via multichannel MADI connections from the stage boxes or Pro Tools playback sources to the main DSP engine, which can handle 160 full-featured signal paths.

For Hough, S5-BP's V5.0 software adds several other useful operational features, such as the ability to quickly set up an auxiliary mix and send it to the musicians as a stage-monitor mix for overdubs. "We had that situation during a recent session with the band Explosions in The Sky, who were asked to record a new theme song for the show," he said. "I used the Aux Page to create a monitor mix for the band so that they could add overdubbed guitar and bass."

The S5-BP's Expand Tracks function lets "ACL" video editors, who cut the show on Media Composer, quickly conform Pro Tools tracks from the recorded concerts to match the picture edits.

The new upgrade was added through the able assistance of two Avid support personnel: application specialist Ozzie Sutherland and professional services solutions architect Scott Wood.

Wood also introduced the show's staff to a new AAF-based auto conform feature from Avid: the Expand Tracks function. This function lets "ACL" video editors, who cut the show on Media Composer, quickly conform Pro Tools tracks from the recorded concerts to match the picture edits. Because there are high-speed audio and video fiber-optic links between the two locations linked to Avid ISIS servers, this allows Hough to record the show at the Moody Theater, return to the original studio and start remixing the edited show quickly.

While remixing the live concerts for subsequent broadcasts on PBS stations and other outlets around the world, Hough makes substantial use of the S5-BP multitrack mixing functions to create enveloping 5.1-channel and stereo mixes. BE

Mel Lambert is a freelance writer based in Los Angeles.

TC Electronic's loudness radar meter

The unit provides a valuable tool in the ongoing fight against the loudness wars.

BY THOMAS LUND

The most fundamental audio issue of all — control of loudness — makes millions of people adjust their volume controls over and over on a daily basis. The CALM Act and legislation in other countries are signs of how serious the issue has become in digital TV and with multi-platform broadcasts around the world.

TC Electronic's radar loudness meters represent a quantum leap away from simply measuring peak level to measuring perceived loudness. The old method is responsible for unacceptable level jumps between programs and commercials, and an increased audio workload at the station because audio formats and program genres are incompatible when only peak level is considered.

Radar meters are part of a new, globally standardized system, whereby audio may easily and consistently be measured and controlled at various stages of production and distribution, thus creating a transparent loop from creation over delivery to logging. Workload is minimized and audio quality is maximized not only in AC3-based transmission, but in delivery to all platforms. Follow guidelines given in this article to be compliant with the latest ATSC, EBU and ITU recommended practices.

Loudness on the radar

The meter displays momentary loudness and loudness history in a single, unique radar view. (See Figure 1.) The circular, color-coded display makes it easy to balance audio visually and to see when level falls below or exceeds the end-listener's loudness range tolerance. Figure 1 shows a scene from "Desperate Housewives" that is generally too soft. It's a tremendous help for a mixing engineer or a video editor to know which radar area to stay inside as shown in Figure 2, where a film scene from "Pirates of the Caribbean: On Stranger Tides" clearly falls outside normal broadcast expectations.

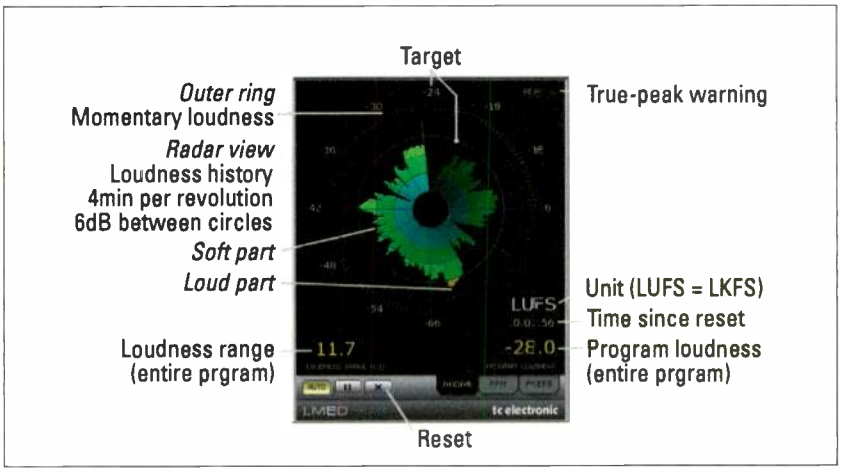


Figure 1. This shows a scene from "Desperate Housewives" that has audio levels generally too soft.

The old method of loudness measurement is responsible for unacceptable level jumps between programs and commercials because formats and genres are incompatible when only peak level is considered.

The radar itself is complemented by a true-peak warning and by two numbers to characterize the entire loudness 'landscape' of a program, film or music track precisely. By default, the numbers displayed are program loudness and loudness range.

Program loudness is a standardized integrating loudness measurement. If one program should be aligned in loudness with another using only a gain offset, that offset would be the difference between the program loudness values of the two. Practically speaking, both programs should simply be normalized to a certain target loudness. In the United States, the value to aim for is -24LUFS. That number is directly compatible with AC3's dialnorm parameter, which should also be set to 24.

