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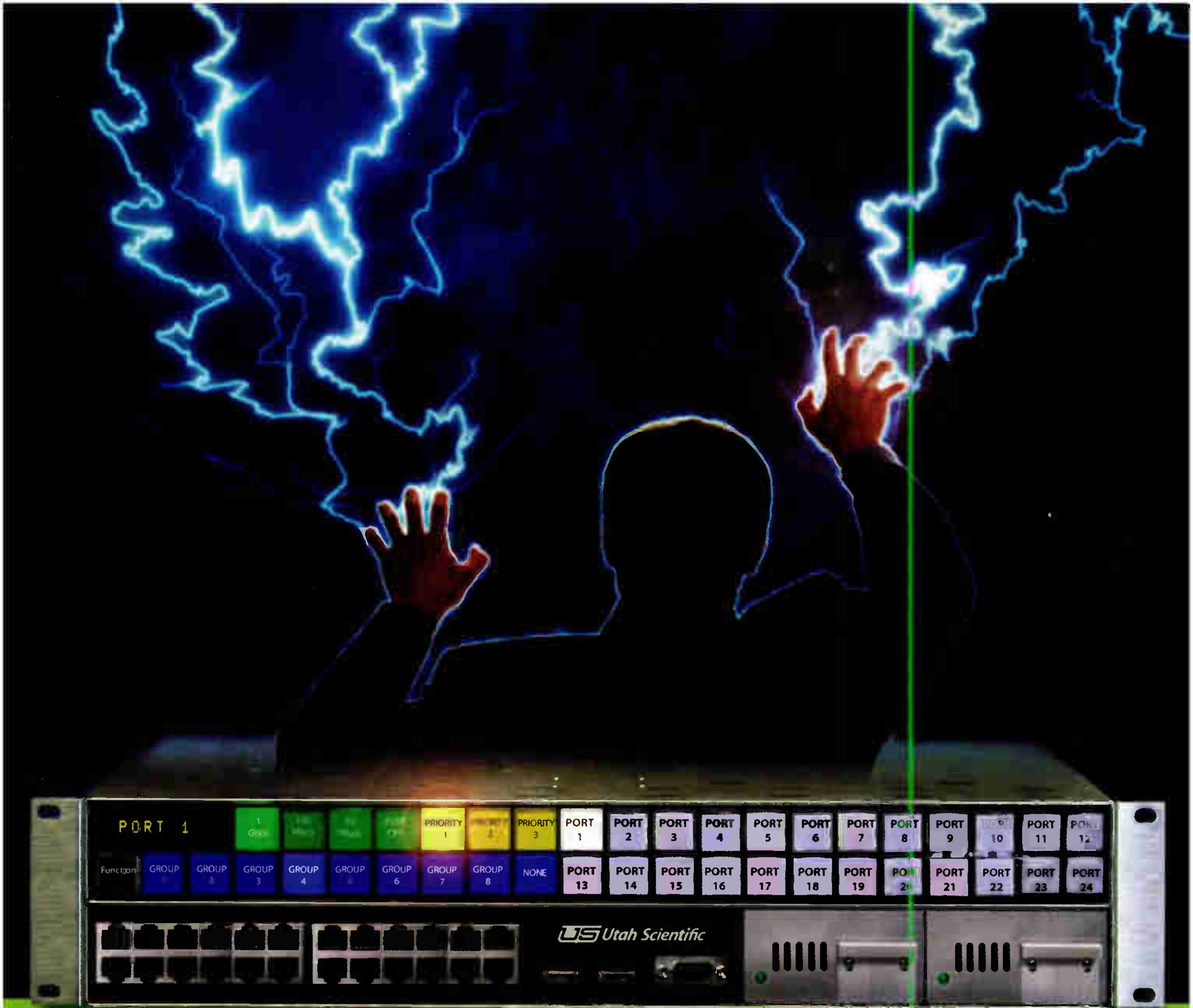

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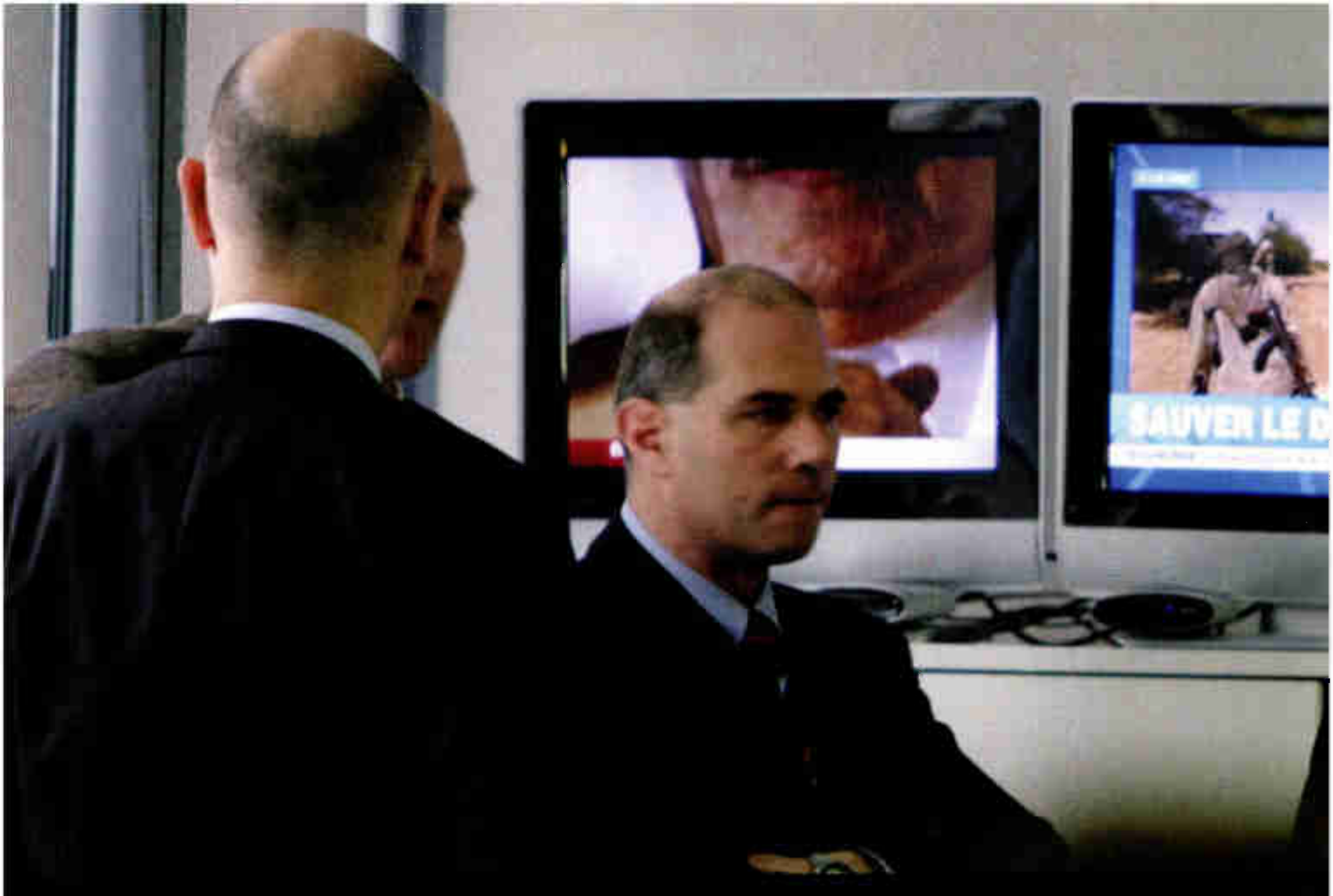

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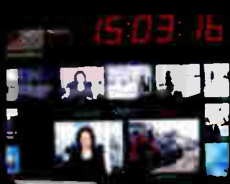

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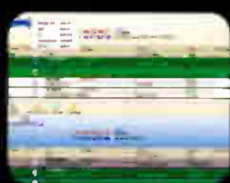

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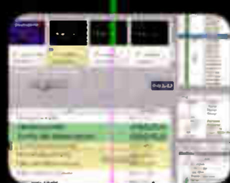

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ON THE COVER:
A quality Web viewing experience, through IP distribution, can significantly expand a broadcaster's reach.

Blackmagicdesign

New DeckLink HD Extreme has Dual Link 4:4:4/4:2:2 SDI, HDMI and analog connections in SD, HD and 2K!

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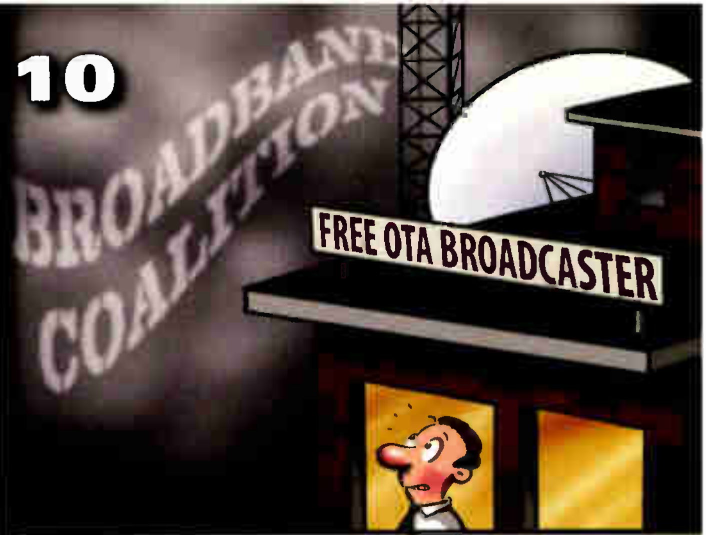


SEE IT ONLINE!

Check out Brad On Broadcast, editor Brad Dick's blog, for industry insights. A recent post, "Noise wars," discusses the new book "Noise Wars, Compulsory Media and our loss of autonomy" by Robert Freedman. The book "portrays the daily battle many of us face in simply trying to remain free from other people's noise — be it aural or visual."

Learn more at *http://blog.broadcastengineering.com/brad*

LATEST NEWS!

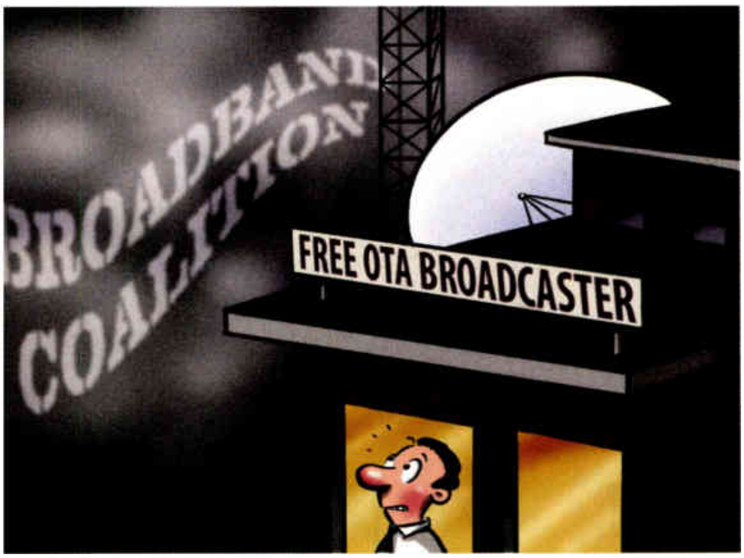
A group made up of representatives from the broadcast industry, retailers and government have developed an advisory and consumer tips sheet to help over-the-air viewers resolve antenna-related DTV reception issues.

Learn more at *www.broadcastengineering.com*

Perfect storm

Dark, ominous clouds of potentially cataclysmic, business-changing proportions are brewing in Washington. Formed by converging forces of progressive-philosophy-leaning government officials, increased consumer pressure for bandwidth, the worst economic times since the Depression, and a Congress and president panicked for new revenue, these winds of change could put every TV broadcaster out of business.

In October, the Consumer Electronics Association submitted to the FCC a 22-page report, "The Need for Additional Spectrum for Wireless Broadband: The Economic Benefits and Costs of Reallocations." The report,



authored by Coleman Bazelon, outlines a plan to implement wireless broadband (and kill over-the-air TV) through three simple steps:

• Buy out broadcasters and turn off OTA TV broadcasting;
• Provide free subscription cable/satellite programming to current OTA homes; and
• Sell the freed-up spectrum to the highest bidders.

On the surface, this might seem like a laughable proposal. After all, broadcasters just relinquished more than 100MHz of spectrum and spent billions of dollars to complete the conversion. However, even those efforts may not be sufficient to stop the pro-broadband agenda.

Broadband benefits

Few would argue against the benefits of wider wireless broadband implementation, but this report makes some extravagant claims. Among them:

• Broadband deployment will create an additional 1.2 million jobs, and every 1 percent increase in broadband penetration will create another 300,000 jobs.
• A 10-percentage-point increase in broadband penetration will increase gross domestic product by 1.2 percent.
• "... Lives will be saved and tens of thousands of hospitalizations can be delayed or avoided."
• Estimates of potential reductions in greenhouse gases due to additional wireless broadband vary from 1 billion tons over 10 years to almost 8 billion tons by 2020.
• Consumer surplus (total value of broadband benefits) range from $500 billion to $1.2 trillion.

The proposal requires the selling of all TV channels, which it claims would generate $62 billion. The offsetting conversion costs (free cable/satellite) range from $9 billion to $12 billion. "Such a significant mismatch between the value and costs indicates radio spectrum is currently inefficiently allocated," says the report's writer. "The benefits of the proposed reallocations could be more than $1 trillion and also represents the cost of inaction."

Plan B

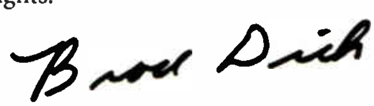
If you don't want OTA broadcast to go entirely dark, the CEA's report offers Plan B. This scheme would clear only three-quarters of the TV band (216MHz). Among the results:

• VHF Channels 2-14 would be kept, and UHF Channels 15-35 and 37-51 would be relocated to wireless.
• Broadcasters would be required to share channels, with no OTA HD.
• The total value of TV station properties would decrease to $6.2 billion.

More frightening, a similar proposal was apparently raised in an October meeting between FCC broadband czar Blair Levin and key TV broadcasters. One report said he suggested broadcasters might want to consider giving up their channels in exchange for a share of the billions that a spectrum auction would generate.

Should these antibroadcast forces ever get their way, broadcasters may be left with two options: relinquish their license, turn off the transmitter, give up any potential new OTA revenue streams and become a cable-feeding program stream; or simply take the buyout money, turn off the lights, and go home.

What would you do? Visit the Brad on Broadcast blog at *http://blog.broadcastengineering.com/brad*, and share your thoughts. BE



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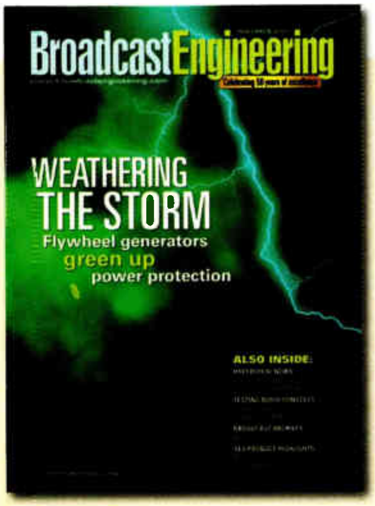

In praise of new media technologies

Dear editor:

I'll bet I'm not the only reader finding the tone and content of Brad Palmer's letter "A word of thanks" from the Feedback column of your November issue almost laughable.

I was most surprised that a modern media company's VP of operations questions the importance of raising efficiency and, hopefully, profits. He seems to believe that job prospects of up-and-coming journalists trump the value of running a viable business.

I wonder how many unemployed newspaper and magazine journalists (reporters, writers, editors, artists and photographers) wish their companies had adopted more efficient business systems and processes and taken advantage of new technologies for production, distribution and monetization. Their answer has been a steady flow of layoffs and folded publications.

I was a newsroom computer systems pioneer, working in sales and management roles in the late 1980s with Jefferson-Pilot Data Systems, BASYS and (later) Associated Press Broadcast Technologies. In the late 1980s, only dentists ranked lower than broadcast news operations in their use of computer support systems. These were the days of electric typewriters and six-part script sets.

Newsroom systems were initially positioned as cost- and time-saving investments, but I can't recall any cuts in newsroom staff as the direct result of a newsroom system implementation.

In fact, I contend advances in media technology create more options and opportunities — not fewer. The ability to produce and distribute news is no longer a power held only by rich networks and stations. Technology has made news programming less costly, more immediate, more accessible, more relevant and — if anything — has reduced the technical complexity of broadcast journalism.

Aspiring broadcast journalists should view creative application of new media technologies as part of the challenge of being a reporter, editor or videographer. I wonder if Mr. Palmer would have taken up the cause of monks when Johannes Gutenberg invented the printing press and reduced the demand for Bibles reproduced by hand.

Jim Cundiff
Executive VP and managing partner
Sales Performance Associates
Roswell, GA

CRT displays

Dear Aldo Cugnini:

I have looked at HD monitors during the last couple of years and have found that LCD technology will not meet or come close to "broadcast standard" in a color correction room or an editing room. We have looked at the $26,000 Sony unit and found it poor when compared to their old HD CRT monitors. It is my belief that the industry must look for a different technology for broadcast displays — organic LEDs or the technology shared by Canon and Toshiba. Another problem with the existing flat-screen displays is the processing delay, which causes lip sync problems.

Before reading your column, I was under the assumption that the transfer characteristics of LCD and plasma displays was linear. Do you know what causes the gamma transfer on these devices? Is it added electronically to make it match CRTs? As an old color camera designer, one of our major problems was the noise added when we gamma-corrected the video signals from the pickup tubes.

Today, the only two ways to view HD video in a broadcast environment is on an old Sony CRT monitor or a projection system.

Ted Dunn

Aldo Cugnini responds:

While it is arguable whether LCD displays are currently close to a "broadcast standard," the sad truth is that CRT displays are going the way of the dodo. With fewer CRTs being manufactured and sold, the economics of the bottom line will make (or has already made) the point moot. As for processing delay, any good monitor should account for this and make for perfect lip sync. As for gamma, modern devices are not linear, due to the physics of displays, but have their own particular transfer characteristics. Again, a good design will take this into account.

Cost-cutting measures

In response to your "Broadcasters slash expenses no matter the cost" article on your Brad on Broadcast blog, that was the funniest thing I read in weeks. Nice work, Brad! Unfortunately, you are correct. I think everyone has learned a hard lesson in making an effort to save company dollars. But as you state, some companies have taken this to the extreme. Seriously, no clocks at Sprint? I would hate to see what Las Vegas does to reduce OPEX. The "no clocks" policy is already in place there.

Eric Harrington

Share your thoughts at
http://community.broadcastengineering.com/forums/80.aspx

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Surround monitoring

Basic changes can improve surround-sound monitoring in the broadcast control room.

BY HOWARD MULLINACK

When preparing to originate programming in surround sound, there are some fundamental guidelines for loudspeaker selection and placement, equipment for monitoring loudness and mixing techniques.

For the local TV station, it's been a long tortuous transition from analog video and BTSC stereo to transmitting ATSC digital HD video and surround sound. HD video is far more revealing of details and imperfections. The same holds true for digital surround-sound audio — the 3in speaker is no longer the norm in the home TV set. According to the CEA, more than 20 percent of viewers are listening to the audio on high-quality surround systems, with this percentage growing each year.

