NAB preview

Your Personal Guide to NAB 2001
- DTV Marketplace • DTV Answer Book • FASTtrack

Special Report:
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"ONE OF OUR KEY REQUIREMENTS was the ability to support many more microphones, mix-minuses for IFBs, and satellite sources without routing and patching sources and inputs. WHEATSTONE's TV-80 audio console was the logical fit for our needs. It featured eight internal mix-minuses and was "tried and true" technology. Its preselects with Event Computer give us the expansion and flexibility needed to satisfy a diverse range of needs, from live production out of multiple sets and studios to pre-production for specially produced programming.

THE WHEATSTONE FACTORY commissioning and training worked out very well. It was well coordinated and the operators (both old and new hands) seemed to understand the console, the layout, and the functionality. There have not been any major operational ‘bugs’ using the audio console live on-air and user satisfaction with the console has been very good. Setup time and ease of operation have improved significantly. To date we have not had any service needs."

— John Orr, Mgr., Broadcast Engineering Projects

"YOU JUST CAN'T GO WRONG with WHEATSTONE. Their boards are intuitive and clean sounding, and you can track signal flow at a glance. In my eyes the greatest feature of the TV-80 is their mix-minus bus system. Anyone out there who's 'faking' mix-minus by using submasters or an external box will wonder how they did without it. The TV-80 is a definite time saver, both in installation and operation. It makes audio operators more confident and reduces show prep time—we're now able to do more and better pre-production. Definitely WORTH EVERY PENNY!"

— Craig Reeves, Audio Engineer
Taking care of today's broadcasting needs while moving toward a digital future is a tough juggling act. You need to maintain and, perhaps, upgrade current systems. Maybe you're even contemplating complete station makeovers. Fortunately there's a company with the resources and dexterity to help you maintain your balance: Harris.

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“There's nothing better...”

“DVCPRO50 clearly builds on DVCPRO25, which has been an excellent workhorse format for us. We knew how reliable DVCPRO50 would be. It's cost-effective and the quality is excellent—there's nothing better for our needs.”

- Dale Kelly, senior vice president, Pappas Telecasting

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A look at the technology that shaped this industry.

VTR features
Name this Ampex VTR, year first shown at NAB and two features that made it unique from all of its predecessors. A bonus will be given to the first person who includes the official internal code name used for the machine while it was in development. Enter by e-mail. Title your entry "Freezeframe-March" in the subject field and send it to: editor@intertec.com. Correct answers received by June 1, 2001, will be eligible for a drawing of Broadcast Engineering T-shirts.
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Welcome to the Demo Room

I usually spend this pre-NAB space promoting the upcoming convention. I'm always excited about the show and love to talk about it. But this year, I've got something else I'd like to tell you about. It's called the Demo Room.

Ever since the Broadcast Engineering website was launched, I've wanted to bring active video and audio to readers. Maybe it's because of my broadcast background that print has just never completely filled my desire to communicate. Moving pictures and audio provide a powerful form of communication that the print page can't provide. Until now, it's been impossible to tie an audio/video presentation with the print medium. Technology has changed such that and I can now offer you, the reader, that missing element — streaming video.

We've just launched the Broadcast Engineering Demo Room. It's available through the BE website: www.broadcastengineering.com. Once you're on the site, look for the Demo Room logo, which is shown below. Click on the logo and you'll be launched into the room where you can select from several product demonstrations.

Vendors who want you to better understand their products provide the product demonstrations the most effective way to get a feel for a product.

No one gets to all the booths they'd like to see at NAB. There are just too many. And having enough time to view all of the recorded demonstrations while you're there isn't likely to happen because, again, there are just too many. The Demo Room helps to solve that dilemma. You can now enjoy full product demonstrations right in the comfort of your home or office.

Products with demonstration videos are identified in the magazine with the Demo Room logo. These logos will appear next to a company's new product announcement or on their advertisement.

When you see the logo, you know there's a demo online for you to view.

The product's manufacturer provides the videos and they are solely responsible for the content. No log-in or registration is required so you're completely anonymous and it's absolutely free.

Clearly the manufacturers want you to better understand what their products are capable of and how they work, so the demonstrations are targeted on applications and functionality. From the Demo Room, you can directly access the manufacturer's site via a clickthrough if you want more information.

Many of these monthly videos will be archived for future viewing. You'll be able to enter the archive section of the Demo Room and select previous months' videos of products you may have missed during their initial publication in the magazine.

Please give the Demo Room a try and let me know how you like it. See you at NAB. It's going to be a great show.

Brad Dick, editor
Fix your Incoming Feeds

The Miranda *imaging* Series provides broadcasters with the most integrated and compact solution for decoding, equalizing, synchronizing, processing and adjusting video and audio signals regardless of original format. All the functionality you need on two compact cards, allowing multiple channels per frame to be fixed. Connect to this our highly adapted control solution and you will be able to weather the worst of feeds with ease.
Editor: In Barb Roeder’s recent article, “Getting Started with Streaming Media,” is the following paragraph:

“Today’s streaming media can be delivered using several different methods. True streaming media requires a specialized server such as RealServer, Windows Media Server or the QuickTime Streaming Server (QTSS). Your content is then delivered and viewed in real-time whether it originates from a live event or an archived media file. The caveat to true streaming is that the bit rate of the movie must match the bandwidth of the connection or buffering will occur and playback will be interrupted.”

I have been streaming Real Player video files off of ordinary servers (including a free server) for some time now. So long as my connection speed is adequate, I don’t experience buffering or playback interruption. I have heard this statement made as regards Real Player so many times — even a presenter for an Adobe seminar insisted on it and insisted that what I was already doing was impossible!

I suspect Real Player wants people to believe this, for obvious reasons, and has perpetuated the myth.

Barb responds:

Any video can be served from an ordinary server, which is sometimes referred to as HTTP streaming. HTTP is the protocol for transport of web pages over the Internet. The specialized streaming servers mentioned in the article use, Real Time Streaming Protocol (RTSP), as least a first choice, for delivering the streaming media. RTSP has a lower overhead and less error correction, so real-time delivery is better.

The error correction and feedback communication built into HTTP permits the guaranteed delivery of data, just not necessarily the timing of that data. Hence, we wait for web pages if the connection is slow, but we always get all the information unless the connection is broken altogether. If the player has to wait for packets due to poor connection performance, buffering occurs during playback.

As Steve says, “So long as my connection speed is adequate” there is no buffering during streaming from an HTTP server. Using an ADSL line capable of up to 6Mb/s, chances are you would never see poor performance because most streams are designed for 300- to 500Mb/s even in the broadband market.

So how much ERP do I really need?

Aloha, I read the article “Engineering KICU’s path to DTV” by Jim Boston and David Lingenfelter. I have a simple question: What is the approximate ratio of DTV to NTSC ERP needed to maintain existing city grade coverage patterns for UHF stations?

KEN WOOLEAN

Jim responds:

Ken,

The FCC used the Grand Alliance guidelines in assigning DTV power for each station 12dB below the NTSC power level for UHF to VHF transitions, but didn’t use it for VHF to VHE. The difference in power between NTSC and DTV is due to the signal-to-noise ratio for impaired viewing between the two. It is generally recognized that NTSC viewing becomes objectionable at 28dB S/N. With DTV, the signal hits the error cliff edge at a little above 15dB — a difference of approximately 12-13dB.

One reason that the FCC is concerned with UHF is that it increased the time factor for considering coverage for UHF from FCC (50,50) to FCC (50,90) (50 percent of sites receiving the signal 90 percent of the time). As you know UHFs tend to have larger grade As than VHF because of the large powers usually radiated, but much smaller grade Bs. (Note: Grade A and B coverage is not used in DTV measurements.) Also UHF’s radio horizon is usually the same as the optical horizon, whereas VHF can have RF horizons well beyond the optical. Thus the FCC tended to be a little more liberal with VHF power levels.

JIM BOSTON

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NAB booth # L141 – North Hall
Digital television is not the same old television we've grown accustomed to. There's a host of new services that come to the table with digital broadcast television, causing engineers to scramble to keep up with what's out there.

The kinds of things of particular interest are the technologies that make use of the unused portion of the broadcast bitstream. The equivalent of one NTSC service over a digital television broadcast system leaves a considerable amount of room for other services, additional NTSC-quality channels or the transmission of digital information that would interest many different kinds of audiences. Keep in mind bits are bits. Once encoded, one kind of digital information is virtually indiscernible from any other to the transmission system.

What is the best use of the unused portion of your bandwidth? Fill it with moneymaking services offered by companies like iBlast. iBlast promises to be a revenue generator and its approach is a significant departure from conventional television. Considering the company recently opened an impressive Network Operations Center (NOC) in Los Angeles, the company looks to be broadcast ready on a large scale.

Peter Ludé, senior vice president of engineering and operations for iBlast said, "Our network now consists of 253 television broadcast stations, which cover 93 percent of the population in the U.S., and we are adding more stations every month." Ludé explained that what made iBlast different was that each member station of the network was a shareholder and owned a piece of the iBlast action.

"Our service is one of the enhancements that makes DTV worth looking at," Ludé continued, "and this service is not compatible with analog television; it is a digital television service only. What makes the iBlast service distinctly different, when compared to conventional analog television services, is that the services we offer are not necessarily audio and video related. Think of it this way, anything that can be sent digitally, irrespective of the..."
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media, CD, bit stream, games, MP3 and TV programs, can be transported on the iBlast system. Anti-virus software and latest anti-virus shields can be broadcast to users within minutes of their development.

If it can be transported on an IP (Internet Protocol) network, Ludé said, “it can be carried on the iBlast infrastructure. In addition to what has already been mentioned, iBlast can also deliver video games to Playstation modulators technologies other than 8VSB, Ludé reassuringly said, “the iBlast system is agnostic to the modulation system; it doesn’t care, as long as it works.”

Should the iBlast user not have his or her computer on at any given time, it is quite likely the desired information would be broadcast several times throughout the day. iBlast does not have to send information in real time. This is true of any television programming always has priority, and data will move as fast as the infrastructure can accommodate it. At current bit rates, no less than 50 full DVD quality movies can be transported a day without any noticeable difference in the television service sharing the same transmitter system.