Loudness range is a standardized measure of the loudness range of a program. It measures the difference between soft and loud parts. From an application's point of view, loudness range is compelling 1) as a production guideline, 2) for prediction of platform compliance during ingest or on a server and 3) for verifying a transparent signal path all the way from the studio to the home-listener.

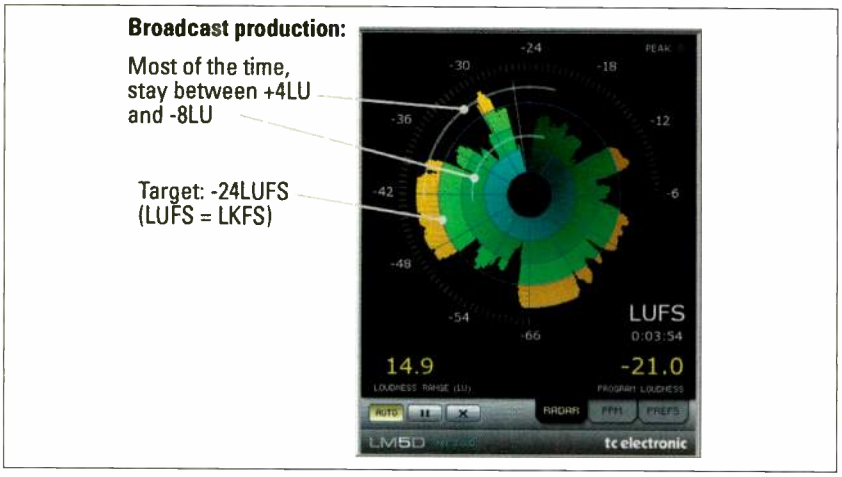


Figure 2. This illustrates the target loudness within which levels should be aimed. In the U.S., the level should be -24LUFS.

Audio is precious and deserves to be reproduced respectfully.

Note that the number stays the same downstream of production, even if a program is later normalized.

LKFS, LUFS and LU

Since the units used on different loudness meters currently varies, it's important to be aware of the differences and similarities of these units. First of all, LKFS (Loudness 'K-weighted' Full Scale) and LUFS are interchangeable, and both denote an *absolute* measure of the loudness of a digital signal. For instance, -24LUFS is precisely the same as -24LKFS.

LU, on the other hand, is a *relative* measure of loudness. When displaying loudness level on an LU meter, a certain target loudness is explicit. For instance, if the target loudness level of a station is -24LUFS, the radar meter can be configured to show that number as '0'LU, which causes a level of -27LUFS to be shown as -3LU, while one of -20LUFS will be shown as +4LU. In other words, it's merely a question of preference whether an absolute or a relative display of loudness level is preferred. TC radar meters present both options to the user.

Radar meter platform range

TC's loudness radar meter comes in a number of different versions. The LM2 stereo hardware loudness meter will show the above-mentioned descriptors on a built-in display, while the full radar meter (stereo version) is included as software for PC and Mac. Further, TC TouchMonitor TM7 and TM9 feature the radar meter as does the transmission processors DB4 MKII and DB8 MKII.

Finally, it is also available for Pro Tools HD as the LM5D plug-in, for TC's System 6000 MKII digital signal processer and as a new LM6 plug-in that is compatible with most audio and video editors, such as Mediacomposer, Final Cut Pro, Pro Tools, Nuendo, Sequoia, Logic Pro and more.

Transparent and closed loop

On a global scale, broadcasting is adopting a transparent and predictable loop, spanning from production over distribution to various end-listener platforms and logging. TC embraces this closed loop and stands committed to support further loudness and true-peak based improvements to already-existing broadcast standards in the years to come. Without forgetting linear audio, work will continue optimizing delivery of data reduced formats and refining trickle-down techniques for dealing easily with multiple platforms without locking broadcasters into proprietary solutions.

Conclusion

Audio is precious and deserves to be reproduced respectfully. For ages, sound was a natural phenomenon, only existing in the exact moment it was being produced, but technology allowing for recording and reproduction of audio has changed that once and for all. Now, beautiful audible moments can be captured and reproduced to enjoy at any time.

However, technology can also be abused, which, as described in the above, is rarely beneficial to the music and film-loving listener. Excessive and inexpedient use of compression, limiting and maximization causes audio to suffer considerably. The radar meter aims to offer production, post and broadcast professionals a valuable tool in the ongoing fight against the loudness wars, and help them reclaim the right to, once again, deliver wide, dynamic-range program material. BE

Thomas Lund is HD development manager at TC Electronic.

Digital Rapids' Transcode Manager 2.0

The new version enhances scalability and automation.