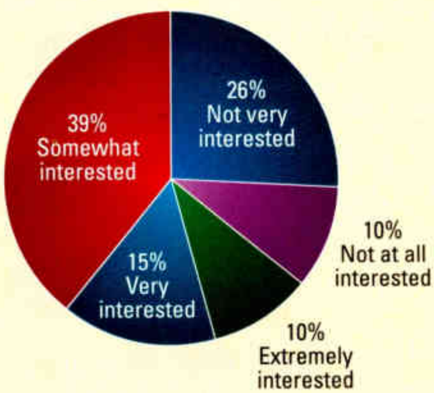
In the analog world of BTSC, we monitored and mixed for the limited dynamic range required for the vast majority of viewers and for analog audio carrier's technical limitations of 25kHz deviation and 75µs pre-emphasis. BSTC digital audio offers a dynamic range of more than 100dB and with it the opportunity for creating great sounding mixes and the challenge of loudness deviations that exceed the comfort range of the viewers. Loudness complaints are on the rise; legislation is pending in Congress to mandate controls and penalties (H.R. 1084, The Commercial Advertisement Loudness Mitigation Act).

"Late Night with Jimmy Fallon" uses nearfield monitors with sound absorption at the bottom of each speaker to minimize reflections off the console.

These opportunities and challenges have been under study by the ATSC. Last month, the ATSC released the "ATSC Recommended Practice: Techniques for Establishing and Maintaining Audio Loudness for Digital Television (A/85)." The document covers the ITU-R BS.1770 loudness measurement, target loudness and dynamic range management, metadata management, audio monitoring setup, and two essential "Quick References Guides," one for station engineers and management, and the other for audio mixers and editors. An upcoming issue of *Broadcast Engineering* will feature a detailed report on A/85.

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

TV viewers are interested in watching 3-D content at home.
Thirty-nine percent of viewers are somewhat interested.



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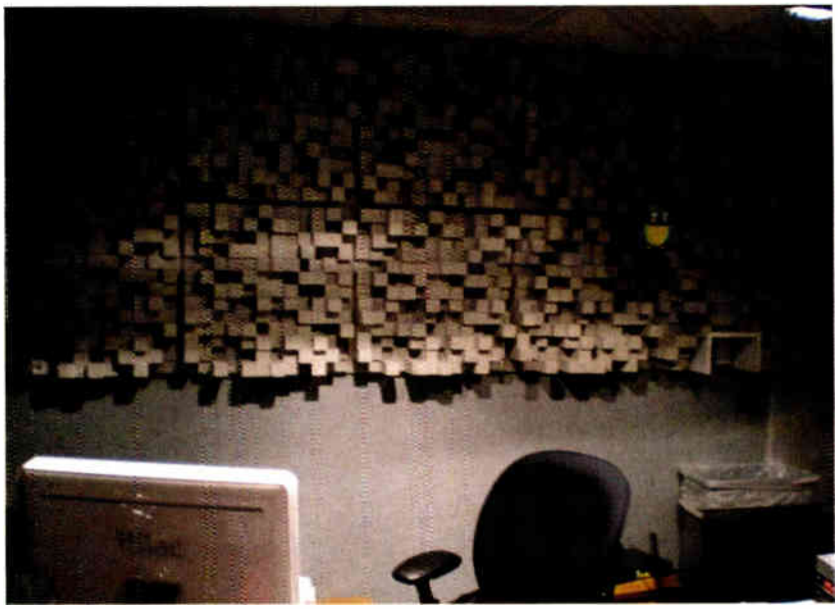

This "Saturday Night Live" mix studio uses sound absorption on the rear wall to minimize reflections.

Speakers and speaker placement

The typical broadcast audio mixing environment is often far from ideal. There are, however, a few basics than can easily be followed to assure that what you hear is representative of what your viewing audience will hear on the typical high-quality system.

Speaker selection is critical. In a panel discussion at the Audio Engineering Society convention in New York in October, Sam Berkow, principal consultant for SIA Acoustics, offered valuable advice: "For effective monitoring, the LCR speakers should be identical, with the surrounds tonally similar to the LCR. We found that monitors that worked for stereo mixes are not always acceptable in surround. This is because the off-axis energy of the L and R speakers is absorbed by acoustical treatment, but for the C speaker, treatment is less effective because of the glass window. Finding monitors that are well behaved in their off-axis response can really affect the way that they are heard in a real working environment. We also found through testing that better off-axis response results in better subjective preference and less listener fatigue."

The front LCR speakers should be positioned equidistant from the sound mixer's central position. (See Figure 1.) A time delay resulting from different path lengths produces a comb filter effect at the mixer's ear. If necessary, delay can be used to compensate for less-than-ideal placement. If the surround speakers are closer to the mixer than the front speakers, they too should be delayed.

The LFE subwoofer adds its own challenges. Berkow found that "rooms that worked well for standard stereo mixing may have all sorts of problems when you introduce subwoofers. The position of the subwoofer can be very important in how it interacts with the acoustics of the room and the LCR loudspeakers. Some basic acoustical measurement can be very helpful when positioning subs, and there really are very cost-effective ways to resolve low-end problems in many rooms."

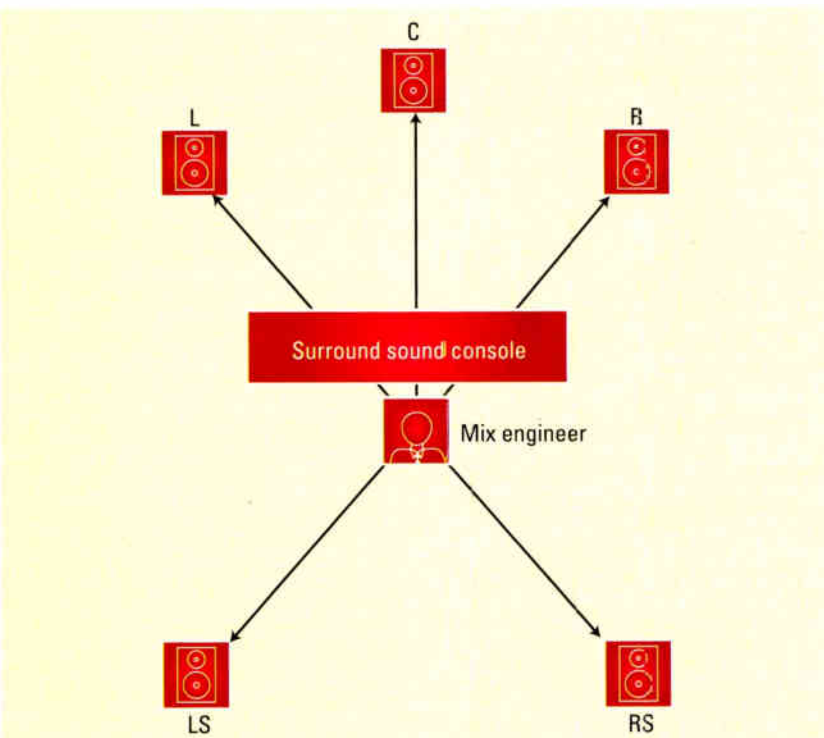

Figure 1. Left, center and right speakers should be positioned equidistant from the mix engineer. Rear surround speakers should be placed at a distance equal to or greater than the distance of the front speakers to the mix engineer.

Room considerations

Speaker equalization is often used to correct less-than-ideal room conditions, but there's a fundamental downside to this approach. What the mixer hears is a combination of direct sound, early reflections off of adjacent surfaces (walls, furniture and the mixing console itself) and room reverberation. Speaker equalization tuned to correct room defects improves the room reverb response at the expense of coloring the direct sound. Most of the spatial cues come from the direct sound, and a non-flat direct response can result in a less-than-ideal mix. Room anomalies are much better addressed through acoustical treatment.

Equipment in the control room with

fans raises the ambient background noise, often masking low-level detail, noise and hum. Wherever possible, locate such noisy equipment outside in an equipment room. The same holds true for HVAC; control flow rate and install duct treatment to reduce air noise.

Mixing fatigue is also a critical factor in the quality of the mix. Don't underestimate the value of a comfortable chair and fresh air.

Loudness monitoring and reference mixing levels

For decades, sound mixers used two tools: VU meters (or PPM) and their ears. Now we add the BS.1770 Loudness Meter. The VU meter and the PPM were designed to protect the electronics and the recording media; they are not a useful indication of subjective loudness. The ITU, in a joint committee, designed and extensively tested an algorithm to measure loudness in a manner that correlated closely to subjective hearing: "ITU-R Recommendation BS.1770 — Algorithms to measure audio programme loudness and true peak audio level." The BS.1770 algorithms integrate audio from all channels except the LFE, and present the operator with a single number representing perceived loudness, on a decibel scale in units of LKFS. BS.1770 meters, in hardware and software versions, are available from several manufacturers. The ATSC adopted BS.1770 metering as a required tool in the sound mixing control room.

Jim Starzynski, principal engineer and audio architect for advanced engineering at NBC Universal, is the network's in-house specialist on audio technologies and practices, and chairman of the ATSC subcommittee that developed A/85.

He says, "Using the BS.1770 metering has been the major culture change in the transition to digital. Put the meter right in front of the sound mixer, typically on the meterbridge. (NBC's engineers prefer a meter that gives a simple easy-to-understand numerical indication.) Use the console's onboard metering solely to keep levels well below the peak clipping level.

"Mix with your hearing. Monitor with the BS.1770 loudness meter, using it as a tool. Look at the meter to set up your aural reference, and then use your ears to determine the layering of the mix. While mixing, switch frequently to a two-channel downmix. If possible, listen through a stereo AC-3 emulator to simulate the metadata effect on the content."

The ATSC A/85 Recommended Practice includes a "Quick Reference Guide for Audio Mixers and Editors Creating Content." Distribute it to your mixing engineers. **BE**

Howard Mullinack is a technical editor for Linear Acoustic.

Morpheus is the most flexible and powerful automation solution on the market today. It is capable of managing everything from simple server playout, to complex channels where schedules are changing regularly and unpredictably. Format and device independent, Morpheus offers a robust and resilient content distribution mechanism that's ready to integrate new devices to meet future demands.

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unless both ends of the communication establish a connection. (Think of telephone voice calls, for example.) In general, packetization delays and resynchronization delays are small for ATM and large for IP.

ATM uses time division multiplexing (TDM) to encode data into fixed-length packets called cells, each containing 53 8-bit bytes — a 5-byte header and a 48-byte information payload. (The ATSC standards specify MPEG transport carrying packets of 188 bytes, where one byte is a synchronization byte and 187 are payload.

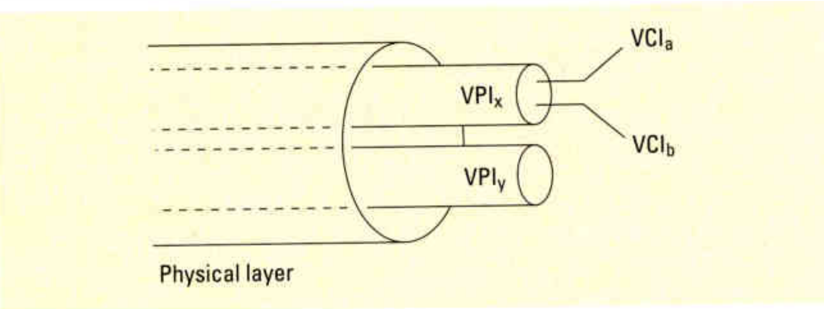


Figure 1. ATM connections are defined by virtual path identifiers (VPI) and virtual channel identifiers (VCI).

This packet approach was specifically defined with ATM switching in mind, as each 188-byte MPEG-2 packet maps into the payload of four ATM cells, with only 4 bytes of padding required.) The data streams within an ATM connection travel over virtual paths from source to destination; within these paths, multiple channels can be defined. (See Figure 1.)

ATM was once envisioned as a key element of emerging broadband integrated services digital networks (B-ISDN), but these were supplanted by the Internet. The ATM protocol, however, still provides a useful method for digital audio interconnection. ATM can run on top of different transport mechanisms and can adapt to new transport technologies and greater speeds. It can be set up with guaranteed bandwidth and at a low latency, making it ideal for LAN and even WAN distribution of audio. Running at 155Mb/s over Cat 5 cable, ATM can support up to about 80 channels of audio, if there are no other calls to be supported. Permanent connections can be established, and ATM circuits can be provided by your favorite telco.

Within a plant, AES47 specifies the means to carry multiple channels of audio in linear PCM or AES3 format as calls across an ATM network. The standard allows for point-to-point and point-to-multipoint networking, and there is no theoretical limit to the maximum size of an AES47 network, given the required transport bandwidth. Audio is supported at from eight to 40 bits per sample, and the ancillary data specified in AES3 can be relayed, providing information about channel status (pre-emphasis, sample rate, channel numbers, etc.), private data, and analog conversion validity. AES51, published in 2006, specifies how an ATM service can be provided over Ethernet hardware (ATM-E), combining the benefits of both technologies. The performance of this interconnection is such that real-time audio is viable. On a 100m point-to-point link, the signal latency from end-to-end will typically be less than 10µs; this includes the buffers at each end, the duration of each ATM cell and the delay over the physical medium (usually a cable). The standard also adds the ability to relay timing information to a resolution of less than 0.1µs, providing a tool to aid A/V synchronization issues.

ATM can run on top of different transport mechanisms and can adapt to new transport technologies and greater speeds.

The distinction must be made, however, that efficient carriage over Ethernet hardware does not automatically mean the same performance over an Ethernet-based WAN, which may not be able to guarantee the QoS needed for a real-time audio connection. While Ethernet hardware can support ATM-based audio, the networks are a different matter. For this reason, AES51 is primarily intended to be used in one of two ways: as a point-to-point connection between two pieces of equipment, such as an ATM switch and a piece of audio equipment, or as a way to connect a PC-based audio processor (or similar device) to an ATM network.

If service over an IT-based Ethernet network is desired, one would ordinarily expect larger delays, a greater jitter in the arrival of packets, and even dropped or out-of sequence packets. However, prioritization processing can improve the QoS, and embedding packet timing information can mitigate packets arriving in the wrong order, at a slight increase in processing delay.

Of course, interconnection to a LAN will mean that multiple virtual connections can be made to equipment over the same network, a versatile feature. As before, however, the QoS will be constrained by the operation of the network. For this reason, audio and IT networks should be independent when full QoS is demanded from the audio network. BE

Aldo Cugnini is a consultant in the digital television industry.

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

Audio interfaces

Distributing audio over data networks provides more flexibility and less physical complexity.

BY ALDO CUGNINI

Digital audio has not been spared from the usual "alphabet soup" of interfacing and distribution formats. Now relatively mature, AES3 (and the related S/PDIF), AES10 (Multichannel Audio Digital Interface, a.k.a. MADI) and SDI provide point-to-point digital audio connection methods. Distributing audio over data networks, however, while not as mature, is emerging as a way to provide more flexibility and less physical complexity in a broadcast plant. The ubiquity of Ethernet wiring would seem to make it an ideal choice for distribution of audio, but some practical concerns must be addressed.

Ethernet LANs are characterized by ease of installation and expansion, together with many solutions for routing and distribution. Originally designed around the concept of multiple computers communicating over a shared "ring" of coaxial cable, the networking scheme allows simultaneous transmissions to be handled by a collision detection and packet distribution protocol. Coax was later replaced by Cat 3 and Cat 5 twisted-pair cable and routers or switches, greatly reducing installation costs. As the Internet emerged, Transmission Control Protocol/Internet Protocol (TCP/IP) became the predominant communications protocol for PC and data device interconnection, again using a packetization scheme for the data and Ethernet as the physical medium.

But TCP/IP only provides a best-effort delivery of data; there is no guarantee that all packets of data are delivered to their destination in a timely and synchronous fashion (or at all), and so the quality of service (QoS) is not likely to satisfy live audio needs. Surely, for real-time delivery of video and audio, the protocol is inadequate by itself. However, the ease of use of Cat 5 cable and connectors has inspired several manufacturers to develop proprietary schemes for transporting digital video and audio over the physical medium, both in point-to-point connections as well as LANs and even WANs. Such nonstandard schemes, however, while fulfilling some needs, do not provide for high interoperability of different equipment without multiple conversions.

To help this situation, AES50 was developed, providing a bidirectional, point-to-point connection for multichannel audio and system control over a single Cat 5 or Cat 6 cable. By using this standard with dedicated routers, a small network can be built that has low and consistent latency, with nonblocking routing, i.e., 100-percent QoS. However, while AES50 can use Ethernet wiring and routing components, it does not use the Ethernet frame structure and could thus cause compatibility issues with some devices. Also, it was not designed for large and widespread networks.

The ATM network protocol can be set up to provide for the QoS needed for a real-time service.

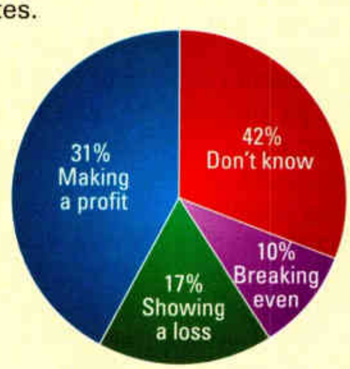
ATM provides compatibility and reliability

The ATM network protocol can be set up to provide for the QoS needed for a real-time service. This is because ATM is connection-oriented, meaning that communications are set up as a call that cannot be conducted

FRAME GRAB *A look at tomorrow's technology*

Revenue made from TV station Web sites

When surveyed, 31 percent of TV stations said they made a profit from their Web sites.



Source: RTNDA/Hofstra University *www.rtnda.org/www.hofstra.edu* unless both ends of the communication establish a connection. (Think of telephone voice calls, for example.) In general, packetization delays and re-synchronization delays are small for ATM and large for IP.

ATM uses time division multiplexing (TDM) to encode data into fixed-length packets called cells, each containing 53 8-bit bytes — a 5-byte header and a 48-byte information payload. (The ATSC standards specify MPEG transport carrying packets of 188 bytes, where one byte is a synchronization byte and 187 are payload. This packet approach was specifically defined with ATM switching in mind, as each 188-byte MPEG-2 packet maps into the payload of four ATM cells, with only 4 bytes of padding required.) The data streams within an ATM connection travel over virtual paths from source to destination; within these paths, multiple channels can be defined. (See Figure 1.)

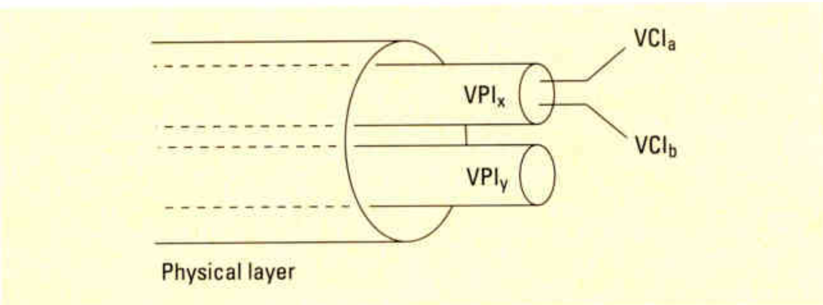


Figure 1. ATM connections are defined by virtual path identifiers (VPI) and virtual channel identifiers (VCI).