As to the economy of delivery systems, Ludé pointed out that other delivery methods are from one- to seven-cents per megabyte now, but the iBlast approach is one or two orders of magnitude less.

Says Ludé, “Were not selling anything to broadcasters, they’re our partners. We don’t sell equipment, only our pipeline. Yes, we do help broadcasters broker this system, it’s in everyone’s best interest.”

What is the best use of the unused portion of your bandwidth?

users and with 27 million gaming consoles in the U.S., there’s definitely a market for that kind of software.”

One of the things that sets iBlast apart from its competitors is the way it is distributed. Others distribute their digital content to edge server locations around the country, where the content resides on an Internet service provider’s (ISP) server in the user’s nearby area until it is needed by the user.

iBlast, on the other hand, is distributed to member television stations and is immediately broadcast over-the-air to users. The iBlast signal is not received by a television set, but by the user’s computer system equipped with a receiver board for that purpose. This receiver board is unique in that no MPEG decoding is needed; only an 8VSB chip. For those who support IP-based system. Multiple bits of material can be broadcast simultaneously. A computer’s hard drive can be downloading MP3s while anti-virus protection is updated and the movie you want to watch tonight is slowly filling the bit bucket for recall at your convenience.

Because Hollywood is adamant about copyright protection and because the distribution of the iBlast data is via satellite, the subject of conditional access (CA) and other forms of protection come into discussion. Ludé said, “CA keeps the honest people honest. We have no specific security on our system. The content owners have that kind of thing in place already on their material and our network can accommodate it, if it is IP-based.”

Fear not, with the iBlast system, sharply reduced role for the FCC.

Heading up a Commission that has two vacancies out of five and a third likely, Powell will have the opportunity to significantly reshape the FCC and related telecommunications policy. In contrast with Powell’s two immediate predecessors, he has somewhat cordial relations with House and Senate leaders. According to The New York Times, some House and Senate leaders have taken credit for

---

**Powell takes over**

The transition to digital, from a governmental perspective, is now in the hands of the newly appointed Chairman of the FCC, Michael K. Powell. Powell is setting out to distance himself from the ways of his Clinton administration predecessors by voicing skepticism about a bevy of regulations affecting broadcasters and other services. At his first news conference he left no question that he places greater faith in the marketplace to correct possible problems and emphasized a
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Chyron customers enjoy advanced features, including Lyric 2D/3D text, graphic, and keyframe animation software. The easy-to-use creation and playback graphics package is the premiere application for the Duet Video Graphics Engine. In addition, INFINIT! users can exchange messages directly into Lyric software, while Lyric can also be used off-line with Windows NT. With Duet, automation has never before been so simple. Basic web-style applications can be easily tailored to manipulate multiple clocks and ingest external data for real-time, automated display alongside Lyric.

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In the words of one customer, Chyron’s Duet running Lyric Character Generator and the Aprisa Video Graphics Server “lets us push out twice as much volume - all at the high standards our viewers expect. It allows us to not only maintain quality, but also to increase it.” Perhaps that’s why when more and more broadcasters take a closer look at Chyron’s powerful, integrated graphic solution, they like what they see.

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EEO rules invalidated

BY HARRY C. MARTIN

In a unanimous decision, the U.S. Court of Appeals for the District of Columbia Circuit vacated the EEO rules that became effective in April 2000. The Commission suspended the new rules effective Jan. 31.

While the Commission could appeal the court's decision, it is unlikely given Chairman William Kennard's departure and replacement by Chairman Michael Powell, a Republican. However, it is expected some public interest groups that participated in the case will appeal even if the Commission does not. This could delay the final demise of the rules.

In the meantime, broadcasters are not required to file Forms 396 (EEO Program Report filed with renewals), Form 396-A (Model EEO program filed with assignments, transfers and new applications), Form 397 (Statement of Compliance) or 395-B (Annual EEO Report). Annual Public File Reports are no longer required either.

The legal basis for the court's suspension was it found the EEO rules unconstitutional because they were not narrowly tailored to further a compelling governmental interest in preventing discrimination. Focusing on Option B of the Commission's rules, the court concluded the FCC's requirements pressured broadcasters to focus recruiting efforts on minorities and women to induce more applicants from those groups. In this connection, the court noted that the FCC had clearly indicated it would investigate any licensee that reported few or no employment applications from minorities or women.

The court said the requirement in Option B that licensees report the race of each applicant would be relevant to the prevention of discrimination only if the FCC assumed minority groups would respond to non-discriminatory recruitment efforts in some predetermined ratio, such as in proportion to their percentage of representation in the local work force. It was found any such assumption stood in direct opposition to the guarantee of equal protection under the Constitution.

Efforts to promote minority participation in the media are now being made in Congress, where various groups are seeking the reinstatement of the tax certificate program. Under the previous tax certificate program, companies that sold their stations to minority-controlled titles were eligible to defer payment of capital gains taxes. Also, in a statement released just before his departure, outgoing Chairman Kennard urged Congress to increase funding for the Telecommunications Development Fund, which provides capital for minority-owned and female-owned businesses.

Application deadline extended for Class A LPTVs

The Commission extended the deadline for eligible Class A LPTV stations to file license applications to 90 days after issuance of an order on reconsideration of the agency's LPTV Class A licensing rules. This could extend the deadline into late 2001.

Pursuant to an April 4, 2000 Report and Order that implemented the Community Broadcasters Protection Act of 1999 (CBPA), LPTV stations became eligible to convert from secondary status to the new Class A protected class created in the statute if the following was met during the 90 days preceding the date of enactment of the statute:

1. The station broadcast a minimum of 18 hours per day; (2) the station broadcast an average of at least three hours per week of programming produced within the market area served by the station, or the market area served by a group of commonly-controlled, low-power stations that carry common local programming produced within the market area served by such group; and (3) the station was in compliance with the Commission's requirements for LPTV stations.

In addition, the station must be in compliance with the Commission's operating rules for full-power television stations from its application date for the Class A license.

Licensees intending to seek the Class A designation were to file a certification of eligibility with the Commission no later than Jan. 28, 2000. Those licensees that filed timely certifications were to be allowed to file Class A applications up to six months after the rules adopted in the order were effective. This was on June 9, 2000, making the original application deadline Dec. 11, 2000. At the time, the Commission felt the six-month time frame was reasonable and provided ample time for eligible stations to prepare and file their Class A license applications. However, the Commission received several petitions for reconsideration that raised issues regarding everything from eligibility requirements to inter-ference and other engineering issues.

In order to give eligible LPTV licensees adequate time to prepare and file their Class A license applications consistent with any clarification or rule changes that may be adopted on reconsideration, the Commission has extended the filing deadline until the issues raised by the petitioners have been resolved.

Harry C. Martin is an attorney with Fletcher, Heald & Hildreth P.L.C., Arlington, VA.

Send questions and comments to: harry_martin@intertec.com
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Set top boxes uncovered
BY JIM BOSTON

It has recently been said that set top boxes are the next hot Internet appliances. Some would argue a killer app is also required to make the set top box (STB) pervasive. Set top boxes today have a wide range of architecture that designers can choose from. Some rely totally on hardware and firmware while others take a polar opposite approach by implementing what increasingly looks like a classic PC. Many are in between, using ASICs to implement DSP-like functions with a microprocessor interface to accomplish the required tasks. Part of this diversification is due to the fact that the market is divided into three parts depending on the type of network: satellite, cable and terrestrial. No matter what approach is taken there are similar functional blocks in every STB.

**Input**

The input to the STB differs based on what transport mechanism delivers the data to the box. DTV requires 8VSB demodulation (at least for now), DVB needs COFDM decoding, cable needs QAM, etc. Many today can handle more than one flavor of modulated data. Up front though, regardless what the RF modulation looks like, it is usually a tuner/channel equalizer ASIC.

Behind that is the application specific demod, or demods, as just mentioned. Next comes the MPEG demux chip. This ASIC breaks the MPEG transport stream into its separate packetized elementary streams (PES). The desired sets of PES are then sent to an MPEG-2 decoder, which generally operates as MP@ML (Main Profile @ Main Level), and an AC-3 decoder for the audio. The decoder decodes the set of PES (at least one video PES and one audio PES) based on information found in the program allocation table (PAT), which vectors the decoder to the proper program map table (PMT). The PMT lists all the PES that comprise a program. The STB’s system controller does this. The PAT containing the various PMTs indicating the associated PES are sent no more than 400ms apart.

From the video decoder the baseband video generally passes through a graphics controller that, depending on its complexity, is also known as a multimedia compositor. (See Figure 1.) Here is where menus, program guides and other services can be laid over decoded video. In fact many STBs today have modem ports or even network interface cards (NIC) to supply data that can be composed into a composite multimedia display that comes out the STB’s video out.

Many boxes today have security sub-sections. The open cable folks like to call this section the point of deployment (POD) module. Non-

Actually, there is no technical reason why a broadcaster could not install a personality in an STB that looked out for the interest of the broadcaster.

Figure 1. This simplified typical set-top box supports three types of cable signals: analog, digital and interactive digital transmission. The signals enter the digital tuner on the right, are demodulated and, if necessary, decrypted. Streams can be developed and routed to the multimedia compositor, an application-specific integrated circuit (ASIC) that develops the desired output signal format.
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sessions between an STB as both a client and a content-provider server. The STB OS will also manage the memory in the box. In essence, a single set of hardware can take on extremely different personalities with different applications loaded by various DBS and cable providers. Actually, there is no technical reason why a broadcaster could not install their desired personality in a STB that looked out for the interest of the broadcaster.

The STB is a logical candidate for the portal into the networked house of the future. Applications that would allow the box to act as a firewall, router and hub of an internal home Ethernet are currently being developed. Boxes are currently available that have modem and 1394 (Firewire) ports. In the future, it could be technically possible to connect multiple STBs together over Ethernet or 1394. This could solve the must carry issue for both the broadcaster and the cable operator, or the local into local issue for the DBS and the broadcaster.