BY MIKE NANN

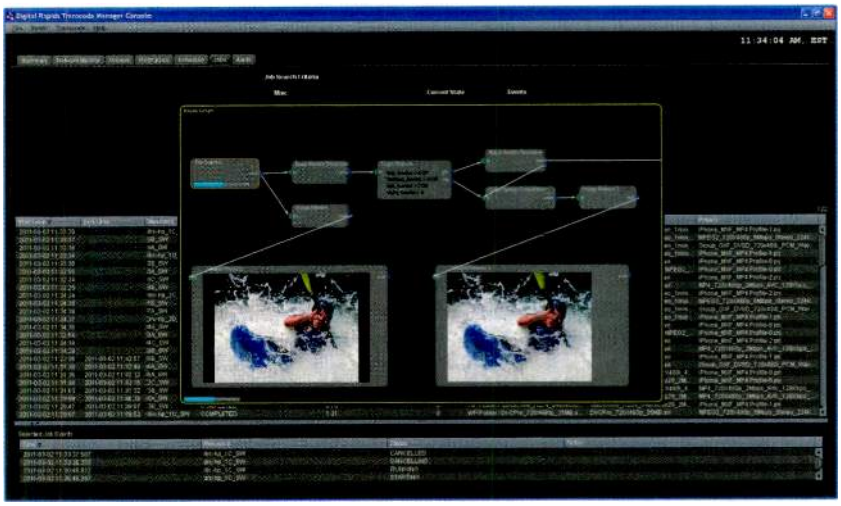
The rapid growth of multiscreen distribution opportunities and increasing volume of content to be processed are putting more operational pressures on broadcasters and media enterprises than ever before, and driving fundamental shifts in their content processing workflows. Striving to grow their operations and output capabilities while managing costs, large media organizations are seeking more efficient automation of their remaining manual processes, and ways to scale cost-effectively to meet new opportunities and peaks in demand.

Version 2.0 of the Digital Rapids Transcode Manager automated media transformation software was designed to directly address these challenges. Built on the new Kayak application platform, version 2.0 combines the software's established quality, format flexibility and performance benefits with new features including logic-driven workflow automation, dynamic deployment flexibility and elastic scalability. Like the earlier releases, version 2.0 is optimized for high-volume, multiformat workflows, supporting a distributed architecture with up to hundreds of transcoding nodes and dozens of compression and container formats for acquisition, production, archive, broadcast and multiscreen distribution applications.

Adaptive automation

A key goal in developing the software was to enable a new level of workflow automation intelligence that could squeeze even more manual effort out of the transcoding process, enabling faster turnaround, reduced errors, greater flexibility and lowered costs. The most basic level of this is the ability to automatically detect the characteristics of the source media — for example, its aspect ratio — and assign subsequent processing parameters accordingly. That "analyze-then-act" ability alone, however, only scratches the surface of what's possible, and has been historically achieved by tying together separate applications. Such approaches in which a separate workflow management layer passes media linearly between distinct applications for various processes (such as transcoding, image processing and quality control) can be inefficient for tasks in which ongoing interaction between each function is desirable or necessary.

The software was engineered to overcome these limitations, blending workflow management, analysis, logic branching and transformation functions all at the same application level. Users can visually define workflows combining video and audio manipulations, compression, visual monitoring, publishing and more. Different tasks or parameters can be applied based on the characteristics not only of the input source but also of previous processing results within the same ongoing task, enabling workflows to self-correct based upon the success of earlier efforts. Frame-by-frame, inline analysis and logic branching enable



Digital Rapids Transcode Manager 2.0 blends workflow management, analysis, logic branching and transformation functions. Users can visually define workflows combining video and audio manipulations, compression and more.

A key goal in developing the software was to enable a new level of workflow automation intelligence that could squeeze even more manual effort out of the transcoding process.

workflows to adapt to anomalies or changing attributes even within a single source file, thus reducing the number of exceptions that must be handled manually.

Elastic scalability

To address media organizations' needs for flexible scalability, version 2.0 of the software adds new cloud deployment dynamics. While cloud computing allows media processing deployments to move from capital expenditures into operating expenses, for premium media organizations, such a transition isn't going to be a wholesale change. For larger media enterprises with existing media processing infrastructure investments, the focus is on on-demand scalability within and beyond existing in-house capacity, particularly to meet peaks in demand.

With this in mind, the new version is designed to deliver the experience of an on-demand cloud processing system on-premises within a facility, with a seamless path for expansion into the external cloud. Lightweight transcoding engines can be instantiated as needed using available software licenses and program components checked out from a central pool. This allows customers to leverage cloud technologies on local systems, effectively combining virtualization with a new level of dynamics by elastically "spinning up" new software resources as needed using existing underutilized infrastructure. For customers who later expand their media processing to the external cloud, local transcoding engines and external cloud-based engines appear side-by-side in the software's dashboard for seamless hybrid deployments. (See Figure 1.)