ATM was once envisioned as a key element of emerging broadband integrated services digital networks (B-ISDN), but these were supplanted by the Internet. The ATM protocol, however, still provides a useful method for digital audio interconnection. ATM can run on top of different transport mechanisms and can adapt to new transport technologies and greater speeds. It can be set up with guaranteed bandwidth and at a low latency, making it ideal for LAN and even WAN distribution of audio. Running at 155Mb/s over Cat 5 cable, ATM can support up to about 80 channels of audio, if there are no other calls to be supported. Permanent connections can be established, and ATM circuits can be provided by your favorite telco.

Within a plant, AES47 specifies the means to carry multiple channels of audio in linear PCM or AES3 format as calls across an ATM network. The standard allows for point-to-point and point-to-multipoint networking, and there is no theoretical limit to the maximum size of an AES47 network, given the required transport bandwidth. Audio is supported at from eight to 40 bits per sample, and the ancillary data specified in AES3 can be relayed, providing information about channel status (pre-emphasis, sample rate, channel numbers, etc.), private data, and analog conversion validity. AES51, published in 2006, specifies how an ATM service can be provided over Ethernet hardware (ATM-E), combining the benefits of both technologies. The performance of this interconnection is such that real-time audio is viable. On a 100m point-to-point link, the signal latency from end-to-end will typically be less than 10µs; this includes the buffers at each end, the duration of each ATM cell and the delay over the physical medium (usually a cable). The standard also adds the ability to relay timing information to a resolution of less than 0.1µs, providing a tool to aid A/V synchronization issues.

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Treating video errors

Broadcasters and IT engineers view error correction and error concealment differently.

BY BRAD GILMER

Error correction and error concealment seem straightforward; error correction corrects errors, and error concealment conceals errors. But the topic is quite interesting, especially when you consider how the views of the broadcaster and the IT engineer differ. This topic sits at the confluence of the IT and broadcast world. So bear in mind that when you talk about this topic with a colleague or you hear a presentation on the subject, it is important to know where the other person is coming from.

For those of you who did not start out in broadcasting, suspend what you know about this area, and think about these terms from a broadcaster's point of view. We use the same words as the IT world, but we think about errors and treatment of errors in a different way. For those who started out in broadcasting, consider that the IT world has been dealing with error correction for many years and that there is a whole mindset regarding this topic. Hopefully this article will help you communicate, regardless of your background.

What is an error?

From a broadcaster's perspective, an error is something that can be perceived by a viewer — usually a disruption in video or audio. But in the IT world, an error is any loss of information, whether it is perceptible or not. Even the loss of a single bit in a two-hour movie is an error when seen from the IT perspective.

To further complicate the subject, the effect of an error at the IT level can have disastrous and sometimes unintended consequences for the broadcaster. A single unrecoverable bit error in the transfer of a two-hour movie could cause the entire transfer to fail. The broadcaster might be willing to accept the error rather than restart the entire transfer. But since we live in a world dominated by IT technology, frequently we do not have that choice.

Another point to consider is that a single bit error may have different effects on what the viewer perceives depending upon when the error is introduced. In the case of MPEG-2 compressed content, a single bit error that occurs somewhere in a P-frame may be completely undetectable by the viewer.

The decision to employ error correction or error concealment comes down to a simple question: Do you want to fix errors, or do you want to cover them up?

However, the exact same single bit error introduced in the header of an I-frame may cause the picture to freeze or to go blank for a half-second or longer. To the IT engineer, the bit error rate on the link is exactly the same. To the broadcaster, the impact of the errors is completely different.

Correction or concealment

The decision to employ error correction or error concealment comes down to a simple question: Do you want to fix the errors, or do you want to cover them up? In the IT world, the answer is almost always to fix the errors. This is because a single corrupt bit in a file can cause unpredictable results. Imagine that you have transferred an executable application from one computer to another. Somewhere along the way, a single bit was changed from a zero to a one. Would you want to run that application on your computer? Do you have any way to predict what the result of the single error would be? Or perhaps you are transferring financial data from one computer to another. Again, how can you predict the severity of the error? For this reason in the IT world, the norm has been to either verify that a bit-perfect copy has been made, or to cancel the copy completely.

While in many cases, the broadcaster may desire a bit-perfect copy of a commercial or movie, in other cases, it may be more expeditious to simply conceal an error rather than take the time to fix it. There are several reasons concealment might be the best solution. First, concealment might work perfectly well. If the error is relatively minor and confined to specific areas of the picture, and of limited duration, concealment can take a visible error and make it almost undetectable. Second, error correction takes time, and in most cases, bandwidth. Those commodities may be in short supply. So while concealment is not really part of the typical IT toolkit, it has been, and will continue to be, an important technology for broadcasters.

There are several ways to conceal errors. In its simplest case, concealment repeats existing data. For example, let's say that part of a line of video is lost. A simple concealment algorithm would repeat the previous line. This method may lead to visible concealment artifacts, particularly in the case

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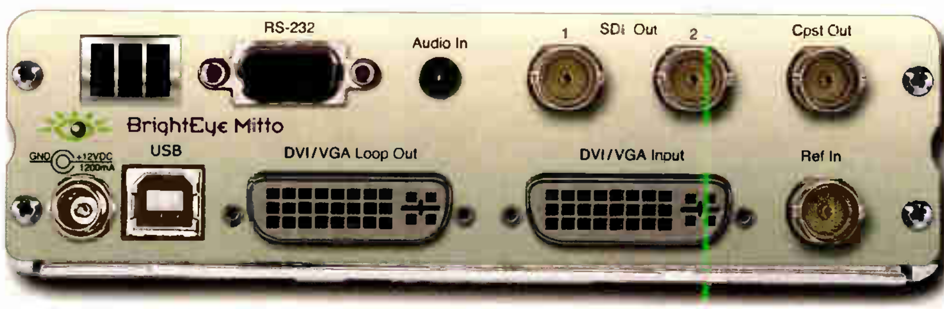
A broadcaster came to us and asked that we build an HD scan converter for them. When we brought the prototype to them for testing, they were ecstatic at how good the output looked.



Use a Mouse to Select the Part of the Video You Want to Output

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*** *Mitto* - the Latin root word for *Transmit* and *Uncompromising***

								Check
2	6	1	4	3	2	8	1	27

Figure 1. In error correction, a simple check number at the end of eight numbers serves as a simple error correction scheme.

								Check
2		1	4	3	2	8	1	27

Figure 2. The second number in the group of eight is lost during a transfer.

of video with strong diagonal elements in the picture. There are more complex methods that yield better results, but the idea remains the same: Replace the missing video using material that is adjacent to the error.

Error correction

Thousands of books have been devoted to error correction, so there is no way I can do the subject justice in a short article. That said, I can at least present some fundamental information about how error correction works.

Let's say that you are going to send a message consisting of eight numbers. These eight numbers are important, but you think that the chance of losing more than one number at a time is low. In this case, include a simple check number at the end of the eight numbers, which allows you to recreate the missing number should one of the eight get dropped. The check number is simply the sum of the eight numbers preceding it. Figure 1 illustrates this basic error correction scheme. Now assume that the second number in the group of eight is lost. (See Figure 2.)

The receiving application can easily recreate the missing number by adding the remaining numbers together and subtracting them from the check number: 27 – 21 = 6. Therefore, six is the number that was lost during the transfer.

This simple example points out several important concepts that are common to error correction schemes. First, sending extra information allows the receiving application to reconstruct data that is lost during a transfer. Second, it is important to have some idea of the loss characteristics of the network or application across which you are trying to protect your data. In this case, we have specified a system that is not robust, because it protects against a single lost number. This may be perfectly fine, but if a second number is lost in the group of eight, this scheme will not correct for it. Third, it is important to understand the limitations and the cost of any error correction scheme. In this case, the limitations are well understood. The scheme will not recover more than a single loss in any group of eight. The cost of the scheme is that an additional check number must be sent with every group of eight numbers. Finally, it is important to understand the efficiency of any error correction scheme compared with other alternatives. This simple scheme is actually inefficient. There are other schemes that would provide the same protection for much less overhead. In more complex scenarios, there may be several competing error correction schemes. To evaluate these, study their cost vs. their robustness at different loss levels.

Remember that concealment may work. In this case, there is zero overhead during transmission because errors are simply masked at the receiver. BE

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

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

Deploying fiber for OB

The design considerations for OB infrastructures differ significantly from fixed installations.

BY EUGENE E. BAKER

Not long ago, most broadcast facilities were designed without the benefit of fiber-optic infrastructures and relied primarily on copper-based coaxial and twisted pair cabling. Now that fiber-optic technologies have become more cost-effective and the bandwidth demands of uncompressed video signals have soared, designing a facility without fiber is unthinkable. In the mobile OB environment, there are similar but even more compelling, needs for a fiber-optic infrastructure. However, the design considerations surrounding OB infrastructures differ significantly from fixed installations.

Multipin expanded beam connectors make repeat matings easy and reliable. Flush, noncontacting lenses simplify cleaning compared with pin-and-socket connectors, which tend to trap dirt.

So many connectors

While fixed installations are designed around generic single-fiber, physical contact (PC) connectors like the ST, SC, FC and LC, OB and ENG operations normally need specialized ruggedized multifiber connectors. In the case of cameras and other hybrid fiber/wire devices, there is often a requirement to also carry power on the same cable/connector assembly.

Multipin connectors can be categorized in several ways, including butt joint (PC) pin and socket versus expanded beam, sexed versus hermaphroditic, fiber-only versus hybrid, etc. Additionally, ruggedized fiber connectors are commonly available in fiber counts of up to 12. With the exception of the SMPTE 358M four-fiber and the SMPTE 304 two-fiber hybrid connectors, multifiber interfaces tend to be proprietary in nature and are frequently sole sourced.

Now that fiber-optic technologies have become more cost-effective and the bandwidth demands of uncompressed video signals have soared, designing a facility without fiber is unthinkable.

The complexity of design, the relatively small market and high skill required to assemble make the cost of multipin optical connectors an order of magnitude more expensive than single-fiber connectors. Repairing multipin connectors requires a skilled staff with an investment in training and tools. The more fibers/pins per connector, the more expensive it is, and the more difficult it can be to assemble or repair without damage.

On the plus side, ruggedized multipin connectors offer a far greater reliability and ease of setup. Making a single connection in an application that is repeatedly set up and taken down saves significant labor and time and will require less troubleshooting. Swapped or mislabeled fibers can burn a lot of time when it is least affordable. In addition, a multipin connector on the end of a TAC-4 cable is physically more robust than a cheap ST connector on the end of a breakout patchcord.

Although expanded beam connectors are generally more expensive than PC types, they are more reliable and maintainable because the optical mating surfaces never touch and have no cavities to collect debris. These connectors do, however, experience higher baseline loss, typically 1.5dB per mated pair compared with less than 0.5dB in a mated ST pair.

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As Chief Technical Partner at BlueScreen LLC., Kertesz specializes in high-end compositing of live images. In fast-paced environments his array of AJA converters and the FS1 ensure he can meet whatever format and equipment challenges he faces. "A client shows up with an HD tape for an SD project? No problem," he explains. "He wants to integrate 720p footage into a 1080i show? No problem. He brings a camera with only component outputs and I need digital? No problem."

For a recent series of promotional spots for NBC's Amercian Gladiators, Kertesz created on-set pre-visualization compositing taking a feed from a Vision Research Phantom HD Camera. "Because of the tight turnaround time, and the talent involved, it was essential that we were working with equipment that was reliable and fast. The camera didn't genlock, so we had to have an on-set solution to feed its footage into the HD Ultimatte 11. The FS1 was essential for that purpose."

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Know your optical loss budget

Fiber equipment manufacturers specify the minimum output power and minimum receiver sensitivity in order for their equipment to operate properly. These two values are absolute power measurements referenced to 1mW and are measured in dBm. The difference between these numbers, called the optical loss budget, is a relative power measurement and is measured in dB.

So, if a SMPTE fiber-equipped camera has an optical output of -8dBm and a receive sensitivity of -18dBm, the optical loss budget will be 10dB. By calculating the total number of connectors times the loss per mated pair from the output of the camera to the input at the controller, as well as the cable's length times loss per kilometer, we can verify the camera is within its operating limits.

Cameras with a 10dB budget will often alarm with losses as low as 6dB, staying well away from the envelope. Leave a healthy margin to allow for the practical realities of dirty connectors and stressed cables, and avoid having a really bad day.

When to multiplex

The two chief technologies to concentrate more signals onto a single fiber strand are time-division multiplexing (TDM) and coarse wavelength division multiplexing (CWDM). Both add complexity and cost to the

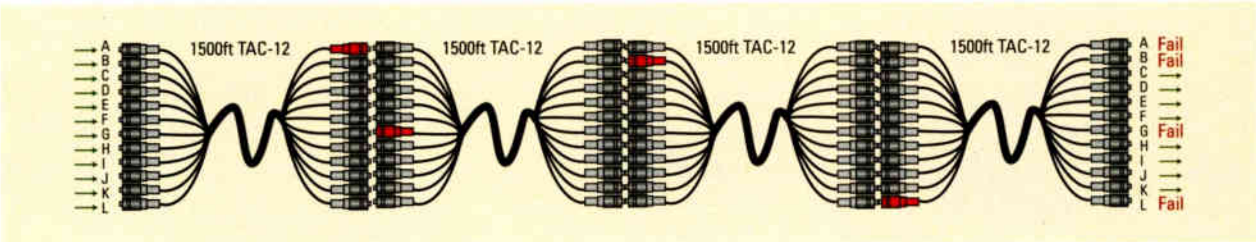


Figure 1. Individual fiber failures in high fiber count cables make troubleshooting a time-consuming process. Fiber failures accumulate when multiple faulty cables are concatenated in series.

terminal gear relative to transporting, for example, one HD-SDI per fiber. In contrast to fixed installations where transmission is normally a short hop within a facility, fiber is cheap and the connectors are inexpensive, in OB the cost of the connectors, the cable and the labor to deploy a high fiber count cable becomes expensive.

In the case where a 12-fiber tactical battlefield-rated cable is required to link an announce booth position 6000ft from the production vehicle, one solution might involve four 1500ft TAC-12 cables, not counting associated patches and jumpers, terminated with either STs or military-style connector. If 5 percent of the connectors need cleaning or repair, statistically, there may only be eight working fibers out of 12 in a concatenated path before the troubleshooting begins, and that's when the overtime clock is typically running. (See Figure 1.) The largest single expense in deploying a high fiber count cable is the overtime spent correcting air gap problems.

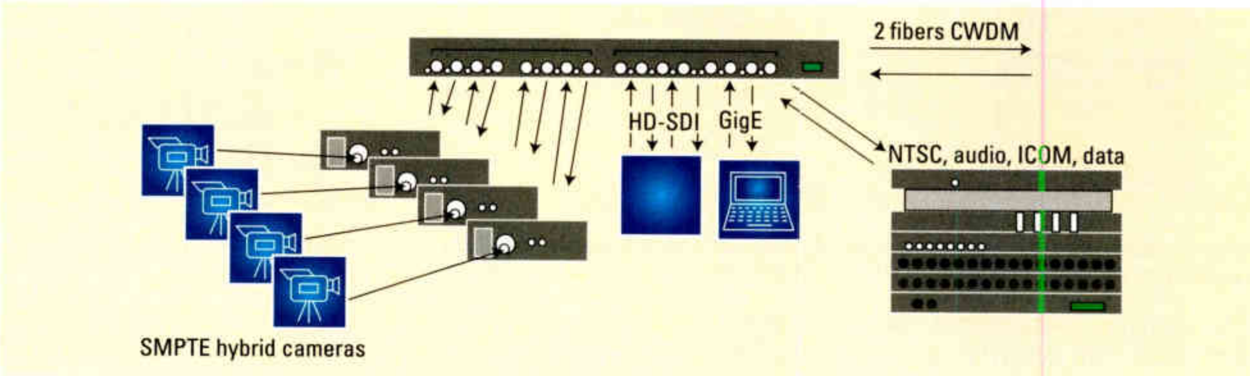


Figure 2. In an OB booth application, two fibers can carry all the bidirectional camera signals, as well as associated HD-SDI video, microphone and return audios, intercom/IFB, Ethernet, and monitor video returns.

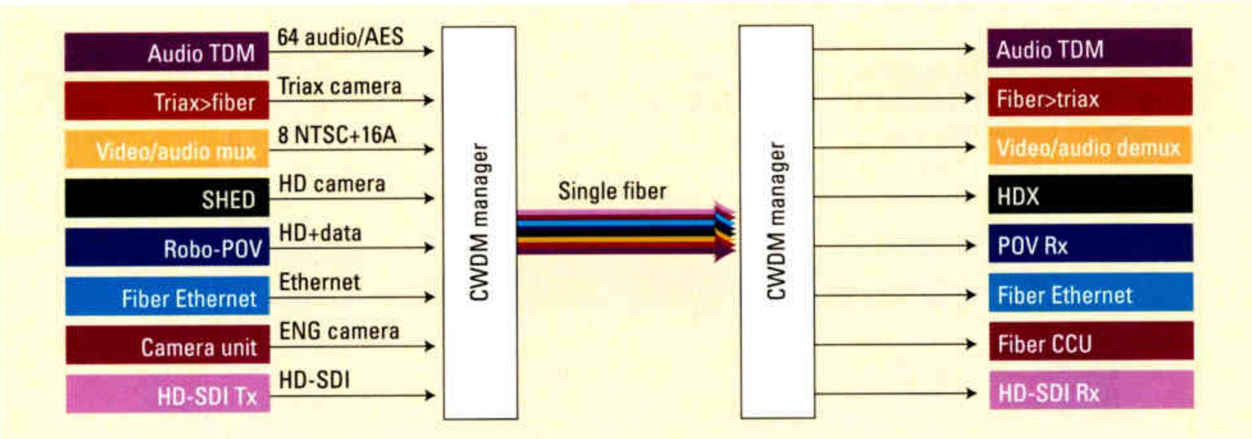


Figure 3. Many diverse, high-bandwidth signals can simultaneously travel on a single fiber. CWDM combines different wavelengths or colors of light onto a fiber and then filters them to their respective receiving devices.

In addition, connectorized cable assemblies are the items that take the most beating in the field and will frequently need repair and/or replacement. They account for a considerable percent of the total life cycle cost of the installation. Therefore, minimizing cabling costs is crucial, and the obvious solution is to use a smaller, less expensive two-fiber cable instead of the TAC-12.

By applying TDM and CWDM, fiber counts for large booth operations can easily be reduced to two fibers, typically one in each direction. (See Figure 2 on page 33.) In fact, CWDM technology, as used in powerful coax-to-fiber and fiber-to-fiber repeating wavelength managers, can enable a single fiber to carry the equivalent of 16 individual fibers. (See Figure 3.) This capability begins to exploit the promise of fiber having "infinite bandwidth."

Smaller cables allow longer lengths on reels and fewer connectors in-line, each with fewer pins to maintain, resulting in fewer problems. From a

A single-unit CWDM manager converts both wideband electrical and optical signals to the appropriate wavelengths for transport on just two single-mode fibers.

practical point, a commonly available TAC-4 cable with four fibers can support the largest remote positions with 100-percent redundancy. In a pinch, even "trusty" SMPTE 311 hybrid cable can carry all of it well beyond its intended use as a single camera cable.

Checklist

Here are some things to keep in mind when executing fiber in the field:

• *Plan ahead.* Know where all connections should be before deployment starts, and pre-label the cables accordingly. The crew should be able to make connections with confidence.