Jim Boston is director of emerging technology for The Evers Group.

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LN1) with line number information in a binary code.

- Two words of cyclic redundancy codes (CRC). Two separate CRCs are calculated for the luminance data (YCR0 and YCR1) and color difference (CCR0 and CCR1)

Figure 1 shows details of the horizontal blanking interval for the luminance (Y) channel. Note that the capacity for carrying ancillary data varies from format to format.

Figure 2 shows a conceptual block diagram of an HDTV serializer. The serializer performs several functions:

- Each of the two-bit-parallel data streams is fed to a co-processor that inserts line number and CRC data. An additional co-processor may be used to insert ancillary data.
- The formatted bit-parallel data streams feed a multiplexer. The two 74.25Mwords/sec bit-parallel data streams Y and Ca/Ca are multiplexed word by word into a single 148.5Mwords/sec 10-bit parallel datastream in the order Ca, Y, Ca, Y, Ca, Y, Ca, Y and so on as shown in Figure 3. In this drawing the first row shows details of the horizontal blanking interval of the Y datastream. The second row shows details of the multiplexed Ca/Ca datastream. The structure of the multiplexed YCa,Ca datastream is shown in the bottom row.

- The output of the multiplexer feeds a parallel-to-serial converter whose output is an nonreturn to zero (NRZ) coded bit-serial datastream with 1.485Gb/s bit rate.
- The NRZ bit-serial signal feeds a scrambler that randomizes long sequences of zeros and ones.
- The scrambled NRZ datastream feeds an NRZ-to-NRZI converter, which converts long runs of ones to transitions, thus further helping the clock recovery process in the receiver.

The digital representation of analog video signals results in a specific number of samples per total line and a smaller number of samples per active line. The difference between the total line duration and the active line duration is an analog television legacy related to the necessity of formatting and transmitting an analog horizontal as well as vertical synchronization signal to ensure a correctly timed reproduction of the picture. Component digital television replaces the analog synchronizing signals with TRS. The EAV and SAV TRS have a duration of four words each or a total of eight words ensuring proper synchronization of the digital video signals. This leaves a considerable quantity of unused words in the horizontal and vertical blanking intervals for other uses such as the transport of ancillary data.

Source format D has a total line duration of 2200 samples, of which 1920 are active. This leaves 2200 - 1920 = 280 unused samples in each

Table 1. Source format parameters.

<table>
<thead>
<tr>
<th>Reference SMPTE Standard</th>
<th>260M</th>
<th>274M</th>
<th>295M</th>
<th>296M</th>
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<td>Format</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>Total lines per frame</td>
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<td>1125</td>
<td>1250</td>
<td>1125</td>
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<td>Y words per total line</td>
<td>2200</td>
<td>2200</td>
<td>2376</td>
<td>2200</td>
</tr>
<tr>
<td>Cb/Cr words per total line</td>
<td>2200</td>
<td>2200</td>
<td>2376</td>
<td>2200</td>
</tr>
<tr>
<td>Total active lines</td>
<td>1035</td>
<td>1035</td>
<td>1080</td>
<td>1080</td>
</tr>
<tr>
<td>Y words per active line</td>
<td>1920</td>
<td>1920</td>
<td>1920</td>
<td>1920</td>
</tr>
<tr>
<td>Cb/Cr words per active line</td>
<td>1920</td>
<td>1920</td>
<td>1920</td>
<td>1920</td>
</tr>
<tr>
<td>Frame rate (Hz)</td>
<td>30</td>
<td>30/N</td>
<td>25</td>
<td>30/N</td>
</tr>
<tr>
<td>Interface ratio</td>
<td>2:1</td>
<td>2:1</td>
<td>2:1</td>
<td>2:1</td>
</tr>
<tr>
<td>Divisor</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Serial bit-rate (Gb/s)</td>
<td>1.485</td>
<td>1.4835</td>
<td>1.485</td>
<td>1.4835</td>
</tr>
</tbody>
</table>

The capacity for carrying ancillary data varies from format to format.
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of the two datastreams (Y and Ca/Cr). As shown in Figure 3, the combined EAV, line number data (LN0 and LN1), error detection codes and SAV data amount to 12 words, leaving 268 Y words (numbered YA0 to YA267) and 268 Ca/Cr words (numbered CA0 to CA267) available for carrying horizontal ancillary data (HANC).

The vertical blanking duration is 45 lines for each of the two basic datastreams. Each active data line has a duration of 1920 Y data words (numbered YD0 to YD1919) and 1920 multiplexed Ca/Cr words (numbered CBDO to CBD959 and CBR0 to CBR959), which can be used to transmit vertical ancillary data (VANC).

In a future article we will describe the manner in which ancillary data are multiplexed into an HDTV data-stream.

Michael Robin, former engineer with the Canadian Broadcasting Corporation's engineering headquarters, is an independent broadcast consultant in Montreal, Canada. He is the co-author of Digital Television Fundamentals, published by McGraw-Hill.

The Second Edition of Michael Robin's book may be ordered directly from the publisher by calling 800-262-4729. It is also available from several booksellers.

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Figure 3. Formation of Y, CB, CR multiplexed datastream from separate Y and CB/CR datastreams.

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Help me," screamed the engineer from the graphics suite. His 20GB file had just failed to transfer twice to the post room storage, and Bobby, the editor, was screaming that our network sucks and it is nothing like the one at ABCD Productions. "Who created this garbage network anyway—a bunch of monkeys?"

Believe it or not, I recently heard a similar conversation as I was touring a friend's facility, looking at their new DVD production suites. Once we were out of the fray, I turned to him and asked what was going on. To me this looked like a new facility. After he gave me the history of the place—very interesting, it was actually an old firehouse—we got down to the network question.

I discovered that because of the way the facility's network had grown up over the years, it was actually a collection of networks as opposed to a single cohesive link. Sure you could move files around, but in the worst case they went from an AppleTalk network through a gateway to a switch out to a router then to a hub and finally to an artist's desktop. He had a mix of twisted pair, coax, Fiber Channel, 1394 and a Gigabit Ethernet switch they had just gotten in. What a mess! Does this sound familiar?

Networks that were once built to carry text are now being required to carry everything from graphics to real-time interactive HDTV. Walk into any post production/post room in the world and you'll see more computers than cameras. Whether video is initially created in digital format or not, digitization is a key part of virtually every production and post production process. We once thought AppleTalk could do it all, only to find out that 10 Base-T is useless and 100 Base-T is not much better. Gigabits Ethernet and ATM switches are where post production networks are happening today. More and more, our post networks are looking a lot like high-end telephone company backbone providers.

So my friend saw me snickering, as he was explaining all this and asked if I had a suggestion. In my most obnoxious voice I said "Throw it all out and start over." Of course management would not think of throwing out the device they paid $100k for, even if it is nearly worthless today. They figure, why should they if it isn't broken?

The challenge here was to take an overall view of the facility. We looked at their technology plan (amazing that they actually had one, but all facilities should) and where their customers were going to take them in the future. There seemed to be a growing need for more high def and even wide area connections to a planned remote facility and external partners.

So, over the course of the next two days, we worked out a plan to better utilize what equipment he already had and put a proposal together to migrate to a unified network. The first thing we did was segment his production processes into "islands" mainly based on bandwidth needs. This was actually quite obvious once we had a clean sheet to work with.

So we drew out a 100 Base-T Ethernet network for the mostly ProTools audio suites, using existing equipment around the facility. This included a 16-port switch and a number of hubs. We dedicated three ports for each of the four audio rooms and added a dedicated 16-port hub for each room (a total of 18 ports per room). The remaining four ports were saved for gateway functions.

The DVD room was already a self-contained network based on Gigabit Ethernet so we left it alone.

Next were the mighty editing suites—mostly digital equipment, but still with a little bit of analog gear just to make the old timers feel at home. This is where we actually had the most trouble. There was a lot of dedicated gear with dedicated interfaces and protocols, media file servers, NLEs, routers, switches (the video kind) and effects boxes. Here he had Fibre Channel for the media servers, Ethernet and ATM for the NLEs and effects.

### Media 100's iFinish4

Media 100 recently announced a streaming media production system for Windows 2000, iFinish4. iFinish4 is an interactive streaming media solution optimized for corporate networks. The package enables creative professionals to develop high-quality interactive streaming media (video and audio) content for delivery on the Web. Web designers can create content with which viewers can directly interact using EventStream, which allows them to embed interactive instructions directly into streaming media programs to trigger highly visual, content-rich capabilities, including graphics, Flash animations and Java applications—all synchronized with the video on the site.

Designers can define hot spots, URL flips and chapter marks that allow viewers to interact with the stream by clicking on objects to gather information, launch related websites from the video or even purchase items depicted in the content. Such capabilities are advancing interactive online advertising and e-commerce and raise interesting questions about revenue models for broadcast stations looking to generate revenue from streaming their content.

For more information, go to Media 100's website at www.media100.com.
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The recently completed center of worldwide activity for The Church of Jesus Christ of Latter-day Saints includes a nine million cubic foot world-class Conference Center featuring a 1.5 million square foot, 22,000-seat main hall equipped with HD, SD video and audio facilities. The same systems also service a 900-seat theater that is a part of the center. This project was unique in several technical respects, quite apart from its sheer physical size, which in itself presented significant economic and technological challenges. For example, live operations support simultaneous program dissemination in 60 languages. The studios are live-theater in nature and the main hall is among the largest and best equipped in the world. All command an audiophile state-of-the-art level of audio production and a similar level of excellence in video quality. Production in the center is distributed to literally millions of people worldwide, demanding fault tolerance and backup protection. As valuable Church history, the system also requires formatting and performance designed to support archiving in perpetuity. Live video programming from the center is produced simultaneously in both SD and HD while a third video path adds sign language as part of both distant and

Three views of The Conference Center across from Temple Square in Salt Lake City. The images throughout were captured from tape or live broadcast using an AJA video capture card.
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Audio

Within this environment of treasured spoken word and music, audio quality is of primary concern. The Conference Center has two separate operational groups for live broadcasting and sound reinforcement. Audio control consists of two broadcast audio live/post production rooms, theater sound reinforcement, hall house mix, hall sound reinforcement and stage monitor control consoles for both the main hall and the theater. In view of the larger broadcast audience and archiving issues, television broadcast audio operation maintains control of the microphone source splits and distribution levels, rather than the more common method of receiving splits from the sound reinforcement process.