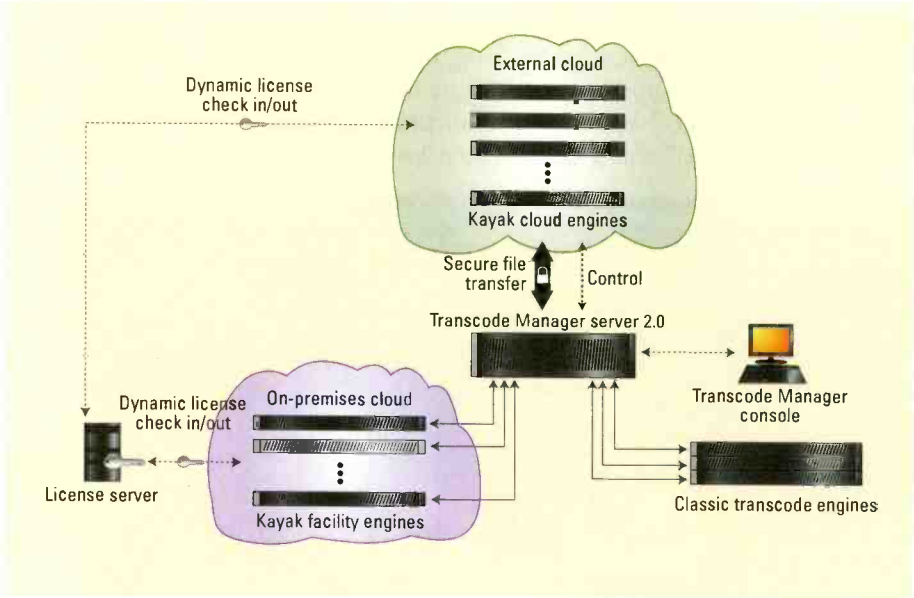


Figure 1. The software incorporates a dynamic deployment model and can "spin up" additional transcoding engines on demand with expansion to the external cloud. Dynamic resources appear side-by-side with fixed resources in the software's dashboard.

A foundation for the future

All of these new features and benefits — from increased automation intelligence to dynamic deployments and elastic scalability — are enabled by the underlying Kayak application platform, a rich, multilanguage component-based development framework and toolset that can also be used by third-party developers wishing to integrate their technologies with the software. Combined with Transcode Manager's extensive format support and proven quality through optimized codec implementations, the new version offers a modular media processing architecture that can easily adapt to the changing requirements of the expanding media landscape. BE

Mike Nann is director of marketing and communications at Digital Rapids.

SRS Labs' Circle Surround

The system encodes surround sound in a two-channel signal.

BY ALAN KRAEMER

When we think of surround sound today, we think of 5.1 digital transmission, with the most popular transmission codecs being supplied by either Dolby or DTS. However, there are still many cases when transmission of discrete, multichannel surround is impractical due to bandwidth limitations or other constraints such as infrastructure restrictions. It may also be desirable to use a surround format that does not require a proprietary decoder and its associated costs for cases when multichannel surround decoding is not required.

In these situations, technologies exist today that enable surround sound transmission over two-channel paths. Those technologies are backward compatible with stereo in such a way that content that is not surround-decoded plays back as stereo. When multichannel surround decoding is desired, the appropriate decoder can take the input stereo information and render it as an effective surround presentation.

These systems typically fall into two categories: composite and parametric. The composite systems essentially encode the information required to reconstruct the surround field in the audio itself. This audio can then be transmitted or stored on or over any two-channel media, including analog. Parametric systems analyze the spatial characteristics of a multichannel input and encode the resultant information into a low-bitrate digital sidechain that can be used at the receiving end to spatially reconstruct something close to the original surround presentation. Examples of composite systems are the SRS Circle Surround and the Dolby ProLogic II. An example of a parametric system would be MPEG surround.

Digging deeper

From a functional standpoint, composite, or "matrix," systems embed surround decoding cues in the audio through the use of amplitude and phase information. Matrix systems evolved from the earliest days of surround. The original system was Dolby Stereo, which was applied to motion picture sound tracks. When the home video era began with Beta and VHS, and when each eventually incorporated high-quality FM-based stereo audio systems, people discovered that the surround cues remained embedded in the audio tracks of the home releases. This, in essence, was the dawn of home theater.

The original iteration of Dolby Stereo had limitations that prevented it from working well, as it only provided about 3dB of separation between adjacent channels. Dolby ProLogic was developed to overcome this limitation by "steering" the signal based on surround cues encoded in the audio. Dolby ProLogic provided an improved experience, and it had the advantage of being able to play back unencoded content as basic stereo. However, it was still limited to a mono surround channel, which was often reproduced over two rear speakers even though they carried identical information. In addition, a 7kHz high-frequency roll-off was applied to the surround channel to enhance the perception of isolation from the front channels. Even with these issues, Dolby ProLogic was the standard method of storing and transmitting surround sound for many years.

In the mid-1990s, a composite surround encode/decode system was developed by a company called Rocktron. It was designed to address the limitations of Dolby ProLogic cited above. The Rocktron Circle Surround system provided full-bandwidth stereo surround by using a more advanced multiband, variable-time-constant steering system. Circle Surround was later acquired and further refined by SRS Labs and served as a mainstay for sports and music broadcasting prior to the digital era.

In response to Circle Surround's success, Dolby created ProLogic II, which addressed the limitations of the original ProLogic. Both systems, however, could decode each other's encoding and still present a credible surround sound experience. It is this characteristic, along with the ability to encode surround to two channels and the lack of necessity for a decoder when surround is not required, that makes composite surround systems of this type attractive, even today, for certain cases.

Parametric systems such as MPEG surround can create a "near-discrete" surround presentation under the right conditions, but they require changes to the two-channel infrastructure to carry the sidechain data. This extends to both the transmission codecs as well as the internal distribution and playout structure of the content provider.

Conclusion

When transmission is limited to two channels, an excellent surround sound experience can still be made available to consumers through highly effective and mature technologies currently available in the market. BE

Alan Kraemer is the CTO of SRS Labs.

Satellite services and systems, part 1

OTA transmission is more complicated than it looks.

BY JOHN LUFF

Satellites first were used in television for short-duration transatlantic interconnection. Short could mean a few minutes, but at the time it was a technological wonder. Early Telstar transmissions required substantial antennas and large amounts of transmit power due to the low sensitivity and large-transmit beam size with which the satellites were equipped. Though it seems hard to believe today, the satellites were not in geostationary orbits. Dishes had only seconds to acquire a signal and had to track rapid motion — 1.5 degrees per second.