• *Verify functionality before cables leave the compound.* Having both ends of the cable in one place makes verification easy. Putting 1000ft between the ends creates a project.

• *Inspect deployed cables for stress.* Tight bends and knots may not break the glass but may attenuate light signals to an unusable level. The use of tie wraps to dress the cables should not be allowed.

• *Plan your link loss budget.* Count the connections and know the lengths. Allow for dirt and lossy connectors, and then add 3dB for safe measure.

• *Train the crew.* The crew should understand the link loss budget. The key to a successful deployment of any gear is familiarity of how the equipment operates and what the indicators mean. If the equipment is to be used in a way that has not been tried before, experiment well before a critical event.

• *Equip the crew properly.* Having inspection scopes, optical power meters and adapters will take some of the "black magic" out of the technology. If they can see it and measure it, they can understand it.

• *Where possible, one fiber, one direction.* This simplifies troubleshooting and minimizes sensitivity to back reflections.

Properly executed fiber in the field is a "just plug it in and it works" proposition. This is the promise of fiber technology and what OB operators should reasonably expect from their fiber infrastructure. **BE**

Eugene E. Baker is VP and CTO of Telecast Fiber Systems.

Playout automation

New developments can lower operating costs.

BY DAVID AUSTERBERRY

Master control is where the business systems meet the video and audio content, so it could be considered a focal point for a TV station's revenue. The demands on reliability are much higher than the edit shop or graphics design department. It is the real-time nature, where a lost video frame is not allowed, that has traditionally demanded a master control operator at the desk, even if that person has little to do. The expectation of what can be done with automation increases as software systems get smarter, with a goal for some simpler channels of lights-out operation.

The first generation of broadcast automation cued and played tapes to air. The second generation adapted to play out from video servers and added features like satellite recording.

Now stations are looking to their automation to deliver further savings, especially as they may be running additional subchannels, with mobile around the corner.

Now stations are looking to their automation to deliver further savings, especially as they may be running additional subchannels, with mobile around the corner.

Centralcasting

As networks and groups look to take cost out of operations, one approach is to centralcast. This pulls back most operations to a central site, with the remote, or spoke, stations solely responsible for the local news and weather. When the concept was first vaunted, it soon became apparent that the cost of high-bandwidth circuits made the business case marginal.

Much has changed over the last couple of years with long-haul fiber costs falling, so now the economics make more sense. Part of the Recovery Act of 2009 is to provide broadband access to rural communities through the RUS Broadband Initiatives Program (BIP) and the NTIA Broadband Technology Opportunities Program (BTOP).

As rural broadband networks roll out over the next few years, smaller communities will be connected to telco backbones with trunk fiber. The network operators will no doubt be looking for other customers for that fiber. Broadcast groups could utilize this new capacity to connect their remote stations to a central hub.

Add recent developments like WAN acceleration, which improves the efficiencies of large file transfers, and centralcasting becomes a sound business concept.

Spoke or hub?

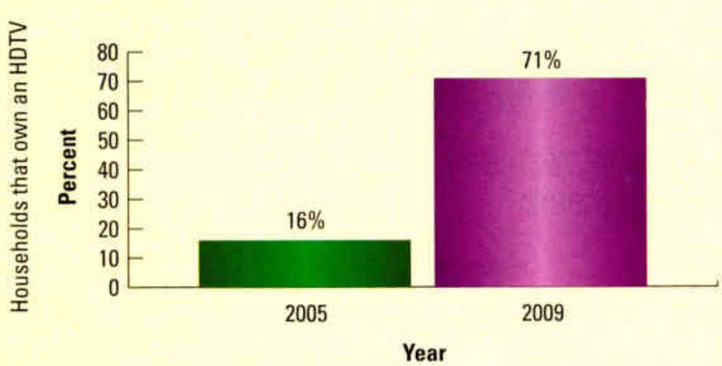
There are many possible ways to design a centralcasting system. The original design delivers all content from the central site to the remote transmitters over high-bandwidth circuits. The local spoke station intercepts the feed for local newcasts and weather. (See Figure 1 on page 38.)

All content is ingested, prepared and quality controlled at the central site. This will deliver staff savings but adds the cost of the interconnecting circuits. An alternative design is to ingest and play out locally, but to control the playout from the central hub. (See Figure 2 on page 40.) The station can switch to local control during the morning and evening newscasts, but can easily save a master control shift by running from the central station outside those periods.This saves on staff and fiber network costs, but still has duplicated tasks, in that each local station must

FRAME GRAB

A look at the consumer side of DTV

By the end of 2009, 71 percent of homes will own an HDTV.
In 2005, only 16 percent of households owned an HDTV.



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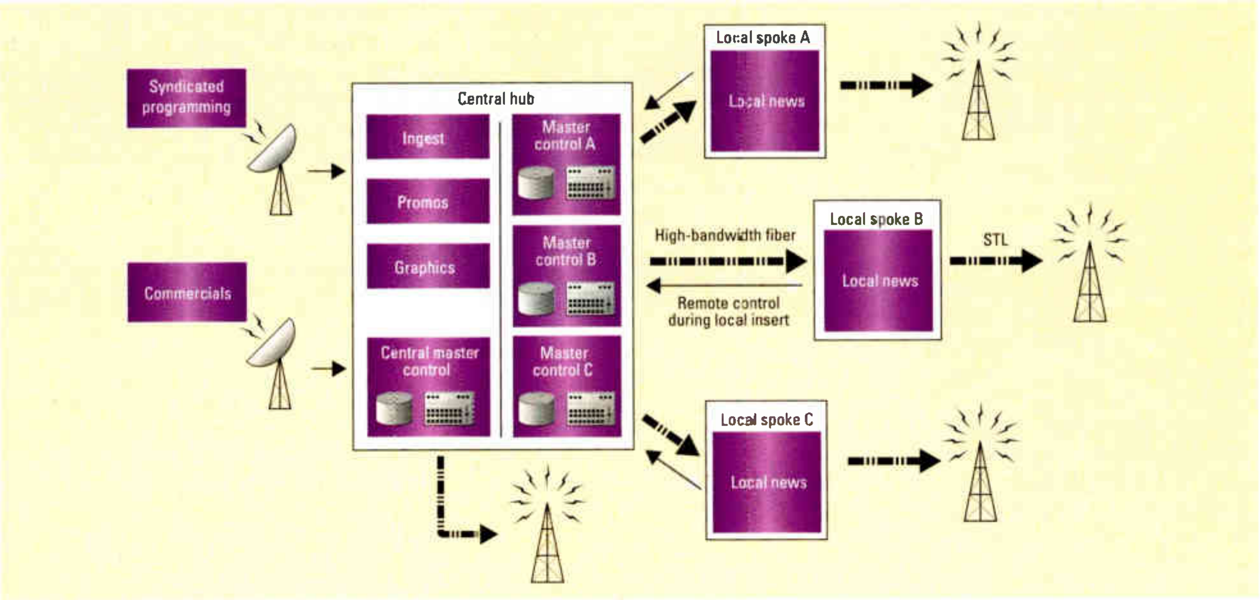


Figure 1. In this centralcasting system, content is delivered from a central site to remote transmitters. The local spoke stations intercept the feed for local newscasts and weather.

ingest and prepare the same syndicated programming.

For most station groups, the sweet spot will fall somewhere in between. Common programming can be ingested and quality controlled at the central station, but the local station can manage all locally sourced content. Operations like graphics creation can also be centralized, creating a common look and feel across a group.

> **Operations like graphics creation can also be centralized, creating a common look and feel across a group.**

Separates or channel-in-a-box?

Just like a home audio system, you can buy separates or an integrated solution (channel-in-a-box). Separates comprise the automation controller, a video server, switching, branding, as well as downstream caption and EAS insertion. There are many hybrid systems. For example, the video server may include the branding and switching.

The option you choose depends on many factors. How complex is the channel? Premium channels with live programming and late schedule changes need more facilities than a simple near-video-on-demand (NVOD) movie channel. Some broadcasters may want to break out sub-channels at certain times of the day. Reliability is possibly the most important consideration. The cost of make goods must be balanced against the total cost of ownership for the automation system. From this can be derived the required service level. It could be 99 percent right up to 99.9999 percent uptime. The latter figure represents a loss of only 30 seconds per year — just one 30-second spot.

From the service level agreement, the level of redundancy can be derived. Mirrored systems are expensive, and for multichannel operations, the n+1 approach may make better business sense.

Reliability is possibly the most important consideration. The cost of make goods must be balanced against the cost of ownership for the automation system.

For multichannel playout, the operator-to-channel ratio will have a big impact on OPEX, and a suitable choice of automation system can ease the job of the master control operator in managing many channels. In master control, the operator is not just monitoring the playlist, but also must watch for gear failures. For this reason, a good control and monitoring system for the plant is an essential adjunct to the automation. SNMP control systems can monitor by exception, greatly easing the operator's tasks.

The impact of BXF

Many vendors offer BXF support, which does raise the question as to whether you could run a lights-out operation in master control, with late changes to breaks run from the sales office. The traffic and sales department may be set up to maximize ad revenue, and can schedule to the second, but master control ensures that no black gets to air, right down to the frame.

It's balancing the risk of a lost spot against OPEX. Much of this can only be learned from experience, and is difficult to judge when installing a new automation system. Again, it depends on complexity of the channel. Does it run live sports and breaking news?

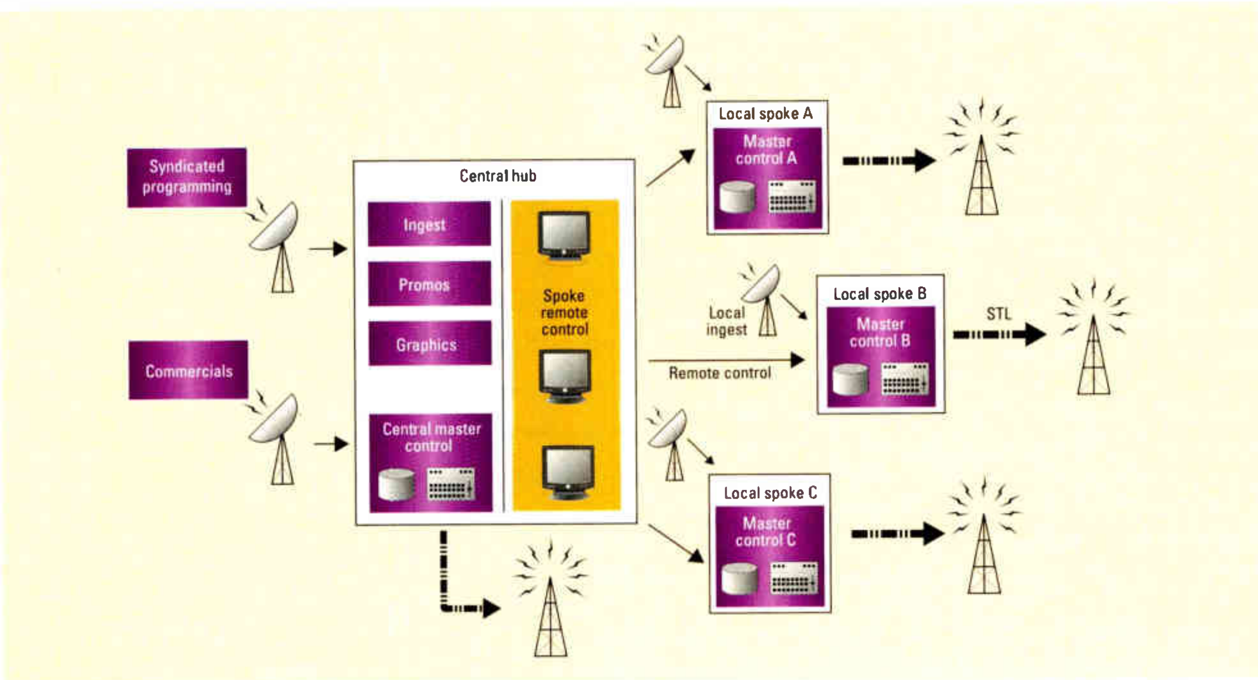


Figure 2. In this centralcasting model, content is ingested and played out locally, while playout is controlled from a central hub.

Automated branding

Stations have long used snipes and end boards to promote upcoming programs as part of their overall channel branding strategy. As stations add subchannels to their primary HD channels, there is another requirement to cross-promote the station's channels. Traditionally, promotions have been assembled in the edit bay and graphics department. If you consider the need for talent to make the voice-overs, the cost of creating promotions adds up.

The creation of promo data — coming next messages, etc. — can be more complex than the feed from an NRCS.

Most master control graphics systems include add-ons that allow predesigned templates to be populated automatically by external data feeds, in much the same way as a MOS CG can be driven from a newsroom computer system (NRCS).

The creation of promo data — coming next messages, etc. — can be more complex than the feed from an NRCS. Generally, the metadata to create a promo cannot be found in one single system. The playout automation has exact timing information, but program titles will be house

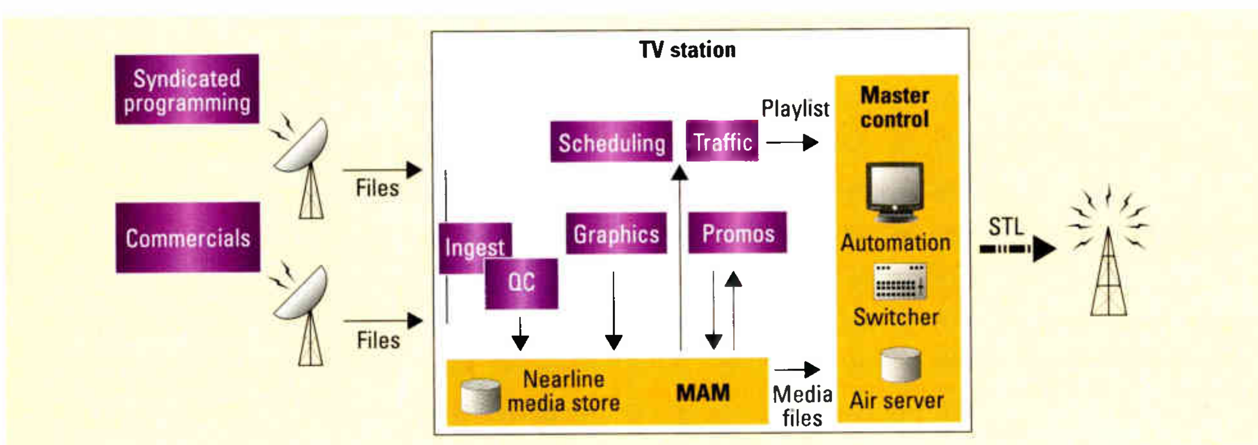


Figure 3. The move to file-based operations transforms the system architecture of the broadcast station.

The deployment of data-driven graphics to automatically create promo messages can immediately remove operational costs and provide more consistent branding.

names with episode information. What is needed is the same information the viewer will find in a listings guide. This is available from the program scheduling system.

By assembling information from all the back-office systems, and parsing with business rules, suitable data can be generated to feed the branding system. For example, the automation's start time for an event can be rounded to the minute, and the program title from the listing added. All the combinations of times and channels can be prerecorded as voice clips — tomorrow at 10 MDT, etc. — again to play out live as required to accompany the visuals.

The deployment of data-driven graphics to automatically create promo messages can immediately remove operational costs and provide more consistent branding.

Promotions

Promo creation is another labor-intensive operation. Many groups now use media asset management (MAM) to help manage content. Such a system can seamlessly link the program library with the promotions department to aid them to manage the promo editing. Metadata from the program scheduling system can be delivered to the editor, and the finished promo dropped into the playlist, with all the correct metadata for the automation to manage playout.

Ingest

Ingest is becoming predominately file-based. Ads have been delivered as files for some time, but increasingly programs can now be delivered in non-real-time as files. A typical example is the Next Generation Interconnection System (NGIS) project that PBS is implementing to deliver content to its stations. Another example is the new syndicated programming delivery service from Ascent Media, Time Warner and CBS. It delivers HD and SD programs multiplexed in a single ASI stream and heralds the end of videotape delivery. In these systems, metadata arrives with the files, simplifying the QC processes that were essential with tape. Tapeless operation also cuts down manual operations and handling costs. (See Figure 3.)

Some of the newer distribution services are using MPEG-4 AVC to reduce bandwidth requirements, so the station only has to transcode from the format delivered to the cache server into the favored MPEG-2 file format on its playout servers, do a quick check, and then the clip is good to air.

Summary

Broadcast automation has moved on from the original function of rolling tapes or cueing video servers to a prepared schedule. Newer developments offer additional opportunities to cut operational costs. Centralcasting and branding automation both offer cost-saving opportunities. As ad and program distribution become solely file-based, the old costs associated with moving tapes no longer exist. **BE**

Computer networks

Knowledge of IP networks is necessary for operators in today's broadcast facilities.

BY RUSSELL BROWN

From the computers that control the automation system to the nonlinear editing systems that share storage, computer networks are everywhere in today's TV facilities. If you have been following the developments in the last several years, you will have seen the growing trend in the IP transmission of audio and video signals. The cable industry has already embraced IP transmission, and so has the new ATSC M/H mobile TV standard, which uses IP transmission to connect the encoders and embeds the IP packets into the transmission stream. Computer networks are the next evolution of DTV.

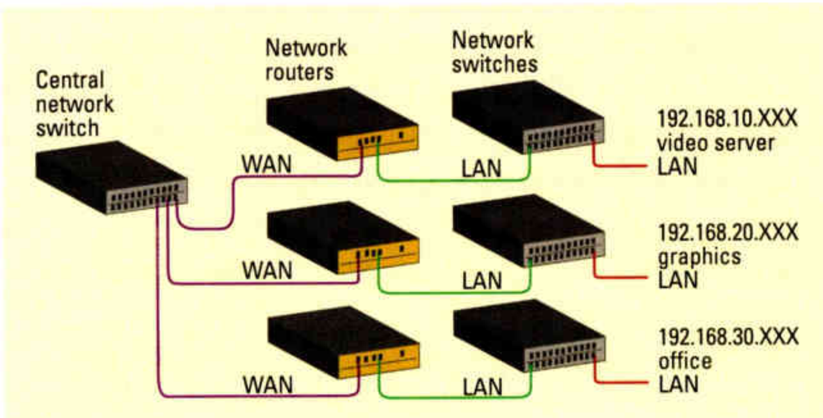


Figure 1. Subnets within a TV station

IP network basics

IP addressing works in two different ways, depending on whether the data is going to a device on a LAN or out to the Internet or a WAN. When data travels over a LAN, machine access control (MAC) addressing is used, but if the data travels out over a WAN, then IP addressing is primarily used.

Most networks use both Dynamic Host Configuration Protocol (DHCP) and static IP addressing, but the address must be unique for each device on the network. With a mixture of static and DHCP, careful planning must be implemented to ensure addresses don't overlap.

Subnet masks are an important part of IP addressing. Subnets break up a large network into smaller, more manageable networks. (See Figure 1.) A subnet mask is commonly what tells a network router what messages stay on the LAN and which need to be sent outside of the LAN. But on large networks, they can used to direct traffic within a campus or large company or even separate the video/audio transmission network from the business network while still allowing necessary data to flow between the two.

This is where routers/gateways come into play. A gateway separates and connects different networks. If an address falls outside the range of the subnet mask, the gateway would be accessed and the IP address would be searched for on the other side of the gateway.