While the intent was to employ standard analog formats and conventional mic/line levels throughout, the size of the venue and the large number of inputs, control rooms, language sources, studios, and campus and backup facilities produced a very large microphone distribution system. The volume of cable required by a traditional system argued for a design based on multiplexing these sources. This approach was supported by the cost convergence of contemporary analog and digital consoles and eventually mandated by economies of scale. A Euphonix C-5 Digital 24-bit system provided the solution to the cable volume issue by facilitating the implementation of MADI multiplexed transport via Lighthouse MADI fiber distribution. The C-5 and its I/O MADI multiplexers also provided a base from which all originating sources could be 24-bit and support up to a 96kHz sampling rate for live and post production.

As a result, all microphone sources are distributed via fiber links to the main hall and theater sound reinforcement consoles, while Euphonix MA-703 demultiplexing processors (MADI to analog) only transform the MADI stream to analog for the live auditorium and the present analog sound reinforcement consoles. Should those consoles be replaced in the future, the same transport structure can be used by exchanging the MA-703s for MD-704s with AES digital outputs. All audio

campus feeds. There are 63 miles of fiber and 234 miles of copper in the system within the building.

Other demanding aspects of the project included designing production rooms that served double-duty as post production rooms when offline, providing full custom control of all encryption and conditional access operations, integrating and supplementing existing facilities and operations, and meeting an absolute, historic and widely pre-publicized project timeline.
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would then be handled in the digital domain, including all facilities in the path from podium microphone, production audio, language control, routing switcher, campus distribution and master control right through to the inputs of the Divicom audio multiplexers for satellite transmission.

In the video control areas, all Dolby 5.1 surround audio monitoring is done by routing Dolby E signals to Dolby decoders. Monitoring levels and speaker selection is operator-selectable via switchers located in the main control deck.

**Video**

Notwithstanding the emphasis on audio, video quality was no less a concern. The live and post-produced programs are produced in a 16:9 aspect ratio, in both the HD and SD production rooms. These two rooms mirror each other and share a companion audio live/post production facility. Both rooms have nearly identical monitoring and the same control surfaces for ease of functionality: Sony BKDS7026 and HDS7000/DVS7250 production switchers with HDME700/DME7000 DMEs. An Evertz 7750 SRG-HD provides the tri-level sync signals necessary to properly lock the production room to the rest of the plant. There are several hundred Sony monitors in the facility, including BVMID24E1UW and BVMID24E1UW production evaluation units, and PFM510A1UW plasma screens. Pinnacle Lightning 500 still stores and Dekocharacter generators round out the production equipment complement.

Full tally and control systems are provided and aspect ratio is switchable in all applications. The available VTR formats are HDCAM 24p, HDCAM, Digital BetaCam, BetaCam SP, DVCPro, DV and S-VHS. Sony BVEF9100 editors have RS-422 machine control routed to all necessary machines through the 64x64 router in the Technical Operation Center. Leitch HD HSM 1600 DAs were employed exclusively for the wide number of splits required. An offline Avid room also has routable access to video and audio sources, and tape duplication is done with 60 Sony SVO 965 units.

Over 150 camera fiber drops were required to support activities in the main hall and theater, the studios, remote truck dock and existing campus studio facilities within Temple Square and the Church Office Building. Cable lengths were up to 2900 feet, and many would have required rewiring for HD if implemented in SD triax. As there was little difference between the pricing of SD and HD cameras, the decision was made to proceed with HD cameras now, rather than in the near future. However, a small triax infrastructure was also installed to satisfy the potential requirements of visiting mobile production units. The resultant design provided for twelve Sony HDCU-900A CCUs to power the HDC900/HDC950 cameras. These cameras provide 1080i video and are HD/SD and aspect ratio selectable. Many of the associated lenses are 60:1 to maximize coverage and to minimize the intrusive presence of the cameras. Up to six Vinten robotic heads are utilized including three fixed-position robotically raised pedestals that can extend to fifteen feet. Other robotic heads were installed in the theater in the LDS Church Office Building. From within the camera control room, robotic interfaces extend throughout the serviced areas into the main hall, the Church Office Building and Tabernacle. Monitoring for the four operating position SD and HD scopes and monitors is switched from an SD/HD Sony DVS-V322M/HDS-V322. Together these facilities ensure that video emanating from this room is of the highest quality.

Because the main hall makes it difficult for photographers to obtain good close-up photos during events, two HD workstations with AJA HD-NTV capture cards allow high-resolution pictures for
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printing and Internet posting. Image display for either side of the main hall and for the theater is provided by Digital Projection Lighting 15SX units.

Routing

The need for flexibility in use of the control rooms and campus feeds led to the routing of signals directly to all areas, rather than buffering each video source with distribution amplifiers, so as to support daily changes in individual facility usage. This decision, combined with the need to service many remote campus locations, dictated a large overall routing capability. Additionally, as program content evolved to include HD production, video layers for distributing both SD and HD were required.

Output program distribution consists of the main NTSC (continental American) feed and a time-delayed PAL (European, Pacific Rim etc.) feed as well as a backup stream flexible enough to cover for one or the other. Lighthouse Digital Systems provided the video router.

None of these requirements is static, and most change with each individual broadcast.

The Lighthouse OZ audio router operates without crosspoints as a full DSP router with a maximum I/O capacity of 2048x2048. All analog and digital formats are placed in memory along with digitized audio, TC, and RS 422 or any other control format. Essentially, any channel can be accessed by any other channel, regardless of format. As a result of the digital signal processing, all channels become effectively equal, AES pairing is eliminated and each AES channel can be treated as having stand-alone content. The OZ essentially replaces the function of system A/D or D/A by applying the source or destination audio format to the router I/O of choice.

The OZ router DSP can also multiplex any of the individual channels and group them into 96 or 64 channels in a MADI format. Lighthouse rate converts to create the 24-bit, 96kHz sampling that the Euphonix production audio consoles can process. This router's ability to multiplex 64 channels of audio and transport them via MADI streams made it possible to realize significant economies in language system cabling. For example, a satellite switcher can be placed at any remote site, connected via coax or fiber, and

As a result of the digital signal processing, all channels become effectively equal.

utilizing non-reclocking crosspoint technology. Their 622MHz SD router handles and directs SDI (at 143.270 and 360MHz), FDDI and data. The HD router is used for HDTV, Fibre Channel, SONET and SDI distribution.

Audio programming is unique in that the three program streams each have up to 60 associated languages. IDS specified that each of the three feeds should be content agile and that it should be able to assign different language complements to each output line. This required that a very large salvo switching capability be implemented. Master control salvo presets could employ up to 180 AES channels, with a similar complement switched to main and standby. Language multitrack recording required another 120 router outputs, in addition to campus feeds. With most campus locations still requiring analog audio signals, format agility and full breakaway capability, several more AES channels were required.

A portion of the 60 Sony SVO 965 duplication decks in the Central Equipment Room.
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operated as a 32x32 or 64x64 AES, or in any preferred 16-channel group. The satellite feed can be developed with structural blocks of 64 audio channels at a time. Lighthouse Satellite MADI (SMADI) handled the system and two different types of control panels, in addition to the JAVA based control system for router programming. Changes in the design of the video router and expansion of the capacity of the audio router made the delivered system unique. Nevertheless, it was delivered on a Friday, bolted into racks and attached to waiting cable systems that had been pre-built in the AZCAR plant in Markham, Canada.

The hook-up was completed in one day, the Lighthouse commissioning team performed full testing and departed on the following Friday, leaving a fully operational 256x256 SDI and 2048x2048 AES router that fits into just two 7-foot racks.

**Intercom**
Bob Breitenbeker established the LDS intercom specification early in the preliminary design process and clearly placed the goals of the theater design requirements into perspective. Theater environments employ extensive party-line systems that extend well beyond the usual broadcast studio applications. Typically, the theater staff prefers to share few channels, while broadcasters like quieter lines with specific addressing and control. In addition to typical broadcast needs, LDS needed separate party-line structures for two theaters and extensive interfaces to theater paging, wireless IFB, two-way radio and existing intercoms within their own campus, as well as communications with the local TV station.

While the use of digital matrices, with their simplified wiring, was considered, the requirement for full-bandwidth audio led to the choice of a ClearCom Matrix III to provide all necessary interfaces. Excluding custom panels, all of the equipment was provided off the shelf from ClearCom, and programming and training, like the system, proved trouble free. Seldom have the full capabilities of any similar system been exercised by broadcasters to such an extent. Seventy-two

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**Theater environments employ extensive party-line systems that extend well beyond the usual broadcast studio applications.**

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ports of the 200x200 matrix were occupied with intercom stations. An additional 20 ports were employed to service the party-line structures, while 10 more served the IFB groups. Another 20 ports serve cameras, two-way, paging, telephone, truck interface facilities, and intercom interface for the Tabernacle and communications with KSL-TV, the local NBC affiliate.

In each of the three main party-line structures eight programs are switched to any number of drops creating a party-line structure consisting of over 178 separate drops, with different configuration assignments. All of these were placed on custom-made panels with custom engraving provided by Bittree, with a fit and finish that was both functional and complementary to their elegant environment.

Master control

The master control system is also unique. There are three program streams of SD video, each including 60 channels of audio. The first program transmits live to Continental North America; the second is a PAL-converted, time-delayed stream intended for off-continent use. The latter stream typically originates from videotape recorded earlier, but the language complement may not be the same as that of the earlier program and plays back from a bank of synchronized PCM-800s.

The third stream is operated as a backup for either of the other two, together with any language mix necessary and is switched in concert with the real-time live content.