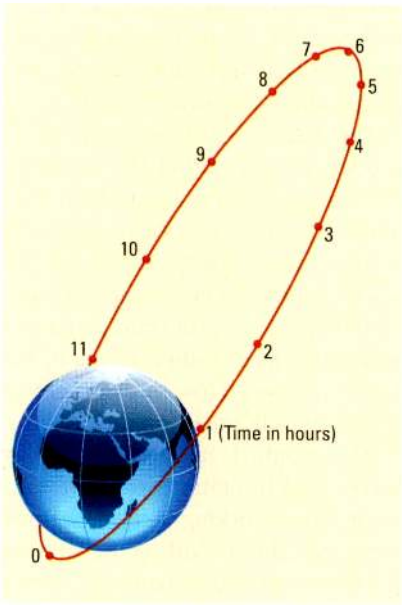
Telstar had one transponder, making each pass usable by only one transmission of about 20 minutes. The cost of transmissions was prohibitively expensive and accessible at only very specific times. That made for a tough business case. Compelling content and experimental use provided for uses. Only two earth stations were available, in Maine and at Goonhilly in southwest England.

Soviet Molniya satellites

Other satellites also were used for communications that were not in stationary orbits. Some of the most remarkable were the Soviet Molniya satellites, which were in highly elliptical inclined orbits. At apogee (farthest from the Earth) they were essentially stationary for long periods, but as they moved closer they sped up considerably, making them practical for most of each orbit, but then useless.

The Soviet national network used them for many years for time zone delays for their large distribution system. In later years, they were used for some occasional feeds by Western broadcasters.

Today we use exclusively geostationary satellites. Each orbital slot occupies a highly controlled location over the equator (essentially a box). Inside this box, the spacecraft moves in a figure-8 pattern that is highly predictable, making unmotorized antennas practical. Antennas on modern spacecraft are extremely complex, making patterns that waste little energy over water or unpopulated areas on land.



Soviet Molniya satellite orbit 1

Satellites will likely enjoy an advantage for high-quality broadcast distribution for some time.

Satellites excel when transmissions are one to many, broadcasting the same signal to many receivers, and thus multiplying the economic advantage manyfold. Though terrestrial delivery over fiber has certainly achieved economies that rival one-to-one satellite service today, satellites will likely enjoy an advantage for high-quality broadcast distribution for some time.

System complexity

In this respect, satellite technology resembles compression. The complexity and cost is pushed to the transmit end so inexpensive and technologically simple receivers can be deployed. An earth station must be licensed for transmission, and the hardware is not inexpensive. Occasional use can be accomplished with transportable or vehicle-mounted systems, but for permanent use a fixed, licensed antenna is the only practical answer. It would be nice if systems could be inexpensive, but there are so many elements that must be part of an uplink that low cost is hardly an option at high bandwidth.

First, the antenna (aperture) and feed must be well designed to achieve adequate performance in the center of the beam, but at the same time the energy that misses the reflector must be extremely well controlled to avoid irradiating areas around the antenna. In addition, the beam itself must have (by regulation) well controlled side lobes to ensure that only one satellite is illuminated at a time. The standards for U.S. communications satellites and others are not necessarily the same in this regard, and each satellite operator has specs for their spacecraft.

Second, the RF sections of the transmission chain need to provide well-filtered signals with sufficient

power to drive the transponder in the satellite to saturation. This is a complex calculation, termed link budgeting. Many factors must be taken into account, including free space loss over the length of the path to the satellite using the actual location on the earth and the location of the satellite in space. The distance is nominally 23,000mi each way, so even a pencil-thin beam loses a lot of intensity by the time it reaches the satellite. The calculations for the link budget must also take into account the gain of the antenna on the transmission end, as well as the gain and power of the spacecraft, plus the gain of the antenna on the ground. All of the figures are easily obtained, and the link budget can actually be calculated online using a variety of available tools.

The constraints on the overall system effectively mean that you cannot simply blast the spacecraft with as much power as you can buy (large aperture and big amplifiers). Interference with terrestrial uses in some bands restricts the actions operators can take — particularly in C band, where the frequencies are shared with terrestrial microwave services. It is often the case that certain frequencies on certain azimuths cannot be used to avoid interference.

The burden of proof is on the operator of the newer service. If the transmission system has been licensed for the full arc of available satellites and all frequencies (transponders), any new services — terrestrial or satellite service — must coordinate their use to avoid interfering with the existing system's licensed use. Of course the reverse is also true.

With Ku (10.95GHz to 14.5GHz) and Ka (26.5GHz to 40GHz) satellites, coordination with other uses is not an issue because there are no sources of terrestrial interference. There are other issues to be understood, the most important of which is that precipitation degrades higher frequencies to a more serious degree. This "rain fade" may make high-reliability service impractical without geographic diversity plans to transmit from a second location. Of course, having diverse receive sites is seldom an option.

Next month, I'll discuss other aspects of the technology, including modulation schemes, the use of compression in links and downlink/receiver issues. BE

John Luff is a television technology consultant.