Because the subnet mask only works on the IP address to direct the message, only certain IP address ranges can be used on LANs. This keeps their addresses from being confused with addresses on the actual Internet or outside of the

Computer networks are the next evolution of DTV.

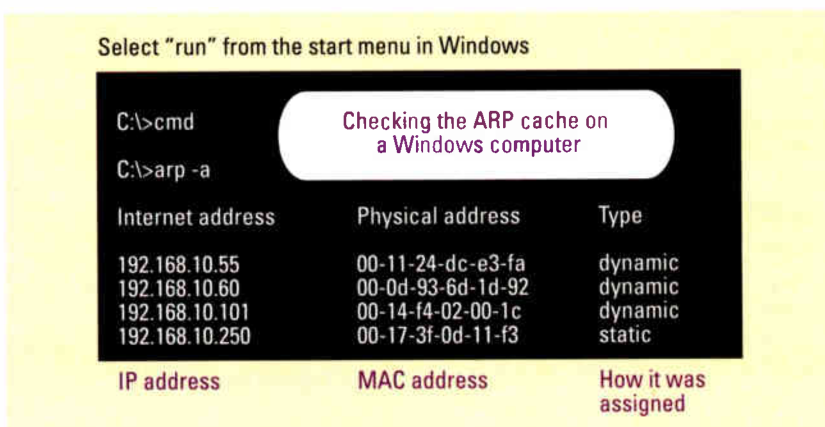


Figure 2. Checking the ARP cache

LAN. Some common ranges include 192.168.xxx.xxx, 172.16.xxx.xxx and 10.xxx.xxx.xxx. The latter has the most addresses available, but any of them will have more than enough addresses for your network.

Switches and MAC

Network switches are used to connect the various computers on a network. Switches direct data via a computer's MAC address. When data is sent out from a computer to the network switch, it carries with it the IP and MAC address of the sender and the intended recipient. The network switch looks at the MAC address and directs the data to the correct port of the switch. It does this by keeping a record of which port is connected to which MAC-addressed equipment. This record is kept in a content-addressable memory (CAM) table within the switch, which operates at very high speeds to expedite the movement of Ethernet frames through the switch.

The network switch monitors and records all traffic flowing through it looking for MAC addresses. When a computer needs to send data to another computer, it must first know its IP address and then its MAC address. To obtain the MAC address, it sends out an Address Resolution Protocol (ARP) request over the network to all devices asking for the MAC address of the owner of this particular IP address. When the computer with that IP address responds, this data is stored on the requesting computer's ARP cache so it can use it again. The IP and MAC addresses of the requesting computer are also stored on all the computers on the network that received the request. The MAC addresses for both computers, requesting and responding, are stored on the network switch.

To keep the cache from being outdated, ARP caches are cleared on a regular basis, and new ARP requests must be sent out to obtain the MAC address again.

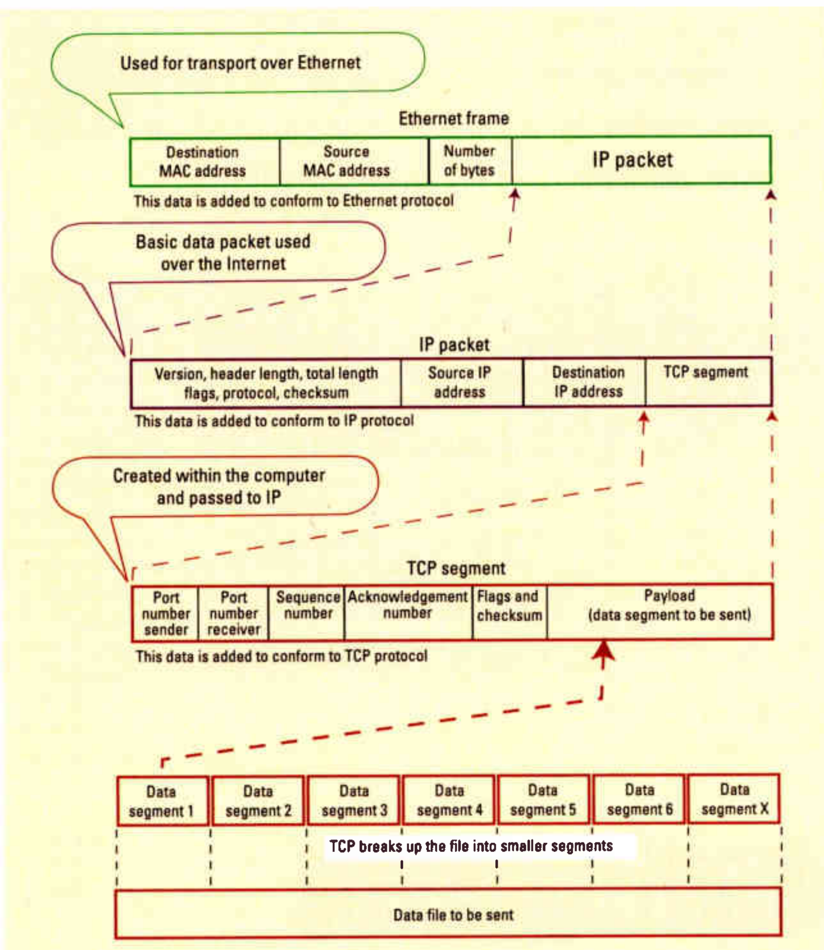


Figure 3. Building up an Ethernet frame

ARP

An ARP request is the method devices use to find out another device's MAC address when only its IP is known. As a device receives an ARP or an answer to its own ARP request, it builds an ARP cache or memory of the IP addresses and associated MAC addresses. (See Figure 2 on page 42.) Network switches monitor all traffic and build their own CAM, so they know which MAC-addressed device is attached to which of its ports.

Because network devices can be swapped out, and to keep the cache from being outdated, ARP caches are cleared on a regular basis, and new ARP requests must be sent out to obtain the MAC address again. On an Ethernet network, each IP packet sent has to have the IP and MAC address of its destination, and one data transfer may require anywhere from one to thousands of packets to send all the data. Once the first packet is addressed correctly, all the subsequent ones are addressed similarly using the ARP cache.

TCP/IP

TCP/IP is the most commonly used pair of protocols worldwide. Transmission Control Protocol (TCP) is software that resides on the computer; when a program needs to send data over the network, it hands that data over to the TCP. TCP is used throughout many Internet applications including browsers, e-mail, File Transfer Protocol (FTP) transfers and even some streaming media applications.

TCP is used to guarantee delivery. The receiving computer's TCP will notify the sender's TCP that each packet was received correctly.

TCP is used to guarantee data delivery. The receiving computer's TCP will notify the sender's TCP that each packet was received correctly, and a timer is used to resend data in case of packet loss. Because both the Ethernet and the Internet are two-way data channels, no forward error correction is used because each packet of data can be accounted for.

For example, when a file is transmitted via FTP, the entire file is handed off to TCP, where it divides the file into segments that, in turn, are the payload of the IP packets. TCP also includes the port numbers for the packet header. Port numbers tell a computer what sort of service this data is associated with, e.g. an e-mail, FTP, HTTP or Network Time Protocol. Ports allow a program to only see data intended for it.

The Internet Protocol (IP) part encapsulates these segments into an IP packet and adds a header with the destination and source IP address as well as other information about the packet. This IP packet is then encapsulated into an Ethernet frame, which includes the MAC address of both the source and destination, for transport over the local Ethernet network. Then this Ethernet frame is sent to the network interface card, and the data is sent over Cat 5 cabling. (See Figure 3.)

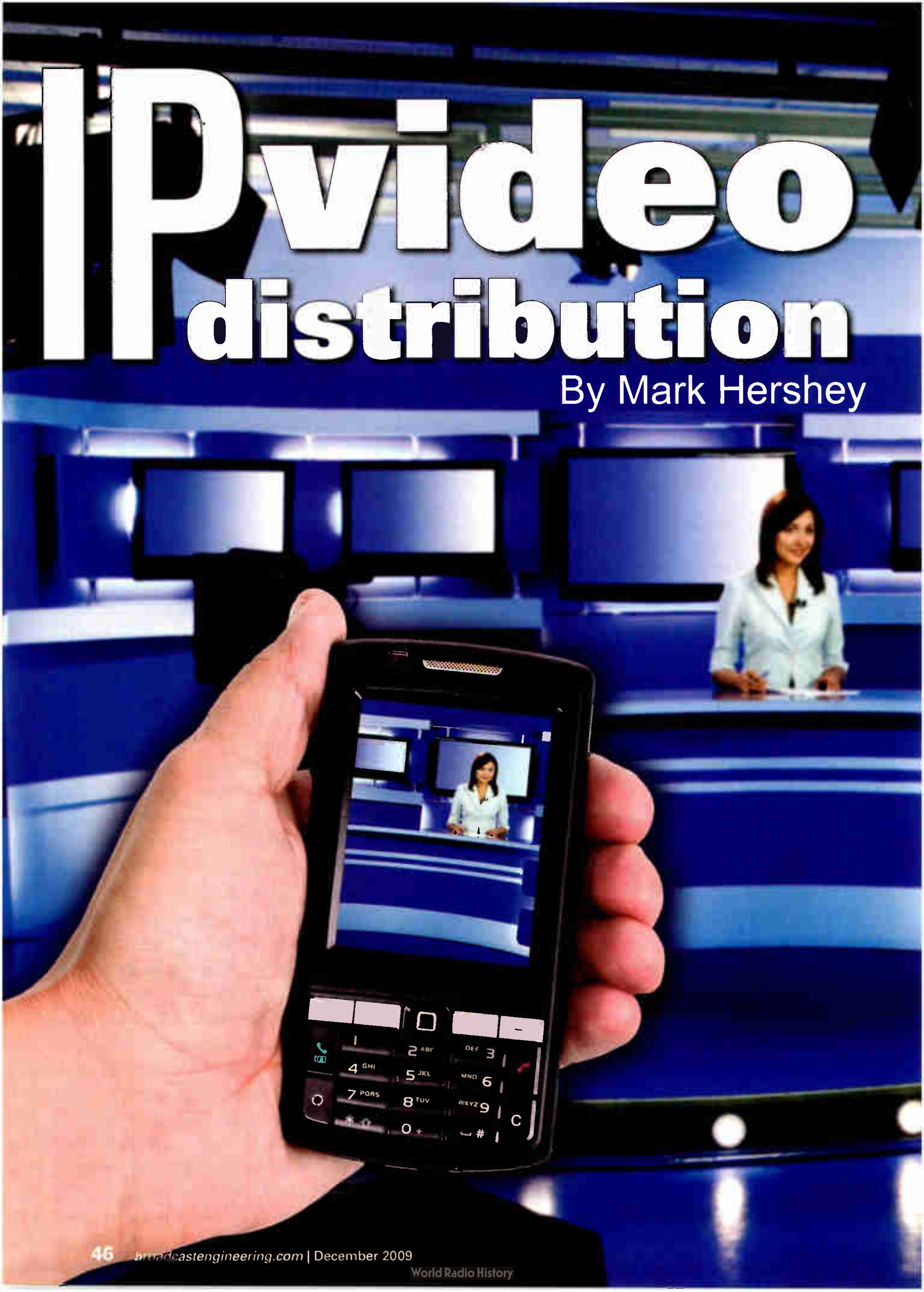
Learning more

For more information on computer networks, sign up for *Broadcast Engineering's* "IT Fundamentals" webinar at *www.broadcastengineering.com.* BE

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

IP video distribution

By Mark Hershey



With the industry's dynamic transformation to file vs. tape-based operations, solutions for effectively ingesting, managing and distributing digital assets are critical to a broadcaster's success. The variables in successfully delivering high-quality video over IP networks are numerous. Bandwidth optimization, compression choices, intrinsic latency, smoothing latency, scalability, integration with broadcast workflows and content delivery network (CDN) integration are just a few. And, while IP-delivered video may have a way to go to equal the experience available through traditional broadcast platforms, a quality Web-based viewing experience can significantly expand a broadcaster's reach, provide channels for potential revenue gain and set the table for success in the new media age.

This article discusses the challenges and solutions involved with the successful delivery of video over IP networks, with a focus on over-the top (OTT) video distribution.

Understand your network requirements

What kind of demands will OTT video — delivered to every conceivable playback device realized or imagined for the future — place on your network? That answer depends on how you respond to two key questions:

- First, what is your delivery strategy? That is, what content do you have to offer, and is it live, on-demand or a combination of both?
- Second, who is your audience? How many simultaneous viewers and what variety of playback devices do you expect? Which of those devices do you consider strategic to allow you to reach your goals? Are viewers predominately local, or do you have global aspirations?

The key factor that encompasses all of these variables, and that has the most impact on network capacity, can be reduced to one word: scalability — how many viewers, how many different streams and how much is to be stored for online access and playback.

Impact of live streaming

If your needs are simple, packaged systems are available that can encode, deliver and manage your entire Web video presence. (See Figure 1 on page 8.) These systems ingest real-time video and compress it to create and deliver the viewable IP streams in real time. In their simplest form, they create one stream (typically in Windows Media or Adobe Flash Live format) and deliver it to a small number of local users via your in-house media server. Many independent stations started their Internet presence in just this manner, and for a small number of stream types and viewers, this is still practical with little impact on the network and existing Internet connection.

However, with the explosion of interest in video streaming, increases in the number and types of devices used for playback, and a higher expectation to duplicate the video viewing quality of off-air broadcasting, the simple solution is no longer simple and no longer adequate in order to remain competitive.

Reaching out to a diverse online and mobile audience now requires multiple streams of differing characteristics. Where one or two streams sufficed in earlier times, the latest adaptive streaming technologies call for as many as five to seven or more streams from each video program source to serve even a small cross section of possible viewers. This essentially forces either a massive investment in in-house encoder and server resources, or forces an outsource-to-CDN strategy where you create separate uplink streams directed to a content delivery provider that, in turn, distributes your content to users or subscribers.

It remains possible to use a conventional Internet connection for one or two of those CDN uplink feeds, but at the risk of playback quality, reliability and consistency when using any but the most optimized Internet connection. As an alternative, consider using managed, unchallenged uplink feeds from a dedicated IP network service provider. They can guarantee reliable packet delivery to the CDN. Uplink quality is critical, any impairment of this feed affects all viewers everywhere, and recovery for even momentary network hits on the uplink are not as automatic as you might expect.

To enhance uplink performance, consider redundant streams on different networks. High-end media encoders can create multiple streams from the same video encoder, delivered via separate TCP/IP ports connected to different networks. Similarly, most CDNs accept multiple uplink streams and will automatically switch over when faults are detected. Of course, redundancy multiplies the impact on your network and will not be effective in preventing catastrophic outages if the redundant uplinks do not take diverse routes.

In practice, you will likely limit the Internet media output strategy to only one of several competing formats. The choice is often driven by the preferred development environment for your existing Web presence. If you already develop in Adobe Flash or use Adobe's Flex environment, Flash Live is a logical choice. If you develop in Silverlight, the Microsoft Smooth Streaming option is appropriate.

Both are examples of adaptive streaming, which offers a quality playback experience (including up to full 1080p HD) by creating multiple streams at different data rates simultaneously from the source content and delivering the one most appropriate for each individual viewer. That's good news to viewers because they experience minimal buffering time, fast startup time and an optimized viewing quality. But these new technologies multiply impact on your IP network and for most practical applications force a non-Internet uplink connection to a CDN. A typical adaptive streaming scenario includes as many as 11 simultaneous streams, although most installations use about five or less in actual practice.

Just how much bandwidth will live adaptive streaming demand of the network? Using Alex Zambelli's Microsoft Smooth Streaming bit rate calculator at *http://alexzambelli.com/WMV/MBRCalc.html*, to deliver five streams configured to reach a good cross section of users at a maximum of 1280 x 720 pixel playback frame size, create five streams of 400kb/s, 662kb/s, 1095kb/s, 1813kb/s and 3000kb/s. Frame size ranges down to 320 x 176 for some smaller devices. Bit rate supports 3Mb/s for well-connected users down to 400kb/s for mobile devices capable of receiving the same stream format.

But, most mobile devices in use today are not equipped to play the same stream formats used for normal Internet streaming for PCs, set-top boxes, game consoles and the new generation of network-enabled TVs. This is becoming less true as more mobile devices support Flash and Silverlight using H.264 compression, but for now there are several different compression technologies and distribution methods in common use.

iPhones are special cases. The encoder must create one or more H.264 streams (three are recommended), delivered as MPEG transport streams to a segmenter that in turn delivers chunked, time-sliced content to iPhone users. The segmenter may be included on the encoder or a separate service running on an in-house server, or on a server or server farm at your CDN.

At the moment, most video-enabled handheld mobile devices are limited by their network speed. A maximum rate of about 350kb/s-400kb/s is typical, configured with

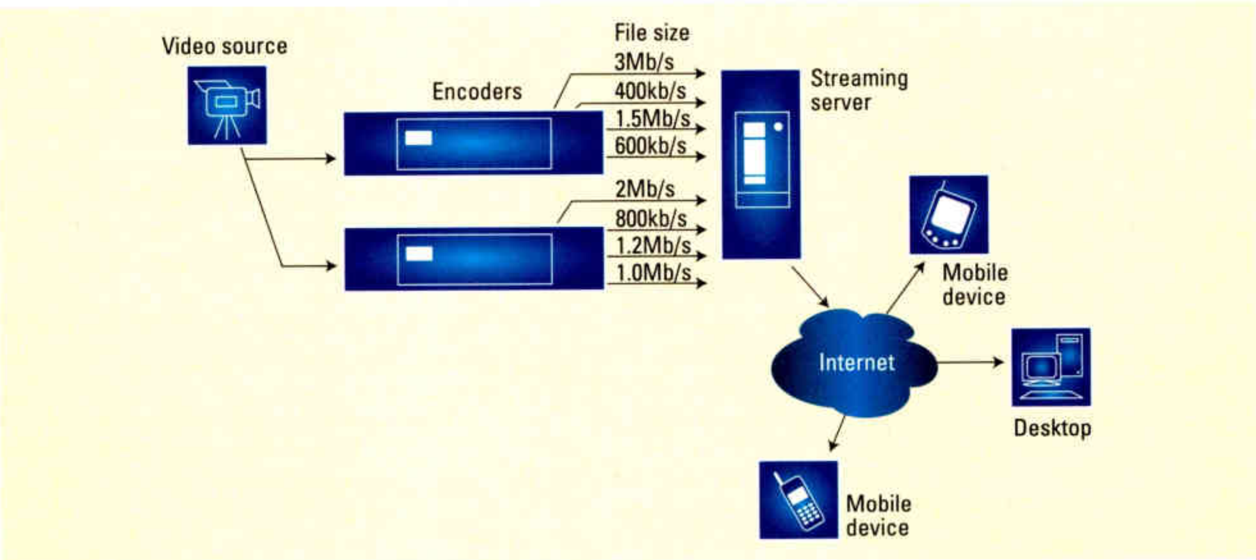


Figure 1. This illustration shows how a streaming media server can simplify the complex workflows often associated with the transformation and delivery of high-definition video over IP and mobile networks.

low bit rate mono audio in order to maximize the bandwidth available for video.