Standard master control processors have considerable bus structure requirements and usually have limited capability for audio channel processing. This application required a digital system that would provide single channel mono audio to support the multi-language requirement. No such switcher being available, Bytheway also designed a full breakaway AES switcher/processor made up of 6x1x4 modules that process the AES inputs as discrete audio channels with mixing capability and typical cross fades and on air control functions. This is a primarily GUI controlled system, although each program language channel can be switched manually from the front of the processor. It also has the additional feature that it can store a short audio program and repeatedly play it out for ID and test purposes.

A complementary 7x1 video switcher provides for the limited video switching necessary. Typical preview, program and clean feed outputs are included with limited titling inserted by Leitch downstream keyers into the largely pre-produced programming. As such, a single program bank is configured with one video processor and 15 audio processors. This necessitated networking of 48 individual processors for the switching of three video streams and 180 audio channels from the GUI interface.

As can be seen, the newest LDS facility in Salt Lake City is impressive on many fronts. It required, involved and crossed many disciplines, technologies and techniques. Indeed, those companies and individuals that were privileged to be drawn into the project can be proud of the new systems, structures and services that their work has made possible.

David George is a director and senior consultant, and Phil Livingston is vice president, technology of AZCAR. John Jay, project manager, and Joe Langel, project engineer, also contributed to the article.

Project team

Legacy Constructors, General Contractor

LDS
Loren Ashcraft, Director of Broadcast and Event Services
Terry Lamb, Broadcast Services Manager
Bob Breitenbeker, Management Level Liaison
David Bytheway, Primary Conceptual Designer
Audio, video and broadcast engineers: Milo Lefler, David Salmond and Del White

AZCAR
John Jay, Project Manager
Joe Langel, Project Engineering Lead
Andre VanKesteren, Director of Engineering
Greg Martin, Project Documentation
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WVPT-TV is the PBS station for the Shenandoah Valley and Charlottesville, VA. The station serves a total population of about a half-million in 22 rural counties with instructional programming, award-winning local productions, and high-profile community outreach activities.

While recognized for many years as a local leader, WVPT-TV has quickly gained statewide and even national exposure for its aggressive campaign to begin the transition to standard definition and HDTV formats. As such, this PBS station is among the first trailblazers to enter the digital realm in the state of Virginia.

Leitch digital synchronizers were used as bi-directional tie lines between the analog routing switcher and the new Pro-Bel 128x128 SPD router and master control switcher.
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The planning

Although WVPT is a small market station, covering the DMAs of Harrisonburg and Charlottesville, the management team was determined to think big from the start to ensure that viewers in this region have access to the same DTV technology and innovation found in larger markets like Los Angeles or New York.

Engineering contacted its counterparts at the other PBS stations in Virginia and began working with them to learn how their conversion plans were progressing. We needed to decide if any group purchases could be made and what interoperability was needed between stations. It is important to determine very early on what you plan to hand off to your neighbors: NTSC, serial digital, or HD compressed to 45Mb/s on a microwave or satellite?

Working with WVPT's Director of Development, we developed a case statement for local fundraising. It was important to state our needs for our capital planning so we could begin to actually realize the funding necessary from our local supporters.

We were determined not to sit back and let the big commercial stations have all the fun — a decision was made that we would be a leader in the local market and begin our conversion early. We quickly decided to move full speed ahead with our transition planning and began to craft a five-year business plan to put us on the road to digital.

WVPT's DTV team

WVPT formed a DTV team, made up of senior staff, to focus on all aspects of the planning. We conducted lengthy discussions with key personnel inside the station. What came out of the next few months' worth of meetings was quite exciting.

Everyone at the station developed a clear vision of how DTV would affect their department, their customers and our viewers. Each manager had excellent ideas and comments regarding possible program offerings and individual services. Each also had many outstanding ways to make this new unfunded federal mandate work to the good of WVPT viewers. We begin to think in terms of "bits is bucks," and how we should divide our 19.39Mb/s bitstream.

Because our goal was to build a facility that all departments will eventually use, we needed honest discussion and communication with all requirements stated. It really is up to you as a director, chief, or DTV superman...
Answering the right questions

Obviously, in order to specify, design and eventually install a new broadcast facility to replace our 30-year-old technology, we had to think outside of the box. Engineering management held several lengthy conversations, discussing every possibility from every angle. During subsequent meetings, we discussed our options even further.

Numerous questions began to arise from those meetings: Is it possible to build a facility capable of standard definition multicasting with data delivery during the day and deliver high-definition video with 5.1 audio in prime time? How about going completely digital from the time anything hits our building? What about tapeless (that is, playing back everything from a super server, rather than tape machines directly to air)? Can we co-brand each of the SD channels that leave the building? How about fully replicating the NTSC coverage area? Questions of manpower were also considered. We have two full-power transmitters and five low-power sites. It takes every engineer we have on board to maintain the studio, the transmitters, and provide support services to our customers in all other departments here at WVPT.

Timing is everything

So how was this task to occur? Of course, a project timeline was prepared. We originally looked at completing the total project in one phase. In a best-case scenario, we anticipated local, state and federal funding would be available at once. Therefore, a 30-page RFP was issued clearly detailing what we wanted to build.

It was time to look at replacing the station’s technical core routing, distribution and tape equipment, which...
meant replacing aging analog cameras with switchable 16:9 or 4:3 serial digital outputs. SD cameras were picked because of the type of productions we conduct in our local studio. It makes sense for us to do field recording in HD, but not a local auction or talking heads show. We needed to phase out our existing analog switchers, CGs and linear editing rooms, and move towards the nonlinear desktop editors. In addition to a complete studio facility, we looked at a virtual studio, HD production, and even a new building technical and office addition to accommodate the needs of DTV. It is clear that you must have a road map to where you are going and you must all go down the road together. We released the first RFP and issued a due date of Nov. 28, 1998.

After reviewing the RFP submissions it was clear we had some very good proposals from the various system integrators. Therefore, we organized a small core group from around the state to take site visits of the businesses who responded to the RFP. We traveled to selected locations the integrators had recently completed, and saw some pretty amazing facilities. All were serial digital and all were completed within budget, time and equipment availability restraints.

After reviewing the quotations, we rethought our plan of attack and decided to break the RFP into two distinct phases. First, the studio plant required the renovation of existing space and conversion of several conference rooms to technical space, with the addition of an entirely new technical office space. The second phase was RF or transmission. Both phases are equally important. One area most people at the station never see, but the other everyone comes in contact with every single day. We specified all uninterruptible power sources, generators, computer floor, multicasting, embedded audio, HD-ready and capable, and the list goes on and on.

As the fundraising picture came into focus, we realized that all funding wouldn't be available at once. It also turned out my existing analog routing switcher was beginning to fail periodically. So the project was further subdivided. Knowing that the old switcher and master control wouldn't make it another year, a breakaway Request for Quotation (RFQ) was issued for a new router, master control switcher, character generation and still store graphics chain. The project also included a QC point for ingestion to our existing video server and a master control QC point.

At the same time, we wanted to begin our format conversion and also have the ability to reuse any equipment that was purchased any time from fiscal year 2000 forward. This required some rather creative thinking over plans to meet the technical requirements, yet be easily moved to the newly renovated tech space once completed. We also wanted to ensure that each piece would build on the previously installed piece and not become obsolete before the entire project was completed.

Phase one

With the purchase in March of new technical core equipment and the subsequent installation and tie line interconnection, we were already prepared for DTV multicasting, analog-to-digital format conversion, and diversifying our technical operations. We have cut over to our new fully digital Chyron Pro-Bel routing and master control switcher. This new technical core features fully integrated switching and Leitch format conversion, and uses state-of-the-art embedded audio throughout the plant. We installed Inscriber character and still stores and networked both production and master control.

The first phase of studio conversion was awarded to The Whitlock Group broadcast & presentation solutions, a nationally recognized systems integrator. Their Digital Transition Team developed the award-winning bid by building a plant around the newly released universal format frame synchronizer by Leitch. This allowed us to cross convert everything as it entered or left the digital world and then reuse those pieces as required. We are currently switching everything in digital inside the WVPT
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plant and then converting it back to analog just before we feed the signal to our analog studio-to-transmitter link (STL). In the next few months, we plan to install digital capable microwave radios, allowing me to deliver a signal directly to the mountain site for both our analog and DTV transmitters. We have recently selected ADCs as our transmitter of choice for digital.

The Whitlock Group’s involvement in the project, therefore, included the system design, engineering and integration of an ITU-BT R.601 digital broadcast routing and master control infrastructure. One of the most critical aspects of the project was to seamlessly integrate the new system into our station’s existing analog plant. To do this, The Whitlock Group took advantage of the new Leitch digital synchronizers. The synchronizers were used as bi-directional tie lines between the analog routing switcher and the new Pro-Bel 128X128 SDI router and master control switcher. The process includes embedding and de-embedding audio as well as audio/video A/D and D/A conversion. The project was built and tested prior to shipment to our station to ensure a quick integration and minimum interference with existing operations. In order to provide staff training, the system was initially installed and commissioned without removing any existing equipment. Once training was completed, the master control console was moved to its final location, which allowed for a seamless transition to the new system. The Whitlock Group enabled WVPT-TV to design, install and migrate to an entirely digital technical core while still maintaining our current on-air program services. This was all done with absolutely no downtime. The facility has performed exactly as specified and we’re looking forward to the next phase of our conversion to digital.

The project was successfully completed in July of 2000.

RF phase

We now have now moved to the RF phase of the project. This means finalizing our DTV transmitter, antenna and MPEG encoder purchasing decisions. We will issue the purchase orders for equipment as the funding becomes available from local, state and federal sources.

The next specific steps in the process include installing new HVAC, electrical, and the technical grounding at Elliott Knob in Staunton, VA, for WVPT-DT and WVBY at Signal Knob in Front Royal, VA. We are in the National Astronomy’s “quiet zone,” so we have special considerations to keep the interference low as the government listens for extraterrestrial activity.