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

Matrox — Mojito

Card supports the new version of Avid Media Composer; provides broadcast-quality I/O and lets users deliver H.264 files for the Web, mobile devices and Blu-ray up to five times faster than software alone; also features 10-bit hardware scaling, inexpensive HD monitoring with the Matrox HDMI calibration utility, and 5.1 and 7.1 surround sound monitoring using professional connections.

www.matrox.com

TV One — 1T-CT-633

HDMI repeater extends range of the 1T-CT-631-A/1T-CT-632 in video system installations; the 1T-CT-631A/632 HDMI extender can achieve signal distribution distances ranging from 125ft for 1080p signals to 195ft for 480p signals; the new repeater can double those distances — typical distance is 250ft in the 8-bit (1080p) mode and 98ft in the 12-bit (1080p) mode; also, within the maximum allowable Cat 6 or HDMI cable length, repeaters can be cascaded beyond the distance provided by just one repeater.

www.tvone.com

Broadcast Pix — VOX

Voice-activated automation control for Granite, Mica and Slate integrated production systems; detects when a particular mic is being used and triggers software to switch to a pre-determined camera position and add the appropriate graphics; lets users set conditions to prevent coughs or one-word comments from changing cameras; mic inputs can be prioritized; allows host override through the included soft panel software.

www.broadcastpix.com

MultiTouch — MultiTaction Cell 55

Large-scale (55in) LCD multitouch display offers a set of advanced touch, gesture and object-recognition capabilities; display measures 4in deep on the sides and 8in deep in the middle; can accommodate large numbers of touch points and concurrent users with full hand recognition; offers response of more than 200fps; designed for interaction with real-life objects; can be stacked to any size or shape using tens of units.

www.multitaction.com

Adobe — Creative Suite 5.5

New version includes the Production Premium package, which serves many mobile TV production needs; offers updated version of the Premiere CS editor, which features a merge clips command for mixing audio from different cameras shot in the field and support for RED and Canon/Nikon DSLRs; also includes an update of After Effects CS, which features stereoscopic 3-D workflow; additional features include new effects such as Camera Lens Blur and an advanced warp stabilizer.

www.adobe.com

Sony — DWA-F01D

New adapter for standalone portable receiver or mixer bag use with the DWR-S01D digital wireless slot-in receiver; supports optional powering of the receiver using Sony InfoLithium L series batteries; also offers users the ability to additional flexibility in multipurpose wireless receiver applications, including V-mounting the portable receiver onto a camera; new companion soft case offers easy access to connectors and battery.

www.sony.com/professional

Panasonic — AV-HS410

19in switcher provides nine signal inputs; inputs are expandable with option boards to a maximum of 13 HD/SD switchable signal inputs; features easy-to-read 7in color LCD panel, new memory preview function, an improved multiview function and a simple key layout optimized for live broadcasts; optional board slots enable support for input signals, including 3-D cameras; includes software development kit.

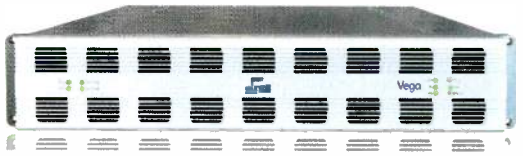
www.panasonic.com/broadcast

Riedel Communications — AVB

Product series allows for transporting AES3/EBU audio in real time with guaranteed bandwidth and QoS via IP-based LANs; based on official IEEE next-generation Ethernet standards such as 802.1Qav, P802.1Qat and P802.1AS; enables risk-free use of AVB-compliant facility or enterprise LAN infrastructure for professional intercom applications; allows for new approaches in system and facility design, providing savings in infrastructure investments.

www.riedel.net

Snell — Vega



96-port router allows users to configure any signal port independently for fiber or coax connectivity; offers dual crosspoints, dual controllers, dual power supplies and dual fans — all replaceable — for maximum redundancy; uses proprietary algorithms to continuously monitor every sub-assembly.

www.snellgroup.com

Media Broadcast — Broadcast Access Technology

New access technology enables use of a barker channel to transmit additional service information data to online portals or live streams hosted by various content providers; incorporates the remote controls of both linear and Web-based systems; gives online providers a direct EPG listing and consumers direct access to services.

www.media-broadcast.com

Sencore — SLM 1478

Analyzes digital TV/RF formats, including NTSC, ATSC, QAM and DOCSIS signals; highly portable for use by installers of high-speed CATV video delivery networks; provides in-depth digital signal measurements from 4MHz to 1GHz; offers signal parameters including pre- and post-BER, average power, MER, spectral analysis, noise margin, and constellation for QAM A and B; features a LAN port for network connections to facilitate FTP uploading of logged test data to simplify system documentation.

www.sencore.com

Rohde & Schwarz — R&S PR100

Operates in a frequency range from 9kHz to 7.5GHz; combined with the R&S HE300 GPS-enabled directional antenna, can quickly detect and locate the source of cellular band interference disrupting wireless infrastructure equipment; the portable receiver provides 10MHz real-time IF spectrum and demodulation over a bandwidth ranging from 150Hz to 500kHz; also includes an audio tone indicator of signal strength to help users identify the source of interference.