To have a broad reach to many viewers, create a large number of streams in real time, delivered via an unchallenged, well-managed, likely non-Internet-based network to a server farm (yours or those at a CDN), which in turn delivers an optimum experience to each viewer. If it seems a bit daunting to create and manage on your own encoder farm, there is another alternative: Backhaul a single full-bandwidth MPEG-2 feed to a company that specializes in transcoding and streaming in all desired formats. Yahoo! Broadcast, Level3 Communications and Real Networks are three examples of CDNs that offer such services to large network broadcasters.

Effect of on-demand video

On-demand video creates its own additional challenges for managing actual clips and segments and making them available to large audiences. Effective file-based delivery dictates that a similar number of different formats must be created and saved as files. The delivery impact on network bandwidth is similar at playback to the impact of live streaming, except that the number of simultaneous viewers is likely to be less.

Creating the different file formats is sometimes done by the live encoder as a byproduct of the live event. Many high-end encoders can be configured to save the live stream in the same media format for later playback. Other scenarios allow for the original source asset to be saved in uncompressed or lightly-compressed format and transcoded on the fly at playback as demand requires.

A future-proof comprehensive solution

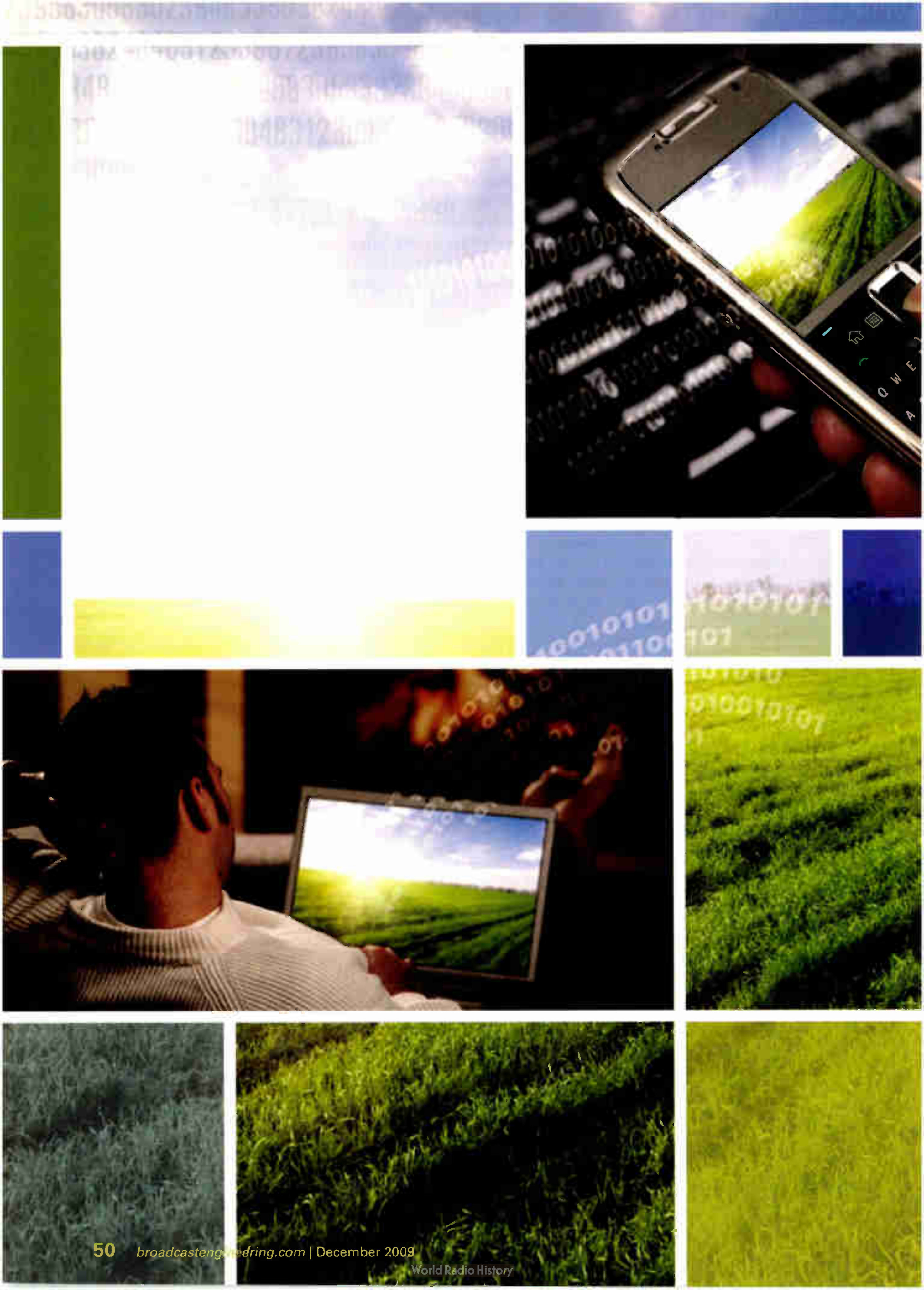
The impact on the network to deliver on-demand video vs. a live stream is about the same, but hosting and managing a video library creates additional challenges to the IP infrastructure, particularly if you intend to offer long-term playback access to your ever-growing library of video clips. As the library grows, so does the number of simultaneous viewers.

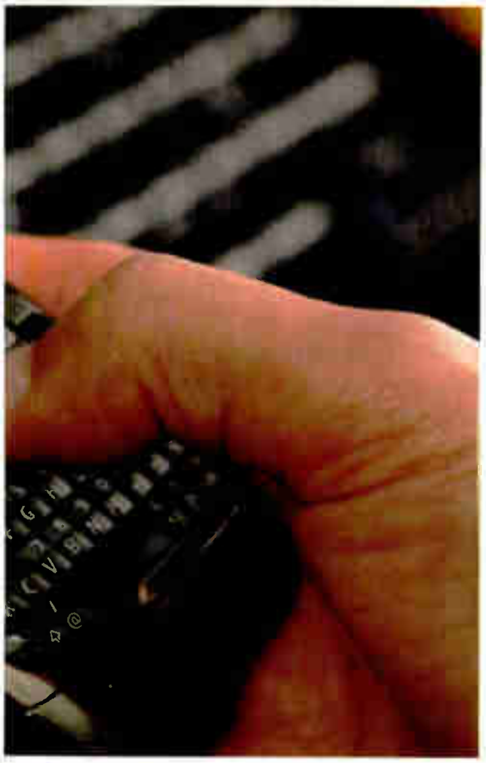
Over time, you may find out that playback from the library exceeds the bandwidth consumed by the live stream operations. This is even truer if you create multiple different file formats for each video clip in order to handle several different playback experiences for different audiences. Furthermore, if you anticipate a need to repurpose the video assets, save the clip in an editable format such as MPEG-2. This creates a need for an even larger media storage array and a corresponding demand on the IP transport facilities.

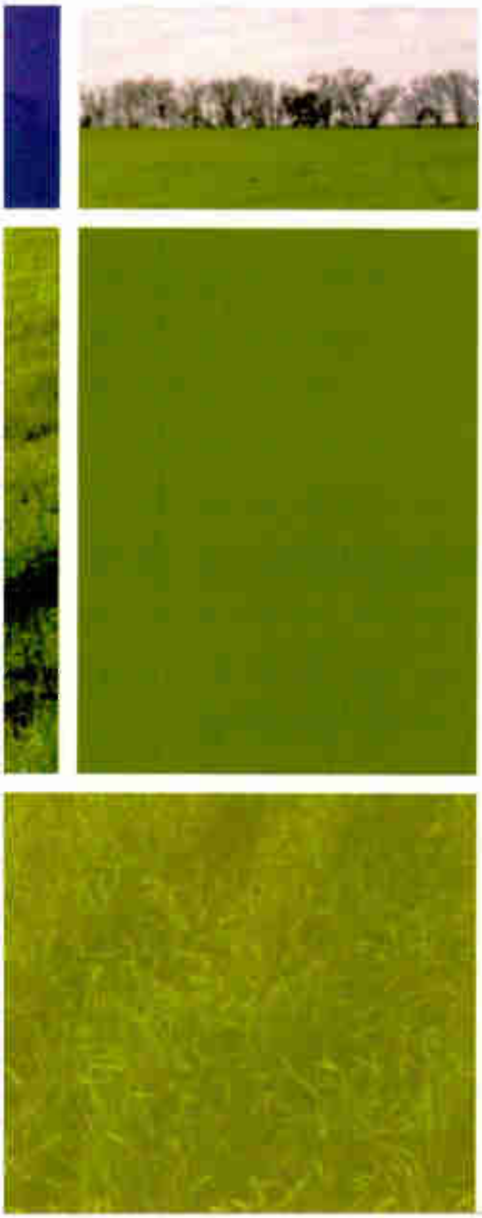
One solution that can easily grow incrementally with your needs without periodic large investments is to outsource the entire video delivery operation, retaining the video capture and video asset management functions in-house. A comprehensive digital asset management (DAM) system can remotely manage the asset library as well as give you complete control over sourcing editing and access to content. Some DAM systems offer comprehensive features that help make live events available as quickly as possible after the event to on-demand viewers and completely automate ingest and delivery functions.

Whatever the size of your operation or the rate of transition to a new digital audience, there are many ways to select and configure a solution that will serve your needs well into the future. BE

Mark Hershey is vice president engineering for ViewCast.







Software-based receivers for DTV and mobile

Software modems are becoming essential for multimedia content delivery in portable devices.

BY CHET BABLA

The integration of multiple wireless technologies within portable consumer electronic devices has been gathering pace in the last five years; devices such as cell phones, portable media players and portable PCs now incorporate multiple wireless technologies including Bluetooth, Wi-Fi and 3G cellular. A key requirement of wireless technology within a portable device — irrespective of the delivery mechanism, whether it is IP, cellular or broadcast — is to provide user access to a wide range of multimedia content for entertainment purposes.

Broadcast is the most effective method of delivering live TV content such as news and sports to a vast number of simultaneous users. Conversely, IP and cellular are better suited to "catch-up" TV and video-on-demand. These three wireless technologies, therefore, complement each other by enabling the user access to multimedia content anytime, anyplace and anywhere.

These three technologies complement each other by enabling access to multimedia content anytime, anyplace and anywhere.

The silicon challenge

The multitude of terrestrial analog and digital TV standards creates significant technical challenges for wireless technology semiconductor vendors and portable CE device manufacturers — the original equipment manufacturers (OEMs). The key reason for this, as shown in Figure 1 on page 52, is due to the differing spectral allocations and channel bandwidths required to support the various broadcast standards. As a result, to date, broadcast receivers have typically only been implemented as single-standard solutions, or at best, a hybrid of one analog and one digital standard. Due to the lack of truly multistandard broadcast receivers, rather than implementing solutions utilizing multiple silicon receivers and thereby violating the two key CE market requirements of small size and low cost, OEMs have not integrated broadcast reception at all. As a result, OEMs have not benefited from economies of scale that a global platform solution could potentially enable.

Meeting the requirements of small solution footprint and low cost is essential if broadcast receivers are to become an integral part of enabling a variety of content on next-generation portable CE devices. From a semiconductor point of view, the challenge remains of how to deliver an efficient solution that can receive global broadcast standards.

Software-defined modems

Broadcast reception is traditionally implemented as two key silicon blocks: an RF tuner that selects (tunes to) the required broadcast channel, and a demodulator that post-processes the selected channel to extract the encoded broadcast information. While recent integration advances have seen the RF tuner and demodulator integrated onto a single system-on-chip (SoC), reducing cost and solution size to a degree, a truly universal receiver based upon silicon has yet to be developed. This is largely because the demodulator architectures required for differing broadcast standards (e.g. single-carrier vs. multicarrier) do not readily lend themselves to circuit reuse, thereby leading to a multistandard size — and hence, cost — penalty. However, there is an innovative solution now possible by the recent advances in low-cost powerful processing: software-defined modems.

The software-defined modem lends itself perfectly to the challenges of enabling low-cost wireless convergence by combining a multistandard RF front end with a back-end modem implemented as algorithmic code running on an existing system host processor. A software modem therefore obviates the need for one or more silicon blocks with the readily apparent cost and size benefits this brings. By redefining the conventional boundary between functions implemented in silicon hardware and those implemented in software, software modems deliver a step-change in flexibility and cost.

Figure 2 depicts a multistandard broadcast receiver. This is a commercial implementation of a software-based modem targeting portable CE devices featuring a host CPU. This soft modem solution uses a reconfigurable multistandard RF tuner and combines it with demodulation algorithms implemented entirely in software running on the system processor. Note that the analog output of the RF tuner must be converted to a suitable digital form for host CPU interfacing, which this solution does via USB interface.

Figure 3 depicts an implementation of a multistandard RF tuner capable of receiving all commercially available terrestrial TV broadcasts. This reconfigurable RF tuner architecture overcomes many challenges,

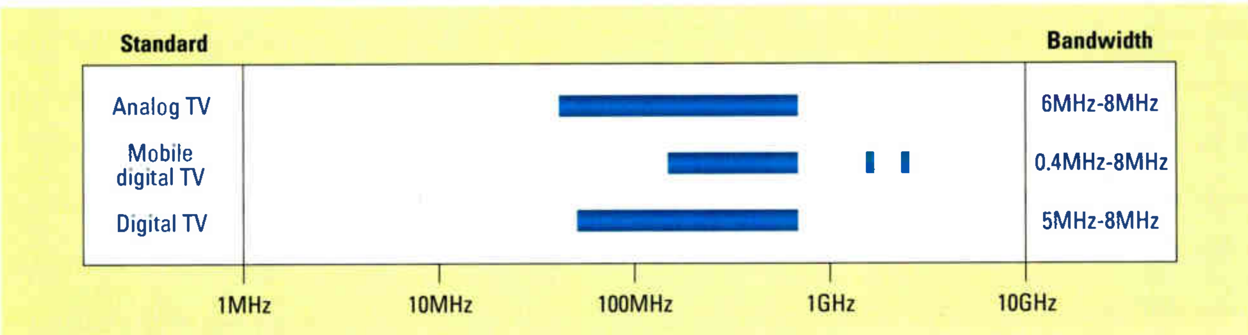


Figure 1. Spectrum requirements for various broadcast standards create technical challenges.

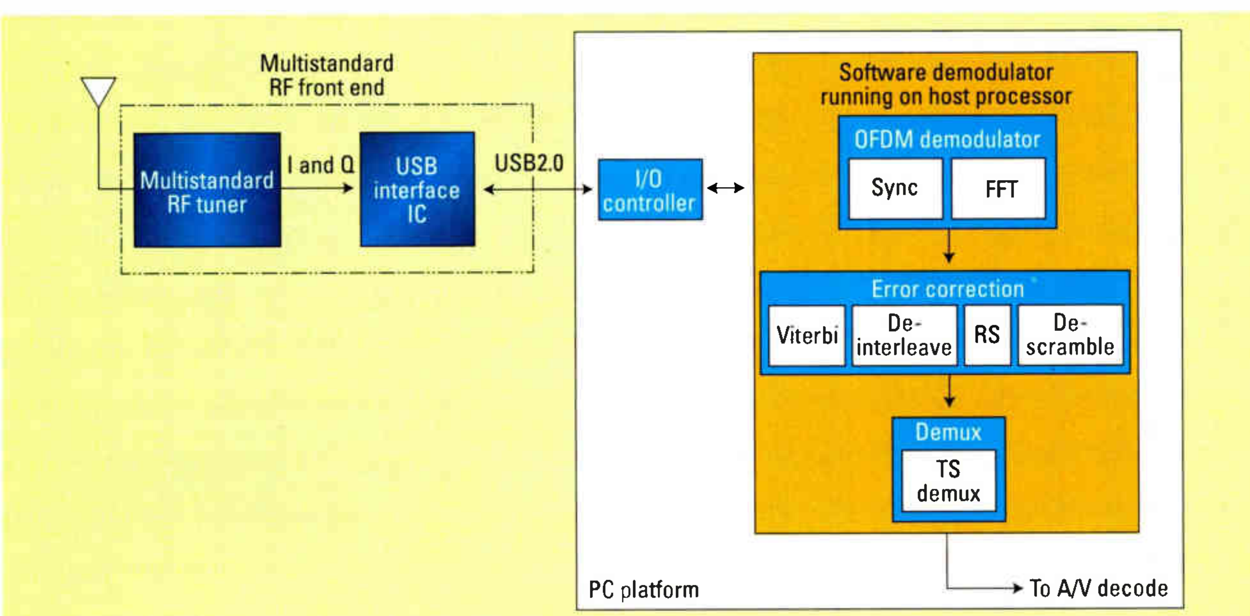


Figure 2. The commercial implementation of a software-based modem targets portable CE devices featuring a host CPU.

including support for multiple bands, bandwidths and different modulation methods.

The challenges for the software-based demodulator are similarly complex, and the algorithms must deliver demodulation performance as good as any silicon-based solution, and meet all appropriate industry requirements such as the NorDig test specifications applied to terrestrial DVB-T receivers.