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It currently takes approximately six months from the time an order is placed for the transmitter, transmission line and antenna to be custom built, tuned and placed on a truck for shipment to the site. We will coordinate the construction of a new 40-foot tower at the mountain site to hold the new DTV antenna. After basic site requirements such as a new concrete pad, protective fencing and site prep are complete, we will install the following components: DTV transmitter, transmitter test and monitoring, transmission line and antenna, interconnecting digital microwave STLs, and transmitter remote control.

While this work is occurring on the mountain, we will simultaneously install the following equipment at the studio site: MPEG-2 encoding, PSIP generation and data delivery terminal gear equipment. Prior to live transmission on-air, we plan to conduct program tests and notify local hospitals and nursing homes of the DTV tests. Our projected on-air date is September of 2001.

Phase Two

Phase Two will include the installation of a 16x16 I/O super server, which talks to air and protect channels of automation and then automatically moves data files between a long form archive and back to the server. Simultaneously, a low-res copy is made of everything on the server so promotions, QC and corporate support can all see data at their local computer desktop.

The Whitlock Group’s Digital Transition Team is working with us to finalize interconnection plans and then install this new state-of-the-art equipment into our newly constructed technical operations center (TOC) once it’s complete. Stay tuned for additional news updates.

Everyone at WVPT-TV is determined to bring the very best in digital technology, digital programming, and digital services to the people of the Shenandoah Valley and Charlottesville.

In the digital age, one thing remains the same: WVPT is committed to using the expanded digital spectrum and the best technology available to advance our mission of education, culture and citizenship. This is truly an exciting time for WVPT and our viewers.

Tony Mancari, Sr., is vice president of Engineering/Operations for WVPT-TV.

---

The Whitlock Group

WVPT Engineering
Moss Bresnahan, President & General Manager
Tony Mancari, Vice President of Engineering/Operations
Tony Barrick, Chief Engineer
John Harper, Studio Supervisor
Scott Kessler, Broadcast & P.C. Network Systems
Fred Bosserman, Architect, APR Associates
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The STL debate goes on

BY DON MARKLEY

In what should be a quiet corner of the industry, a discussion seems to continue about systems for digital television. The argument seems to be that STLs won't work as well for digital television as they have for analog. However, the argument seems to be mainly built on fear and superstition rather than on sound engineering principles.

Some facts are evident. The systems for DTV do have a slightly lower value for power output and/or receiver threshold. This is primarily due to the bandwidth involved in such systems. Some of the manufacturers are using the same power amplifiers for DTV systems as were used in the existing analog radios. The increased bandwidth, especially in the dual systems where two signals occupy the same microwave channel, will normally lower the available power. This directly relates to the gain-bandwidth product that applies to any amplifier.

It is noted that the receiver threshold is a few dB poorer for DTV systems. Again, the bandwidth is increased to handle the requirements of the large data capacity required. An increase in bandwidth is always accompanied by an increase in noise that in turn raises the level of signal required at the receiver if the signal-to-noise ratio is to be unchanged. However, that doesn't mean that the system will be less usable or dependable. It simply means that a little more gain must be built into the system to maintain the same fade margin and reliability.

It is also interesting to note that the same difference of opinion seems to exist in STL systems as in the main broadcast signal. Manufacturers of STL systems are making use of different modulation schemes. Some are using an 8VSB system while others are using COFDM. They have their own reasons for the methods selected and are ready to defend their positions vigorously. However, both seem to work satisfactorily in STL service, which differs significantly from broadcast signals. In STL systems, the path is carefully designed to be free from obstacles, and the signal strengths are carefully calculated at the receiving point. There are no indoor antennas, nor do antennas move. Antenna orientation is controlled and fixed. In such an environment, the differences in modulation schemes seem to make less difference in the final system performance. This seems to be more of an argument for the salesmen to pursue than for the engineer to use in system design.

The primary factors in the system design continue to be the transmitting system output power, the path, the antenna systems and the receiver sensitivity. If those criteria are properly used to design a conservative link, the system should perform as well as the older analog systems.

In looking at some problems that have caused STL difficulties, one problem still exists. Numerous software programs are available that will perform a path plot. These programs all make use of either a 30-inch or a three-

Actual elevations can vary considerably from those spewed out by the computer, especially in very irregular terrain.
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In STL systems, the issue of which modulation scheme to use seems to be more of an argument for the salesmen to pursue than for the engineer to use in system design.

usually come with a 30-inch database, as it requires much less memory. On the other hand, the better (maybe) programs use a three-inch terrain database that is much larger and more expensive. While the databases are obviously different in the interval between points, they also differ in the maps from which the data is obtained.

Database information is also available with three-meter intervals between points. That data is obviously the most accurate available and was taken from 7.5-foot topographic maps. Unfortunately, that data requires an enormous amount of space and is very expensive. As a result of all of these differences, many paths are run using a 30-inch database and are assumed to be accurate. After all, the computer says it is so and who are we to question the computer. Right? The problem is that actual elevations can vary considerably from those spewed out by the computer, especially in very irregular terrain. The author has seen errors of over 100 feet in elevations in very rough terrain or in the vicinity of large terrain irregularities such as ridges or bluffs.

The solution is fairly simple. First, use the computer program and database of choice to run the desired path. Normally, there will be one or two points that control the receiver and transmitter elevations needed to provide a path that gives 0.6 Fresnel zone clearance over the ground (don't forget to include trees when applicable). The better programs will allow the user to identify the coordinates of such points.

Then refer back to the latest 7.5-foot topographic maps. Using the coordinates from the computer study, identify the point that is affecting the path and confirm the exact elevation. That elevation can then be added to the computer-generated plot to check for adequate path clearance. The same applies to the exact elevation of the ground at both the transmit and receive locations.

If there is still any worry about the elevation accuracy, go to the point that is in question with a calibrated alimeter and check the elevation yourself. The alimeter should be taken to the benchmark nearest to the point in question and set to the elevation of that benchmark. Then go to the point and record the elevation and then transfer that to the computer plot. If all of that doesn't work, you have really angered the terrain gods and there is no help for you.

Finally, your author has goofed (again). In a past article, the equation for determining path reliability was given as determined by Barnett and Vignants of Bell Telephone Laboratories. That equation may have been incorrectly printed. It should be as follows: \[ T = a x b x 2.5 x 10^{(a-b)} x f x D^3 x 10^{(a-F/10)}, \] where \( T \) = time out of service as a fraction; \( a = 4 \) for very smooth terrain including over water, 1 for average terrain with some roughness, and 1/4 for mountainous, very rough or very dry terrain; \( b = 1/2 \) for Gulf Coast or similar hot, humid area, 1/4 for normal interior temperate or northern areas and 1/8 for mountainous or very dry areas; \( f = \) frequency in GHz; \( F = \) fade margin in dB; and \( D = \) path length in miles.

Now, for the next goof — probably the dumbest of them all. The author recommended "Engineering Considerations for Microwave Systems," published by GTE Network Systems, as a reference for microwave path planners. That book is no longer in print. If you can find one on someone else's bookshelf, take it to the nearest copy machine. Otherwise, you are out of luck. However, other good reference books on microwave path planning are available. One is "Radiowave Propagation" by Lucien Boithias, which can be obtained from McGraw-Hill. Unfortunately, it is like most textbooks in that it tells you more than you really want to know. Yet, all of the good stuff is in there — you just have to hunt a bit.

Finally, the questions seem to keep on coming regarding STL systems. To help resolve those questions, the author offers this column as a medium to treat those issues. Let us hear from you regarding your experiences or questions concerning digital STL systems. We will attempt to either get answers for your problems or, at a minimum, offer them up for others to provide solutions based on their experiences.

Don Markley is president of D.L. Markley and Associates, Peoria, IL.

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The ins and outs of selecting a lens

BY DAVE WADDELL

Today's shooters are blessed with a variety of good cameras available from many manufacturers. These cameras vary greatly in price and performance but generally all make good pictures under ideal conditions.

The most common method of selecting a camera package is to first determine which camera is most suitable for the job and falls within a certain budget. This is sound reasoning; however, what is often forgotten is the lens can be — and often is — a major mistake.

For standard definition ENG/EFP cameras, lenses generally fall into three categories: package lenses, professional grade and broadcast grade lenses. The first and least expensive is the package lens. These lenses come packaged with the camera are generally designed to be just good enough to get by. Optical quality is marginal at best, and the mechanical aspects of the lens do not hold up well over an extended period of time. These lenses should be the choice for entry-level applications or for a situation where the camera and lens are expendable.

Professional grade lenses are the next step up and offer higher optical quality and much better mechanical strength. These lenses perform quite well in most applications and under moderate shooting conditions. Unlike the package lenses, professional grade lenses are available in various zoom ratios and focal lengths. In addition to more options, there are accessory items such as wide and telephoto converters and studio zoom and focus controls available. Professional grade lenses are designed for the mid-range cameras and, if taken care of properly, will give many years of good service.

Broadcast grade lenses are top-of-the-line in both optical quality and mechanical strength. They are designed to enhance the performance of the best cameras and to offer many years of reliable service under the harshest of conditions. News and production crews worldwide use broadcast lenses on virtually every kind of production. The newest broadcast lenses offer digital servos for faster, more precise zooms, and other digital features include quick zoom, cruise zoom, one-shot preset and RS-232 interface for remote control of zoom, focus and iris. When your livelihood depends on your equipment the broadcast grade lens is the only choice.

Camera manufacturers are currently offering dual-format products. These cameras allow the operator to choose between the long-time standard (4:3) and widescreen (16:9) aspect ratios. A sometimes-overlooked fact in most dual-format cameras is the loss in angle of view when in the 4:3 mode as compared to a standard 4:3 camera. This results in an image that is approximately 20 percent narrower than normally expected. For example, a lens with a focal length of 8mm on a standard 4:3 camera would exhibit an effective focal length of 9.6mm on the dual-format camera in the 4:3 mode. This can become a real problem if you are accustomed to shooting at the wide end of the zoom range. To correct these phenomena, there are lenses with built-in ratio converters that are easily switched in and out as needed to correct for the 20 percent difference in angle of view. Lenses with the built-in ratio converters are available in both professional and broadcast grade products.