www2.rohde-schwarz.com

Softel MediaSphere — DTA

TS generator allows cable operators to maximize the bandwidth capacity of their current, possibly analog, infrastructure for quick, economical delivery of digital services, such as service information, EPG and VOD; can create many types of SCTE data and deliver it to consumer devices, including set-top boxes, DTAs and CableCards.

www.softelgroup.com

Teradek — Bond

Ultra-compact cellular bonding system enables freelance and professional broadcasters to transmit live content over as many as five 3G or 4G cellular modems from multiple carriers worldwide simultaneously from the field; camera-top unit fits in the palm of the hand; incorporates low-power hardware H.264 HD video compression and advanced streaming options such as RTMP and MPEG-TS; also features the company's Adaptive Internet Streaming (AI Streaming) technology, which adjusts bit rate and buffering in real time to handle volatile network conditions.

www.teradek.com

Harmonic — Outdoor Hub

Platform enables delivery of improved high-speed Internet, cable IPTV and multiscreen services over existing cable networks; can be combined with the Harmonic SupraLink 1550nm transmission system to simplify architecture and streamline operations; acts as an optical distribution point for downstream traffic and an aggregation point for upstream traffic; each hub can house modules for optical switching, splitting, amplification, wavelength multiplexing and de-multiplexing, and re-lasing.

www.harmonicinc.com

Yamaha — 01V96i

Digital mixer offers a 16-track USB 2.0 interface for multitrack recording via Mac or PC; features 16 in/16 out USB audio streaming at 96kHz, as well as multichannel in/out via expansion card or ADAT; at a sampling rate of 24-bit/96kHz, the unit features studio-quality head amps with high-performance onboard A/D and D/A converters; shares all the functionality of its predecessor, including 100mm motor faders, 99 scene memories for instant recall, and fully configurable user-defined keys adapting to any studio or sound reinforcement situation.

www.yamahaca.com

Mushroom Networks — Streamer

Portable device bonds multiple broadband connections (fixed or wireless) into a single high-speed pipe to transmit high-quality live video and audio webcasts; works with webcasting equipment, including encoders, switchers, software encoders on laptops as a video source and CDNs, such as Ustream, Livestream, Justin.tv, Akamai and Limelight.

www.mushroomnetworks.com

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Time to pause

A less famous Steve is in the fight of his life.

BY ANTHONY R. GARGANO

In May of this year, I joined about 30,000 others from around the world to converge in, of all places, Dayton, OH. Why would so many people from all around the United States, Japan, China, Germany, Italy, England, the Ukraine and many other countries meet there? It was time for the annual Dayton Hamfest, the largest gathering of amateur radio operators in the world.

That the broadcast industry is well represented each year at Dayton is readily discernable as you walk around indoor exhibits, attend forums and shop at the indescribable flea market. One encounters station and network executives, as well as engineering and technical staff, who not only share a vocation but an avocation as well. Anyone who has attended or, perhaps, happened to pass by the ballroom that hosts the ham radio reception at NAB each year can tell from the overflow crowd that our industry is well populated by hams — and not just those in front of the cameras! The engineering and technology involved in professional broadcasting offer an affinity to the broadcasting aspects and the technology associated with ham radio, thus providing a natural career-path progression for many in the industry.

One such ham whom I met many years ago at ABC's New York network headquarters was Steve Mendelsohn. Steve had joined the broadcast operations center as a systems engineer. Given his quick- witted, extremely sociable and always ready to break into a grin personality, I joined the long list of Steve's friends. Steve had his own lively and extended social network while Mark Zuckerburg was still in diapers. Loving challenges, Steve was a great fit at ABC, where he enjoyed applying his uniquely creative systems engineering skills and was a master at coming up with innovative solutions to the most complex of problems.

I happened to bump into Steve and his wife, Heidi, in the airport waiting area as we were all preparing to fly to Dayton for this year's Hamfest. Greeting me with his usual grin and firm handshake, but with a bit of tiredness in his eyes, I told him it was great to see him and asked how he was doing. His response, despite the grin, was "not too well." He went on to say that in January of this year he was diagnosed with Stage 4 pancreatic cancer and was given a matter of months to live. But, he went on to say with incredible spirit, he was going to lick this thing; he was going to beat it.

Steve had his own lively and extended social network while Mark Zuckerberg was still in diapers.

Steve has enjoyed a remarkable career. He has made major contributions to ABC network's programming and broadcasting capabilities. He was a key part of the design team who created the network's initial all-digital control room. In its heyday, ABC's Monday Night Football sportscast drew huge ratings. In no small part was this due to Steve's contributions to innovations such as the parabolic mic to pick up sounds to accompany video of the on-field mayhem. Steve's love of football, coupled with his ham radio experience, landed him his dream role of being the game day frequency coordinator for the New York Jets. This role led to Steve being asked to take on similar responsibilities for everything from the 2003 Super Bowl to the New York City Marathon.

For the turn of the century a decade or so ago, ABC decided to do a special broadcast entitled "Millenium Around The World." This ambitous project would capture and air live the ringing in of the year 2000 around the globe. The technical challenge was switching from venue to earth-circling venue, back to the network, on air, live. Rising to the challenge, Steve integrated IP, satellite and telephone technologies into what was probably the most complicated communications system ever designed for broadcast television. Steve reached a career pinnacle for his efforts by being awarded a technical Emmy in recognition of his achievement. His industry peers recognized him once again in 2004, when he was awarded the DeForest Audion Gold Medal for his lifetime of significant achievements.