Today, a typical mass-market notebook PC with a dual core x86-based processor incorporating to receive a SD DVB-T terrestrial TV broadcast would require less than 25 percent of the total available CPU load. As the processing power available within these devices continues to increase with time, and as dedicated graphics processing resource in the form of GPUs is added to address HD video decoding and 3-D gaming, the total proportion of CPU load needed to implement software modems will rapidly decrease in relative terms. BE

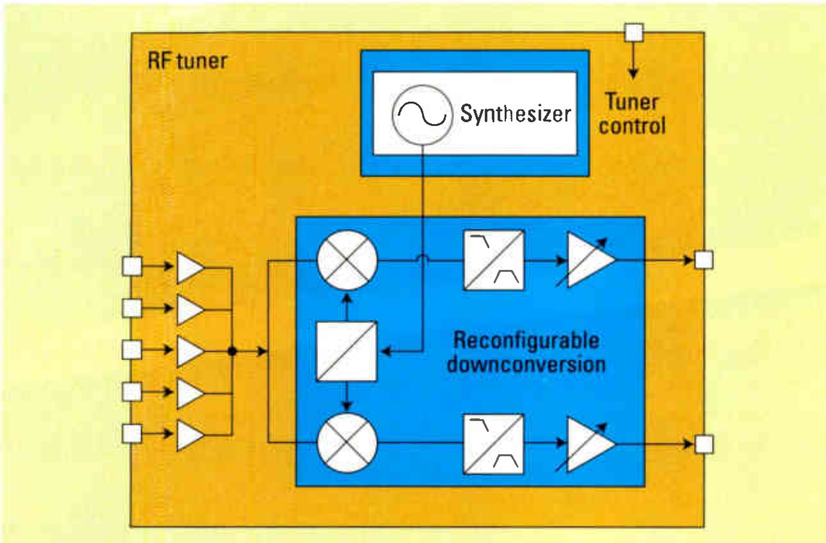
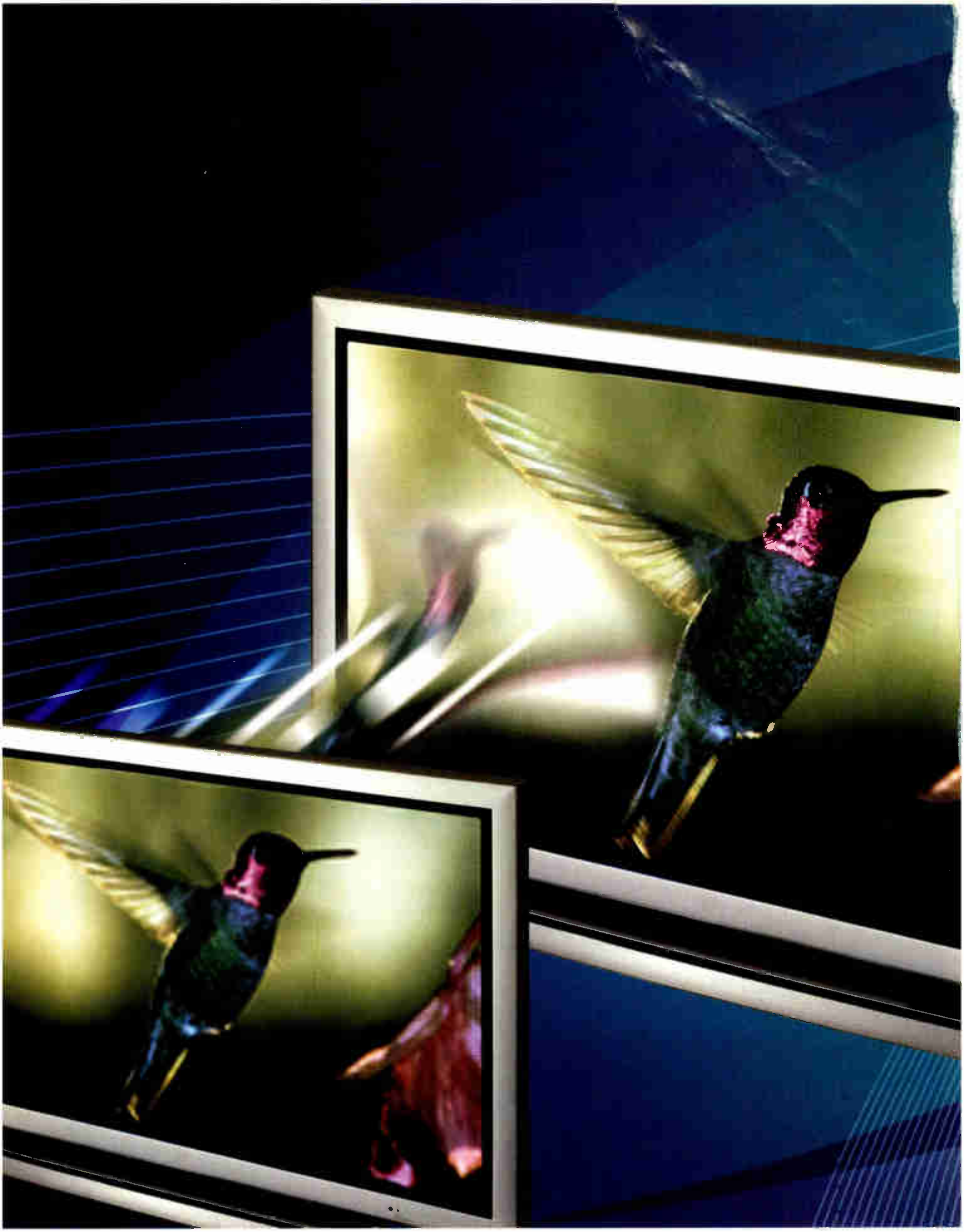
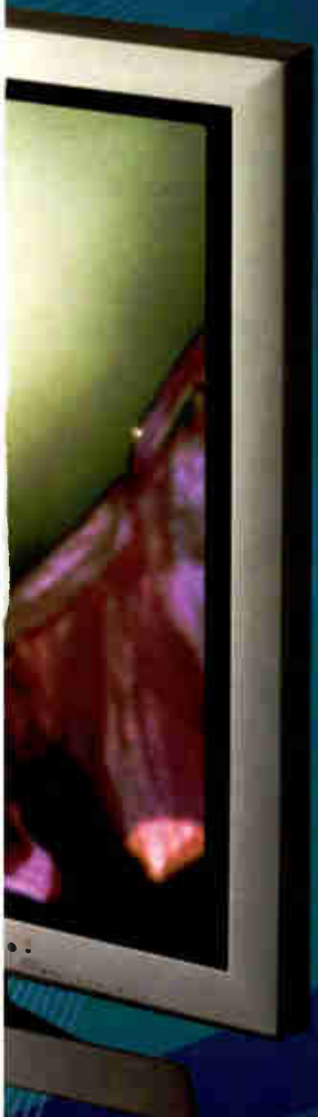


Figure 3. A reconfigurable RF tuner is capable of receiving all commercially available terrestrial TV broadcasts.

Chet Babla is marcom director at Mirics Semiconductor.





Streaming multichannel uncompressed video

BY TAM DO

Designing video equipment for streaming multiple uncompressed video signals is a new challenge, especially with the demand for 1080p 3G-SDI streams. This article examines a multichannel streaming PCI Express (PCIe) Gen2 DMA controller, which can interface up to four 3G-SDI video streams. Such a solution could be used in nonlinear editors, video servers and video-capture applications.

The proposed solution will support both SD and HD applications and will rely on an open-source video packet streaming-format protocol. This software will manage the video traffic between an SDI block and a PCIe block in an FPGA, where the majority of the functionality resides in the efficient PCIe DMA controller used to stream live video.

Video streaming background

Streaming video may involve either on-demand or live broadcast of compressed or uncompressed video. Most broadcast studio applications rely on uncompressed SDI to move video within the studio, typically between switchers, servers and cameras. Compressed video streams are used in certain studio applications for video over IP. Uncompressed video streams provide low delay and offer no compression artifacts. Compressed video may have more technical issues such as jitter, latency and the loss of quality.

Video streaming consists of three steps. The first step is to convert the incoming SDI stream into the 20-bit parallel domain. Next, the signal is converted to another interface standard, such as a PCIe or Ethernet. Finally, the video stream is assigned to a final destination.

Broadcast studio trends

The transition to HD, and now to 1080p using 3G-SDI, is one of the latest broadcast technology trends. Another is implementation of tapeless workflows that offer integrated production and content management for multichannel and multiplatform applications. A tapeless workflow can stream video from ingest to playout while relying on the integration of production video servers, central storage and related production management software.

The PCIe block provides the video-streaming capability for the converted SDI signal to feed the workstation.

A file-based workflow permits the development of a tapeless work environment. This solution provides flexibility and better management of ingested video as it is edited and finally uploaded to broadcast servers' playout. A file-based system suits applications such as IP-based newsgathering, streaming to the Web, and live and on-demand video streaming.

For now, it appears that triple-rate SDI data will be the typical interface used in tapeless and file-based systems. In this scenario, the SDI video is converted to a file format that can be edited in a workstation.

In Figure 1, a Gen1 or Gen2 PCIe bus is used to receive and transmit the converted video stream to and from the SDI domain. SDI-PCIe bridging is used in video servers and video I/O cards for nonlinear editing. The basic building blocks are used to implement video streaming with the PCIe bus. The solution also relies on SDI cable equalizers and drivers as the front-end interface. The core of the video streaming and processing resides in the center block. Programmable logic integrated circuits are used in this block to create a custom implementation for specific solution requirements. The PCIe bus interface can also reside in the same programmable chip.

Video-server and video-capture applications

A video-server and video-capture I/O card share the same basic hardware architecture front end, as shown in Figure 2. Depending on the manufacturer, the ingest and playout functions can be located on a single card or separate cards. Some server applications provide the option of encoding or decoding the raw video using H.264 or MPEG-2 HD in the video processing block.

The PCIe block provides the video-streaming capability for the converted SDI signal to feed the workstation. This block is often the bottleneck, especially if multiple 3G-SDI streams are being processed. Four 3G-SDI full duplex video streams over a PCIe Gen2 card with four lanes would translate into a data rate of 13.5Gb/s. Therefore, this block has to be highly efficient and must provide a high QoS.

Implementing a multichannel 1080p SDI-PCIe bridge

The PCIe architecture within a modern PC workstation has more than sufficient bandwidth to simultaneously transfer several 1080p60 video streams. The challenge for the designer is to use this bandwidth

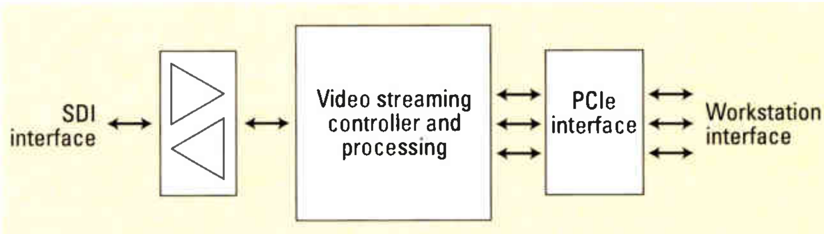


Figure 1. Tapeless and file-based video streaming

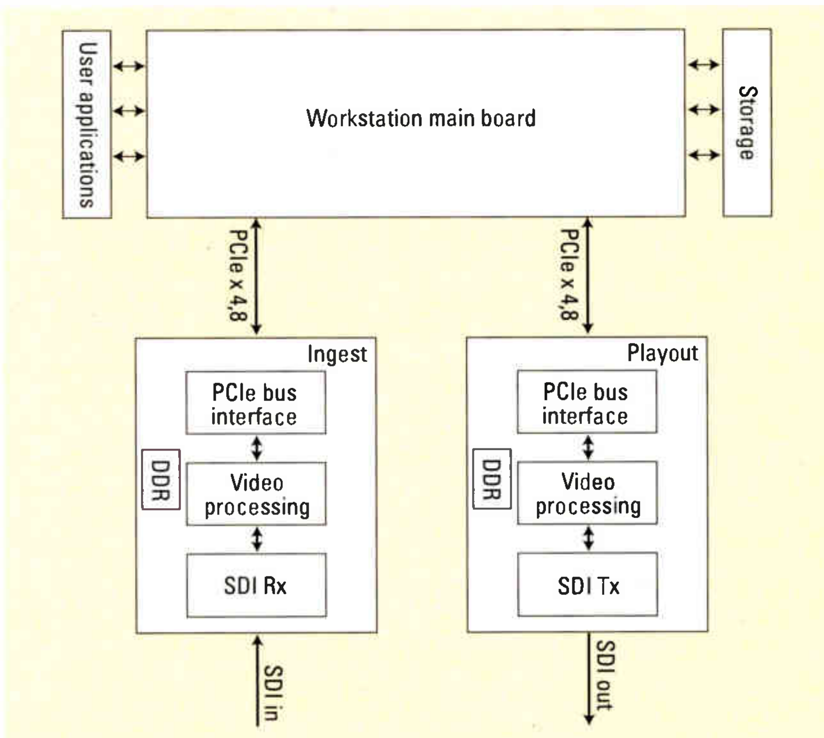


Figure 2. SDI-PCIe bridge

without placing excessive demands on either the CPU or the local storage on the PCIe capture card. This choice of an efficient DMA controller is therefore central to the success of the project.

By packing three 20-bit pixels into two 32-bit words, an active video frame of 1920 pixels x 1080 lines requires just over 5.27MB. In an ideal world, the CPU would move this video frame from the capture card into the system memory of the PC with a single DMA transfer. Unfortunately, this usually is not possible due to the way PC operating systems allocate memory. System memory normally is allocated in 4KB blocks, and there is no guarantee that a request for 5.27MB of memory will result in consecutive physical locations being available.

This requires most PC DMA controllers to support a scatter-gather mode, as illustrated in Figure 3. In this mode, the CPU creates a linked list of DMA instructions, each of which transfers just 4KB. The DMA controller processes each segment of this list in turn, automatically fetching the next entry on the list as it is needed. In this way, the controller can be programmed to cope with the PC's fragmented memory allocation without placing excessive demands on the CPU.

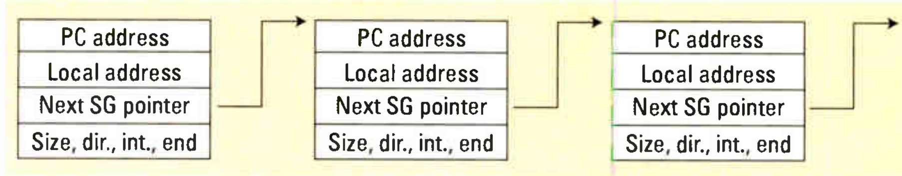


Figure 3. Scatter-gather mode

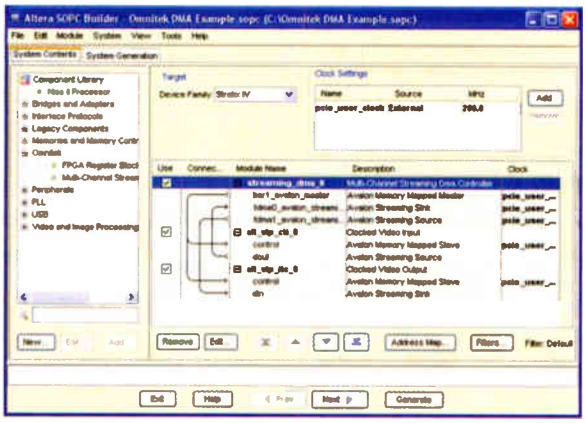


Figure 4. Video streamer tool flow

One drawback of PCIe is that its complexity leads to a higher latency than previous bus architectures. This is especially a problem for read transactions where the requestor issues a packet to the completer asking for the data, which the completer then returns. A requestor or a completer is a PCIe definition for packet receive request or packet sent completed. A requestor will request a certain packet to be sent. A completer will acknowledge that the packets were sent to the requester. This transaction, therefore, means twice the PCIe link delay. Several mechanisms are available to mitigate the effect of this latency, such as supporting large packet sizes and multiple outstanding read requests. In any case, the user must be sure the issue is sufficiently resolved in the chosen solution.

If a DMA controller waits until the previous read acknowledgement by the completer before issuing the next read request, the overall transfer performance from the system memory

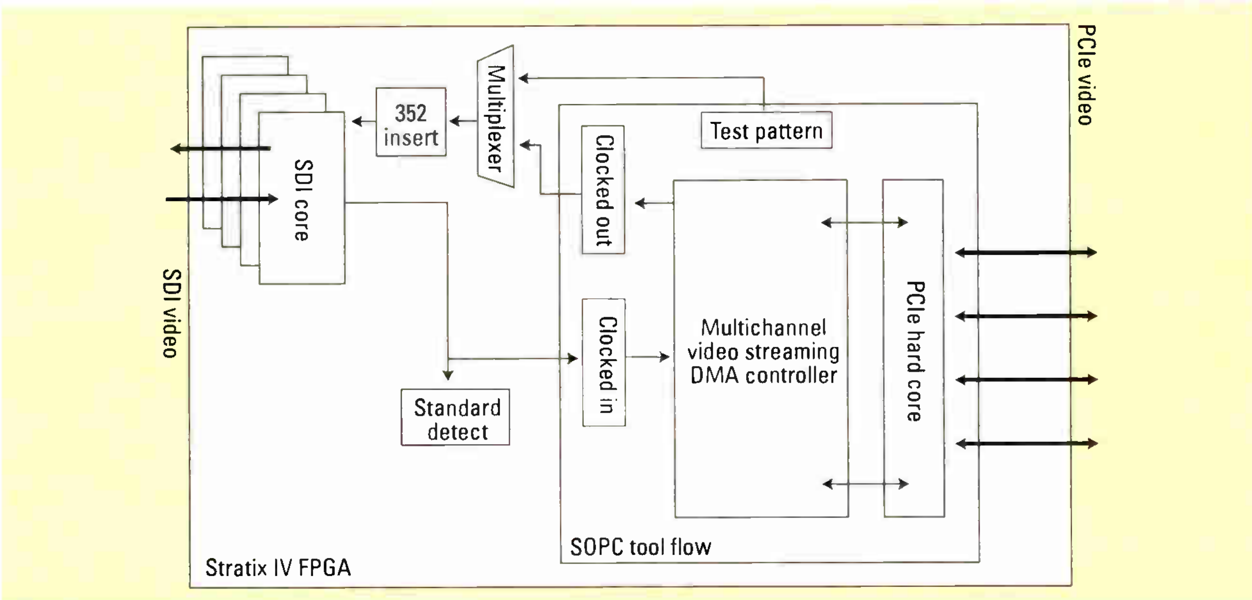


Figure 5. Complete multichannel video streaming on a chip

to the capture card will be poor. To improve downstream efficiency, the DMA controller must support multiple outstanding read requests. This means the DMA controller must always be looking ahead and issuing the upcoming read requests, before the previous bus transaction has completed. In this case, the effects of the read latency on overall bandwidth utilization will be minimized.

The effect is still present, however,

for each individual read access. This is a particular issue for scatter-gather DMA controllers. It is no longer acceptable for controllers to wait until the end of a scatter-gather segment before fetching the next set of instructions. To do so would further lower the overall efficiency of the system, and would increase the amount of local storage required to hold the extra video data while the next element of the linked list is retrieved.

The availability of video-specific development boards, IP cores and user-friendly design tools turn a complex video-streaming system into a much simpler task for the average engineer.

A DMA controller core that provides efficient handshake timing requirements is readily available from chip vendors so that a circuit designer can simply drop the core into a complex design using only a graphical design entry tool. (See Figure 4 on page 57.) This tool allows the interconnection of the 1080p 3G-SDI front end and the PCIe DMA controller without having to actually write the needed code for this video streaming application.

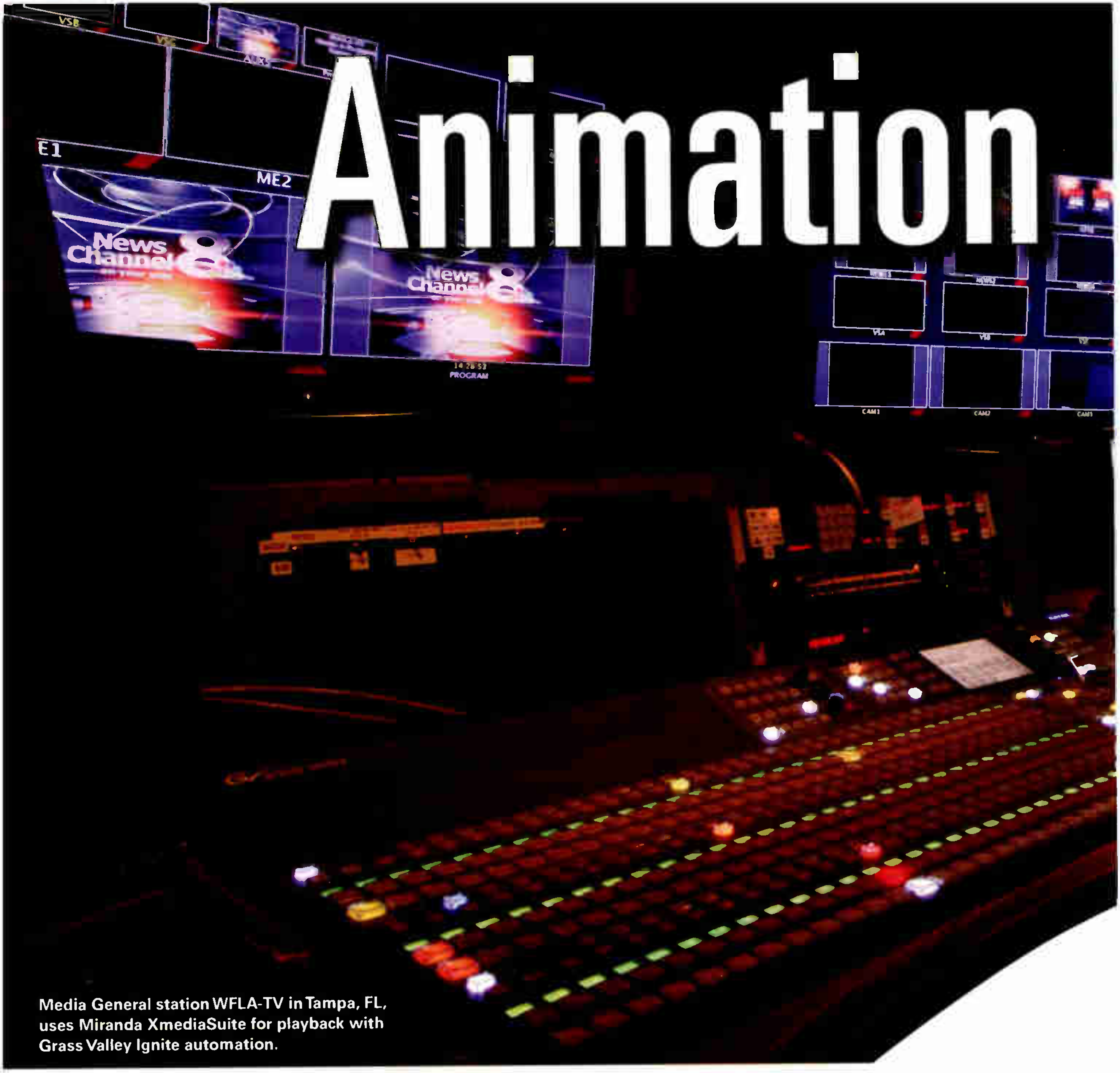
The complete PCIe video streaming interface, together with the DMA controller, are included in the "streaming_dma_0" design module of the IP core. The tool environment uses an FPGA open-source generic video interface protocol to allow IP blocks from different vendors to communicate with each other. The design-entry tool is then used to connect the SDI IP core and the DMA streaming controller together in a single chip design, as shown in Figure 5.