Studio and field lenses

Both studio and field lens technology have made steady progress in the past few years. Studio lenses have become wider and field lenses longer. Present-day studio lenses feature focal lengths from 7mm to 168mm, while field lenses have gone from a standard 55X to an astounding 87X with focal lengths exceeding 2200mm.

Studio lenses are designed for close-up work with a minimum object distance (MOD) of less than three feet. The typical operating distance in an average broadcast news production is six to 10 feet. Because it is necessary for the anchor to read the teleprompter, any greater operating distance is usually prohibitive.

Field lenses are typically used for

Camera Four, shown here at the Meadowlands in East Rutherford, NJ, is situated behind the end zone and mounted on a tripod high in the stands. Camera Four is a Panasonic AQ-7200 studio camera with a Fujinon HA66x9.5 BESM high-definition lens.
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sporting events and large stage productions where camera placement is often a great distance from the action. Minimum object distance (MOD) of these lenses is typically in excess of six to 10 feet, rendering them useless in normal studio applications.

HDTV lenses
HDTV has been around in various forms for many years. However, until recently few pioneers were brave enough to purchase HD equipment. That is rapidly changing and has had a great impact on lenses. Contrary to some rumors, HDTV lenses are not handpicked from the NTSC production line. HDTV lenses are the result of many years of developing technology and are vastly different from NTSC lenses. Lenses for HDTV are designed for higher resolution and much lower chromatic aberration, and the mechanical tolerances are held to an absolute minimum. Because the HDTV format is wider than NTSC, the corner resolution has to be much higher. This is critical when projecting images onto a large screen. HDTV cameras and lenses are a large investment and should be evaluated closely. Be diligent in your evaluation and check out every possible resource available.

Portable HDTV lenses
Unlike NTSC lenses, HDTV lenses are only available in the highest performance. Like the Broadcast NTSC lenses, HDTV portable lenses feature the most advanced digital zoom servo system and the latest digital features. These exceptional products are available as wide-angle zoom lenses with focal lengths from 5mm to 50mm, standard focal length of 8mm to 120mm and telephoto with a range of 7.8mm to 156mm. HDTV is making inroads in feature film and nature show production and holds great promise for the future.

HD-digital cinema lenses
A relative newcomer to the HDTV market, digital cinema is rapidly becoming a reality. The recent introduction of the 24p HDTV camera has finally started to open some eyes. Several movie and TV specials have been produced in HD, and test shots are being performed almost daily. One of the hurdles in the film industry's acceptance of this format has been the lack of lenses, which are the style and quality that camera operators and producers are accustomed to. The recent introduction of lenses to fill these needs has been greeted with wide acceptance.

There are many different lenses available from various manufacturers, and they all serve a specific purpose. While it would be great if a lens could be designed to be all things to all people, that is not — and will never be — the case. When selecting a lens for your next camera or project, a great deal of thought should be put into how the lens will be used and what type of "look" you desire. If that lens is not correct for the application, the final results will surely be disappointing. But with the right camera/lens combination, what you capture on tape will not only match the view before you, but in some cases, what you reproduce on video will surpass what you saw through the viewfinder.

Dave Waddell is a marketing manager and South Central Regional Sales Manager for Fujinon Inc. Broadcast and Communications Products Division.
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To get the inside story on multichannel opportunities for broadcast, visit us on the web at www.seachangeinternational.com
The “new” manufacturer
BY RALPH STRADER

Ten or 15 years ago, terms like local area network, Internet, surround sound, DTV and streaming video were either unknown to most broadcasters or just beginning to emerge as potentially significant technologies. Now they are no longer seen as options to think about, but have become commonplace components of many broadcast operations — large, mid-sized or small.

This technology evolution has had two effects on broadcasting. It has enabled facilities to produce a better product, often in a faster and more cost-efficient method. But it’s also given broadcasters more to learn and be knowledgeable about. It’s not enough just to know broadcasting. Engineers today also have to be technology experts. Even more, they need to be savvy businesspeople, understanding capital justification, payback analysis and profit/loss ratios.

The net effect of this extra responsibility has been a strain on internal resources, many of which were already stretched to their limits. Following the trend of companies in just about every industry, broadcasters are streamlining their operations, whether that means downsizing internal resources, changing or cutting back on specific services, or consolidating the number of vendors or consultants they employ to use only those that provide the broadest range of services (one-stop shopping in a sense).

As a result, manufacturers are being called on more and more to augment the design process by working with stations on the more specialized aspects of their systems. By working closely with systems integrators, manufacturers have even become skilled in many of the tasks traditionally handled by systems integrators. This has helped to share the load of system design, especially as communications systems have grown more complex.

The need for increased third-party support and expertise is even greater in today’s competitive marketplace, to complement and further strengthen the qualified internal resources of many stations. In the past, it was enough to manufacture quality products, get them to market at a good price and have some type of customer service department. But the broadcast industry today is a different animal, and those elements are now simply the basic building blocks of a manufacturer’s scope of services.

This trend is apparent in every aspect of broadcasting, but focusing on one specific example — intercoms — provides a strong microcosm. As stations increasingly become parts of “groups,” intercom systems have to span multiple facilities and engineering areas. For example, during the 2000 campaign, NBC provided election coverage for NBC, MSNBC, CNBC, all owned-and-operated facilities and the Microsoft website. There was a different technical facility for each and they all had to be interconnected through communications.

Another example of where a manufacturer working closely with a systems integrator can be a critical element in a broadcast operation is the

Telex’s Willie Yau at work in the company’s Lincoln, NE, facility, where the company worked closely with NBC to develop the intercom and communications systems component of NBC’s “rack in a box” concept. Each “RIB” was a fully-wired subsystem loaded into one platform.
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recent trend of
the "centralized
control room." Operators
increasingly have
to manage inter-
com and commu-
ications sys-
tems that extend
beyond the walls
of one studio. Many broadcast
operations have
consolidated the
control of sev-
eral facilities into
one location. This type of oper-
ating structure
has several ben-
efits. Operators
are able to exer-
cise more control over the signals
they are delivering to their audi-
cences, and it creates a more efficient
way to manage an entire broadcast
network, since there is now one point
of management. And for operators
looking to upgrade their infrastruc-
tures to new technologies, this cen-
tralized model can also help ease
some of the costs associated with
these activities. Budgets have also gotten tighter
and, accordingly, so have the time-
frames for many projects. Stations
have to do more with less, in less
time. And they’re being pressured to
keep things under budget.
And what about facility up-
grades? They
mean more than simply buying
new products
and plugging
them in. There
are such issues to
contend with as achieving compati-
bility between newer digital gear
and older analog products. Choos-
ing the right product takes time,
and that’s a valuable commodity

NBC and Telex engineers were in close consultation during the design of the intercom and communications systems used for the 2000 Olympics. The systems were tested by NBC at Telex’s production facility in February 2000.
A lot has happened in between.

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that many engineers don't have, so manufacturers can lend assistance in this area. For example, a station that may be in a fully standard-definition environment knows it will have to eventually move to high definition. Or the infrastructure may be set up to handle 4:3 aspect ratios and manufacturers are being called upon to take on a larger role.

Manufacturers have also broadened the scope of their customer relations, helping customers understand what products can do and how they should choose and specify new systems. The first question a customer should be asked is: "What problems do you have that you expect the intercom to solve?" In other words, what are your goals?

This step comes even before budget, because you really can't make an intelligent budget decision until you know all the parameters in which you need to work. Once you understand those, then you can make informed budget compromises.

Many manufacturers recognize the need of broadcasters for increased design assistance, adding staff and resources specifically to provide design support for stations and systems integrators.

Change is inevitable, and necessary to the evolution of an industry. As the broadcast industry comes to terms with this, both manufacturers and facilities will need to work more closely together, as both explore their changing roles.

Ralph Strader is vice president, general manager, Intercoms, at Telex Communications.

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 Manufacturers have even become skilled in many of the tasks traditionally handled by systems integrators.

but the future is 16:9. The staff may not have the resources required to select the products that will help them complete these migrations cost-efficiently and quickly.

Finally, there are issues not only specific to broadcasters but to any professional looking to grow a business: limited layouts, outdated physical infrastructures, building codes and zoning restrictions that could prohibit relocation or expansion.

Stations all need specialized knowledge today. Are they adding staff with this expertise? Not all of them are, because they can't, so many stations are outsourcing these responsibilities.

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Hardly a day goes by when someone doesn't call me to announce that their company has the world's first "total solution" to something. By the time I hang up I'm usually still not convinced there was a problem in need of a solution.

Fortunately, there's the NAB convention. Nothing like the NAB show to force manufacturers to put up or shut up. Without the NAB deadline, I'm convinced we'd have half as many new products as we do now. But still, how do you get to see them all?

Well, Broadcast Engineering is here to help. Need some help with DTV technical issues? See page 92 for the DTV Answer Book. Want an advanced look at hot new products? That coverage begins on page 120. Lost? Check out the LVCC and Sands maps that are bound into this issue. And to make your trek more efficient, there is FASTtrack on 232.

So read on and enjoy. I'll see you at the show.

Brad Dick, Editor
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It has become obvious that the transition to digital is not without its sticking points. As you face the questions that every engineer faces, wouldn't it be nice to have someone who knew the answers, someone who really knew the answers, next to you to tell you what's going to happen to television in the next year? Two? Five?

How do you stream your signal to the Web? When do you seek out a systems integrator? When will consumers start watching? Is interactivity all it's cracked up to be? These are the questions you need to know the answer to today because they'll affect your tomorrow.

To keep you ahead of the curve, Broadcast Engineering once again presents The DTV Answer Book. Here we've collected answers to the above questions and more to help to guide you along the path to a successful transition.

These are the people who really know the answers, so read on. DTV won't wait any longer.

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What changes in newsroom operations has new technology brought to CNN?

BY GORDON CASTLE

Gordon Castle is senior vice president of Strategic Digital Systems for CNN.