Steve is now in the fight of his life. He has started round two of chemotherapy and his weight has dropped to a precipitous 110lbs. But, he has already bested his doctor's longevity prediction several times over. With much notoriety, another Steve, initially diagnosed with pancreatic cancer and also of prodigious creative genius, sadly, was recently lost to us. (Does being named "Steve" impart special technological talents and creativity?) As our industry colleague, Steve Mendelsohn, fights on tirelessly and determinedly, we wish him well. I look forward to seeing him in Dayton again next year. BE

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

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

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Evertz' new **3480 Media eXchange Platform** is a combination of state-of-the-art compression technology and key system level functionality from Evertz' extensive video, audio, VBI processing product lines. The platform simplifies content delivery offering multiple high quality linear distribution encodes/transcodes plus multi-screen resolution encodes. With the addition of Evertz' advanced compression software the 3480 Media eXchange Platform is the right solution for today's broadcasters with the abil ty to adapt to tomorrow's ever changing Television Landscape.

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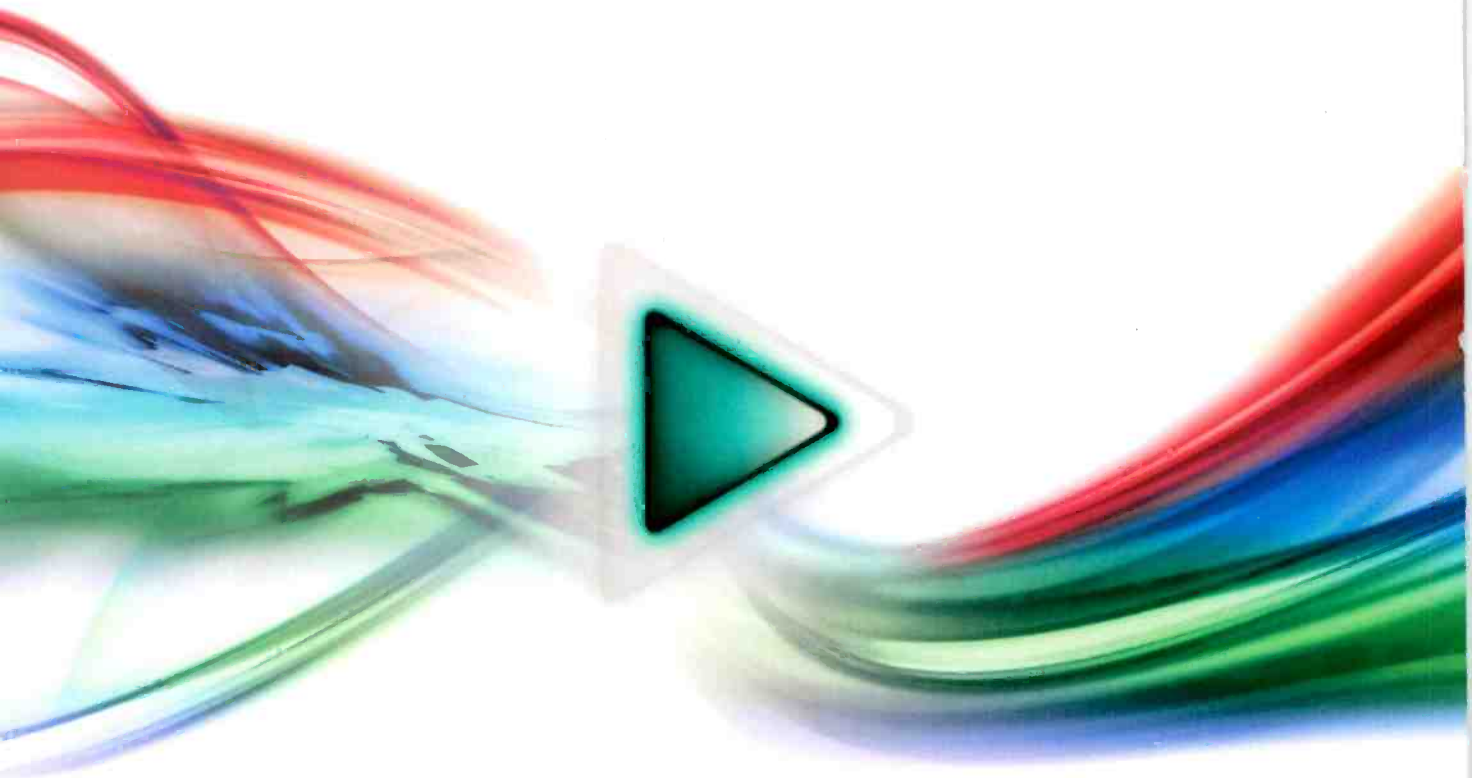
PLAYBOX TECHNOLOGY

From a Single Channel Playout Server to a Multi Channel Turnkey Broadcast Centre

It's All in a PlayBox



- **Single and Multi Channel Playout Automation with interactive CG and Graphics**
- **Traffic Management • Media Asset Management and Archive • Newsroom System**
- **Remote Redundant Playout • Ad Insertion and DPI • Time Shift**
- **IPTV and Internet TV Solutions**
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