Conclusion

The availability of video-specific development boards, IP cores and user-friendly design tools turn a complex video-streaming system design into a much simpler task for the average engineer. Free video reference designs from IC venders also can be used as starting points to create video-streaming application projects. BE

Tam Do is the senior technical marketing manager for Altera.

Animation



Media General station WFLA-TV in Tampa, FL, uses Miranda XmediaSuite for playback with Grass Valley Ignite automation.

It is important to understand the entire graphics system workflow and process from creation to playout in order to maximize the system processes. This article looks at the typical newsroom processes and compares them to new streamlined, workflow optimized-specific, 24-hour news scenarios with multiple graphics palette structures.

Templates vs. pages

The graphics creation process, from a producer standpoint, starts by accessing a predefined template available within the XNews application in ENPS. A producer chooses a variety of options and fills out specific information pertaining to the defined template structure. These templates are saved into pages that contain the MOS information and are placed into the typical ENPS rundown. Within any specific rundown, you may have numerous pages in various orders. (See Figure 1 on page 62.)

Control room playout

The playout process in the control room is to cue and arrange the take templates in the order that the producer stacks these elements within the ENPS rundown. Depending on the options that the producer selected during the creation process, the output and business logic within the template assembles the graphics and/or animation within the specific CG device.

Although this process is conceivable and practical in most 24-hour newsroom environments, there are two areas that make this workflow process tedious and iterative. First, changing current rundown from generic to breaking news takes valuable time in

to automation

BY ADAM MARTINEZ

breaking news situations. These tasks become repetitive finding the rundown and opening each graphic (page) to change specific options. Second, re-recording live events to on-scene for later viewing is the same process where producers have to access each page to make graphic optional changes.

Multiple graphics palettes

Many news stations are becoming more aware of audiences and viewing times and have opted to move in the direction of creating multiple graphics palettes for each day part or specific show. While this provides a fresh new look for each "block," with this comes challenging new workflow strategies.

There are downsides of keeping the current graphic configurations, scenarios and template broadcast logic. First, without any complex broadcast logic, producers will have to perform the same iterative tasks of opening each page and making the optional changes, resaving the page and repeat. Second, the current configuration does not allow graphic templates to float into new day part graphics palettes or different shows without accessing each page to make optional changes. Third, control room directors currently do not have any power over last-minute changes and must wait to rerecord live/on-scene while producers change rundown page graphic options.

In a typical 24-hour newsroom situation when everything is running smoothly, it is essential that the control room production time is optimized for the specific day part period. During this time, producers are recording elements for both the current times and later day parts. It is essential that this factor be taken into the upmost consideration. Directors will need complete control overrides for every rundown element.

With the addition of the multiple graphics palettes, the workflow process needs to be reorganized to maximize production and playout. In order to create the most flexible graphics processes, graphics should be programmed with specific broadcast logic. Consider these factors in development and integration:

- A rundown with graphic elements needs to dynamically choose the correct color palette based on specific time periods.
- Directors need complete control over rundown graphics for last-minute updates or live or on-scene events.
- Directors need overrides to change or hot/swap day part palettes with no producer interaction.
- Producers need to float rundowns into different day parts without changes.
- Producers need minimal amount of work to change all graphics within a rundown to another specific show or day part.
- Automation should be maximized where applicable.

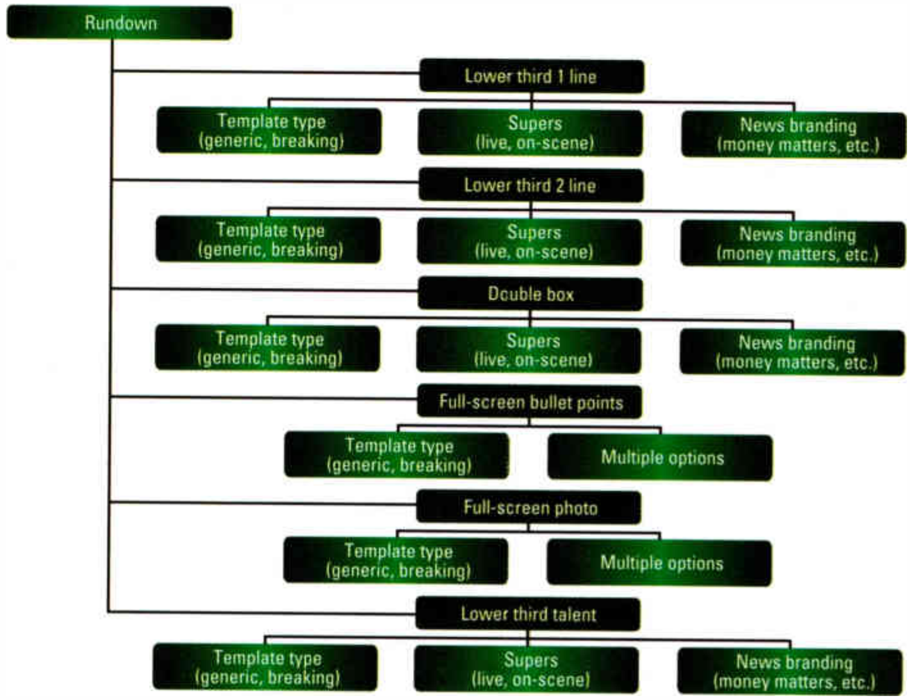


Figure 1. An example of a typical ENPS rundown with CG elements

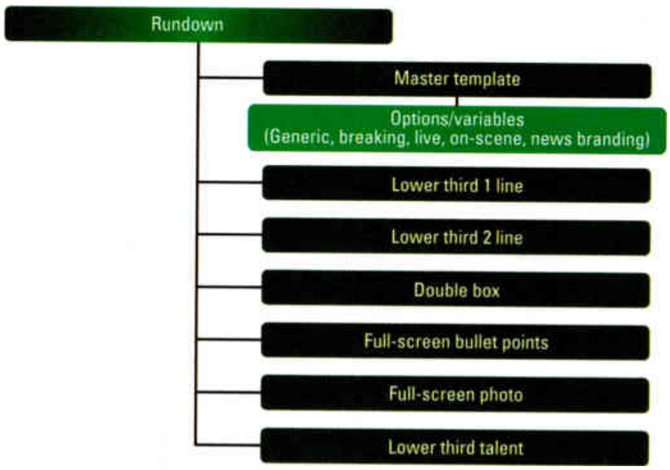


Figure 2. Example of a master template and preceding slave pages

Using the same scenario from Figure 1, implement a master template that producers will first fill out with all the variables that will be assigned to each preceding slave page that is created with XNews for the specific rundown scenario. (See Figure 2.)

The master template allows all the variables for the preceding template to be stored. All other templates contain variables and elements associated with that specific template. The global variables stored in the master template, upon execution, will replace all page variables preceding this master template, until another master template occurs.

Playout

In the control room, a master panel resides at all times within the playout devices. Within this panel, the global variables of the master template are passed. The panel stores these variables, and each preceding page from the rundown will access these master variables. This panel also constitutes the bulk of the broadcast automation logic. The logistics implemented within the panel for optimized automation and various scenarios include:

- Dynamic or automated template and graphic palette selections based on predefined show production times. This ensures the proper graphics palette gets assigned to specific shows at specific times with no user interaction.
- Director override for master template variables for day parts, which enables directors to rerecord and override the master template variables with selected day part graphics palette.
- Director-driven events such as live and on-scene. This enables directors to rerecord and override the master template variables without producer page interaction.
- Breaking news and specific show override, which allows all graphics in any rundown to be assigned breaking news or other graphic show color palette.

Optimized workflow

Utilizing the master/slave template process greatly improves the automated process within the NRCS while minimizing repetitive tasks. Through this process:

- Producers can focus on content rather than repetitive template options for each.
- Producers can quickly update entire rundowns on the fly from master templates.
- Master templates can be copied to other existing rundowns.
- Directors can override rundowns' master templates before execution.
- Directors can change events based on recording live, on-scene and other scenarios.
- Automated graphic palette selection is based on time periods and specific show times.

The four main important factors in dealing with graphics in the NRCS are understanding the complete workflow process, automating repetitive tasks, developing dynamic logistics and leaving room for growth. BE

Adam Martinez is creative director/owner of Southwest Digital and art director at Central Florida News 13.

Camera optics

High-quality pictures start with precision optics.

BY JOHN LUFF

The sweep of technology fascinates me. In the 45 years I have spent in the business, I've seen incredible change in almost every aspect of the industry. Consumers can buy cameras that produce images superior to that of the best cameras of 20 years ago. HD imaging has risen from laboratory oddity to common production practice since 1978 and into the hands of consumers in the form of exquisite camcorders for less than $1000. Recording technology has moved through analog tape and even analog disk to digital recording on flash memory and optical disks in portable packaging. Electronics advanced from vacuum tubes heating equipment rooms to toasty comfort to microelectronics using a tiny fraction of the energy once required. Signal processing progressed from strictly an analog possibility to image scaling and movement in cell phones.

Optics are stuck in analog

There remains one part of the complex system for creating and manipulating content that is permanently stuck in the analog domain — that is if you ignore quantum effects, which in point of fact is becoming difficult to do. Putting an image on a sensor is now and always has been the province of analog optics. Don't get me wrong; optic science has matured and now produces images no one would have thought possible 20 years ago. With sensor sizes from 1/6in to larger than a film frame, lenses must be capable of producing resolution, contrast, uniformity of focus and low chromatic aberration. This is truly science, as well as difficult engineering.

Monochrome cameras used in the 1930s for early commercial experiments in television were fixed focal length. Often the lenses were mount-

This photo of a 1950s camera shows how lenses were mounted on a turret to enable an operator to choose the appropriate focal length.

ed on a turret to allow the camera operator to choose a focal length appropriate to the scene and taking distance. Size manipulation was done in the same manner as film production, with the camera moving to create an object zoom instead of the common optical zoom done today. In fact, the invention of the zoom lens for television was a huge boon to all. In the 1950s, a zoom lens was available, but it was not until the 1970s that fixed focal length lenses disappeared from common use. By the era of the first plumbicon cameras, fixed focal length was no longer a rational choice.

But optical innovation was barely keeping up with the increasing level of imaging quality cameras were capable of. Early color television cameras suffered from registration errors even with the most careful technical setup, leaving residual optical errors (chromatic aberration and other effects) just observable in the final image. Unfortunately, the most recent improvements in cameras have forced intense scientific and engineering development in optics. As we approach an era when 4k and soon 8k cameras are commonplace, we will bump against the limits of physics, as well as straining the ability of excellent engineering to keep ahead of imaging science. Diffraction limits for some imagers and lens combinations are real effects.

The trade-offs of technology

As the industry inexorably pushes manufacturers for longer zoom ratios and higher performance, it is asking for trade-offs that must be understood. Longer focal length without increased physical length presents an interesting challenge. A 101-1 zoom lens (one commercial model is actually 8.9-900mm) is 660mm long, only two-thirds of the maximum focal length, but more incredibly the wide end of the zoom is accomplished with a lens nearly 75X as long as the optical path we are creating. With a 2X extender, such a lens has a viewing angle of only 18 arc minutes, just

As the industry inexorably pushes manufacturers for longer zoom ratios and higher performance, it is asking for trade-offs that must be understood. Longer focal length without increased physical length presents an interesting challenge.

over half the diameter of the moon as seen from the earth. This is perhaps as much a high-resolution telescope as a television lens.

Choosing a lens should be done carefully and with consideration of the application and the rest of the camera chain. A lens with a large aperture may be valuable when working in low light conditions, but comes with a trade-off. MTBF is affected by moving either to high or low f-stop settings, reducing lens performance. Illumination uniformity across the sensor is also affected by both the zoom and aperture settings. This can lead to the feeling of looking down a porthole. Low-cost lenses, especially ones not intended for HDTV applications but used on HD cameras nonetheless, will also degrade performance materially. It is tempting to select a camera that might extend the life of a good SD lens on a new HD studio camera. However, the precision with which new lenses are built matches the quality of the new HD cameras available.

It is easy to see why. A camera designed to be high quality in SD needs to support a limiting bandwidth of only 5MHz. An HD camera is capable of nearly 30MHz luminance bandwidth. The SD sensor has one-sixth as many pixels as a modern 1080p camera. Clearly, a lens optimized for SD and built to be cost-effective in that application can make compromises that a good HD lens cannot make, both technical and in manufacturing economics. It is tempting to try to save money when replacing cameras by retaining lenses, but it presents huge trade-offs. Perhaps the most obvious is aspect ratio. An SD lens does not need to provide high performance outside of the 1.33:1 sensor area, which is 25 percent less sensor area than the 1.778:1 HD TV aperture. Masks are put on lenses to prevent flare outside of the intended image, and a 4:3 mask is the wrong idea for a 16:9 image.

Conclusion

As HD cameras become more cost-effective, the lens may again become more expensive than the camera. But keep the analog nature of imaging in mind, and acknowledge that high-quality pictures start with precision optics. That is not possible with low-cost optics, which limit the performance of HDV and other camera formats that use optics packaged with a low-cost camera. The rules of physics are hard to bend. **BE**

John Luff is a broadcast technology consultant.

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

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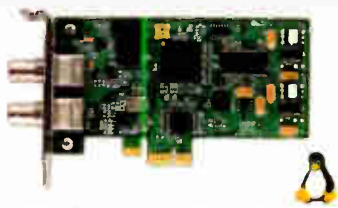

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3-D chatter

How serious is the possibility of 3-D technology?

BY ANTHONY R. GARGANO

Talk about a technology that refuses to accept no for an answer; welcome to yet another incarnation of 3-D as an entertainment viewing medium. From parlor stereoscopes at the beginning of the last century, to the stereoscopic photography craze in the early 1940s, to the spate of 3-D films produced in the 1950s, each generation has been subjected to yet another rebirth, along with the dazzle and hype, of 3-D. And, there's always the same question: Will it stick this time?

Making 3-D a reality

Our European colleagues believe it will. British Sky Broadcasting (BSkyB) announced the launch of a Sky 3-D channel in 2010. As we have seen with our own recent experience with HDTV, there is always the chicken and egg dilemma of available content vs. set penetration. Recognizing the lesson that content availability drives set penetration, BSkyB's strategy is initially to also make the channel available in theaters, particularly for sporting events. The belief is that such exposure to 3-D content will help further drive the uptake of 3-D home receivers. Not to mention, cinema distribution will provide an initial revenue stream to BSkyB while awaiting set penetration in its subscriber base. Morgan David, R&D at Sony Professional Europe, said that in five years, the majority of European viewers will be watching 3-D TV at home.

In Asia, 3-D broadcasts are already a reality. In Japan, Nippon BS Broadcasting's BS11 3-D satellite station has been broadcasting in 3-D since 2008, and many Japanese cable systems now include segments of 3-D content in their program schedules. Korea plans to begin a satellite 3-D service in 2011, with terrestrial broadcasts to commence in 2012. The London Olympics seems to be taking on the mantra of becoming the unofficial watershed event for 3-D broadcasting, as several broadcasters plan to have some level of 3-D broadcast capability in conjunction with the 2012 Olympics.

TV set manufacturers have the most to gain, so it's no wonder Mitsubishi, Panasonic, Philips, Samsung, Sony and Toshiba have announced new 3-D-capable receivers. HDTV is now reaching the point of maturity that more new receiver sales are being driven by feature enhancements as opposed to the necessity of replacement, as was the scenario in the analog-to-digital transition. By the end of 2008, one-third of all U.S. households had at least one HDTV receiver — a penetration level that was double the previous year.

When the 2009 stats become available, it is expected that the penetration rate will have easily doubled again, especially given the unprecedented rate of decline in set prices during the year. Thus, in this digitally enabled era of technological leapfrog, it is not surprising for the receiver manufacturers to be looking for the next replacement technology. Feature enhancements to the existing base technology platform are fine, but nothing drives demand and higher profits like replacement.

It's war!

No new technology is complete without the potential for a standards war. There are four basic methods in popular use today for generating 3-D imagery. The first is anaglyphic, which uses inexpensive red-cyan glasses. This was used for the Superbowl commercial and an episode of "Chuck," which both aired in 3-D on NBC earlier this year. Another technology that uses low-cost glasses is polarized 3-D, which can be viewed with polarized lenses. A more complicated technology is frame sequencing, where right-eye left-eye information is contained in alternate frames and requires the use of shuttered lenses for viewing. Lastly, there is glassless viewing technology or autostereoscopy.

Several geopolitical industry organizations, such as the China 3D Industry Association (C3D), Japan's 3D Consortium, Korea's 3D Fusion Industry Consortium (3DFIC) and 3D@Home in the United States, are involved in some form of the standardizations process. And, SMPTE has a task force charged with defining standards for 3-D home display, which hopefully will bring order and consistency to the process.

The stickiness factor

So, if 3-D really does stick this time, how will this impact the broadcaster? For distribution and transmission, that DTV infrastructure that you just spent millions on upgrading will nicely accommodate a 3-D bit stream. You may have to budget for some encoders, decoders and display devices, but you won't need to spend anywhere near the likes of the upgrade from analog to digital. However, to actually produce 3-D content, welcome to a new world.

To answer my original question: Will it stick this time? For PC gaming and digital signage applications, it probably will. For 3-D HD in the home, there are still a lot of issues, not the least of which is the significant number people who report headaches, dizziness or nausea after prolonged 3-D viewing. David's aggressive prediction is not surprising for a company selling TV receivers, but this is still a technology that under Japan's 3D Consortium fostered a "3-D Stereoscopic Brain Training Working Group." BE

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

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