Several years ago, CNN established a technology plan designed to create an all-digital production environment in which content and metadata is accessible to all CNN users and on all CNN distribution platforms. This multi-year plan is changing almost every aspect of CNN’s production system and, more importantly, the workflow. It is an enormous and challenging undertaking and one, in my estimation, that will put CNN in the forefront of production worldwide. CNN is altering the very core of its system requirements; our plans call for not just digital updates of existing equipment but, instead, we are leading technology providers to develop new systems and approaches.

A key aspect of CNN’s technology plan is a move to systems that handle video, audio and metadata as data files. This means, of course, that video servers will replace tape machines, and computer-based nonlinear editing will replace tape editing. It is easy to see how changes such as low-resolution browse systems, nonlinear editor and video servers provide more features and functionality than videotapes and analog equipment. Users can make changes more easily, share their work with more people and exchange files across systems from city to city. Important as these are, they are only surface-issue changes and do not unlock the real power of the new technology and the ways it will facilitate changes in production, publishing and broadcasting.

One of the key requirements of our technology plan is to couple changes in technology with changes in workflow. Seemingly simple changes or advancements in new technology may actually result in poor performance when put in place without careful consideration of the entire process. For example, a nonlinear system used for cuts-only editing that does not need to be re-edited for multiple versions can be handled faster by a tape-to-tape system. However, when coupled with new workflow and a supporting infrastructure that leverages the capabilities and extension of the content, nonlinear editing is a key component in a more effective and efficient production system.

The new production system we are building will enable CNN journalists to have greater access and better control of content. Our journalists and editors will be able research, access, create and modify all aspects of content from their desktop. And they will be able to create content that can be used in a variety of distribution platforms. Because the tools and digital media are more flexible and adaptive, we will be able to use a common infrastructure to both expand and refine the roles of the editorial and technical staffs.

In some cases, content will be produced by a single person or team and distributed on multiple platforms, such as on-air, online to a website and via satellite to a mobile phone. In other cases, users will focus production on a single aspect or type of distribution. The key is that the analog tape-based linear system mandates a workflow and production chain bounded by the limitation of the formats and equipment. Issues such as play speed, dubbing, transfer time, generational loss and inabilities to actively share material or work require elaborate and rigid workflow to be successful. This is particularly true in live 24-hour news. The design of the production systems at CNN and the other 32 services was based on rigid content and information flow and processes.

As we look forward and use the Internet as a guide, the future of content distribution and consumer experiences will require services that provide interactivity and personalization. The sources that provide this information will have to be extremely flexible. And this flexibility will need to be part of the technical systems and the workflow of the journalist creating the information. The new systems we have been installing during the last few years as part of the technology plan at CNN are all working to improve our flexibility. They will not only allow more flexible access and distribution of content, but they will also make it easier and faster for us to create new production steps or techniques and handle new distribution opportunities.

We are starting to digitize more than 115,000 hours of material in the new digital archive.

Digital servers in use today at CNN have already allowed for several important changes. We have been able to improve the regionalization of CNN’s International networks by allowing common content to be used more flexibly on the European, Asian and Latin American channels to better match the appropriate time zone. We have also been able to centralize our commercial operations and provide a central server for all finished daily news material that can be accessed by CNN, CNN International and CNN Headline News.

Our research and viewing systems have also changed and provide our journalists with greater access. Currently, 1500 hours of raw material are available on newsroom desktops at CNN Center in 1.5Mb/s MPEG-1. And we are starting to digitize more than 115,000 hours of material in the new digital archive, which will serve as the central
long-term storage and media management system for all areas of CNN. All material will be available as high resolution, low resolution and streaming resolution as data files and will be able to be researched by anyone in CNN.

As CNN continues to make technology changes and move more content production to digital systems, journalists, editors and technical staffers will be able to grow with the new systems. The staff at CNN will develop workflow that can take advantage of the power of the new systems and changed aspects of broadcast and Web publishing. We are actively refining our production processes and building requirements for the equipment of the future. New business and technology requirements, coupled with the new digital system, will allow us to deliver news and information even faster, more efficiently and more aggressively than ever.

Legacy engineering and business models must be revised as alternative entertainment and technologies compete for market share. Remember, just a couple of years ago the fighting words were convergence, extensible, open platform, and, worst of all, compression. At the 1996 NAB show, the thought of accepting compression of any kind on a video image was totally taboo. By 1999, compression was accepted as the norm and the issues were what type of compression each manufacturer applied and at what bit rate.

With the acceptance of compressed media, the next transition begins -- open platforms with media captured, stored, managed and shared as a file. With this philosophy, the movement of media throughout a facility doesn't

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**Why build now for digital?**

**GREG DOYLE**

Greg Doyle is president of Doyle Technology Consultants, Inc.

We have seen great promise with regard to technology, digital television and the future of broadcasting in general. As the transition to digital moves forward, many facilities have fully incorporated a digital infrastructure or islands of digital equipment in their plants. However, the full transition has barely begun. As the deadline imposed by the FCC approaches, less than 200 broadcasters are broadcasting a digital signal. Very few of these facilities have the capability to create HD images within their studios, or for that matter, even intend to do so in the future.

The initial move to digital meant dealing with 270Mb/s component digital video.

I designed my first fully digital facility in 1995 when the available equipment was cumbersome and challenging to work with. It also required us to compromise the desired functionality. The industry has managed to move through the initial digital conversion and new tools are available that allow stations to do much more than they were capable of doing in the composite analog world.
depend on a particular video format. It is a file, regardless of the resolution, frame rate or encoding scheme. While this is not realistic for real-time synchronous broadcasts, generators of content will thrive in this environment. Unfortunately most of the major video server manufacturers are not providing open connectivity to the storage side of the system. Currently, you will be required to purchase the storage solution directly from the manufacturer or their strategic partners. We do see this being whittled away slowly as more IT-savvy clients and system integrators demand these features. The next technical/business model is wide area connectivity to the storage devices.

The next technical/business model is wide area connectivity to the storage devices.

Over the last few years we have seen broadcasters consolidate their business model as they compete for programming and advertising revenue. For better or for worse, the day of the mom-and-pop broadcaster is rapidly disappearing. As broadcasters continue these consolidation models, I envision a consolidation of the technical model as well. For example, streaming media over the Internet works on the concept of “edge caching.” In other words, media is pushed across the Internet to points of presence (POP) in major cities throughout the country. This places the content geographically closer to the “last mile” for pickup by the viewer. The same technology can apply to broadcasters who have consolidated their operations from local engineering business models to centrally operated models. The local broadcaster now takes on the functionality of the POP via wide area connectivity and provides the cache along the edge. In this case the “edge” is the feed to the transmitter. Local insertion of advertising, news coverage etc. all reside within this server-based facility and are dropped in as scheduled. Business management and core programming are managed from the central offices of the newly formed networks.

Part of managing all of this media as data will require multiple servers for capture, storage and encoding purposes. In streaming media facilities and network operations centers we typically manage hundreds of servers, PCs and encoders using what we call a KVM matrix. This equipment allows us to route the keyboard, video and mouse of multiple servers to multiple user stations. These devices provide direct connectivity to the remote server including a hard-reboot, if necessary. Category 5 or Category 6 cable is used to connect users’ stations and servers to the matrix.

As new facilities are designed there will be three basic types of connectivity throughout the plant: wide bandwidth coaxial cable (for baseband audio and video); fiber; and Category 6 (or better) for network connectivity. Future designs must include demarcation points throughout the facility to break out or repurpose wiring infrastructure in order to accommodate continued changes in equipment or functionality. In the IT industry these are called an Independent Data Frame, or IDF closet. Basically it is a wiring closet that surrounds major areas throughout the facility. These areas are built adjacent to the central machine room, server farms and large work areas.

In the near future, look for super-wide bandwidth routing backbones that will allow very low data rates as well as full-bandwidth HDTV. Consider the possibility of multiple 4Mb/s pre-encoded transport streams arriving at your facility for re-transmission. This is very common at satellite facilities that handle incoming feeds as SMPTE310 or DVB-ASI. Along with these compressed transport streams comes the need for more advanced bit splicing tools able to perform cuts and transitions within the compressed stream.

In discussing this digital transition five years ago with a station director of engineering, he said, “The way things are going, in another five years, you’ll come in here and the only technical staff you’ll see is a manager of information systems, the director of engineering to keep the license up to date, and a shipping department for when things break.” He missed the date, but he was on the right track. The next technological wave I see coming to the broadcast facility is the movement of data, data storage and asset management. This will come in the form of IP network connected devices and file-based content on open platforms across network-based storage devices.

Webster’s Dictionary defines transition as: A passing from one condition, form, stage, activity, place, etc. to another. Regardless of the FCC mandate, competition and market conditions will require broadcasting to transition to a new business model, and new technology will be required to support this new model. The first step for the broadcaster to prepare for this next wave in technology is education. It is imperative that your staff has a basic understanding of network architecture, IP management, data storage, media archiving and asset management. Start now!
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First Sears Building Broadband Panel Array Antenna
How should a station engineer plan for the multi-step upgrades that most stations must use to become fully digital?

BY GUS ALLMANN

Gus Allmann is vice president and director of engineering for TV Magic, Inc.

Though questions remain about its particular manifestations, one thing for sure, digital television is coming and as broadcast engineers there are things that we can do to prepare for the inevitable.

• Have a plan – Gather as much information as possible about the direction your network or management is heading in terms of DTV and their expectations. Become part of the team. Capture the global picture and get it down on paper. Simple block diagrams, descriptive prose, wish lists, business plans, flow charts or just about anything you can document about where the station is heading will be enormously helpful. Develop your plan to at least the block diagram and signal flow level. As a systems integrator we are very big on having a process map on paper that takes all this into consideration. It makes it easier to see what must be done, and a plan evolves. It’s a lot less expensive to change paper than concrete, steel and equipment. Consider utilizing as many assets as you have now with a simple phased approach to adding the digital capabilities. The simplest plan might follow this path:

1. Establish digital transmission capability.
2. Upconvert present analog program to DTV signal that matches your network feed and switch the DTV formats to air with a simple 10x1 switcher. Downconvert digital-only programming to integrate with existing analog facility.
3. Build an HD-capable digital infrastructure even if you’re only planning to broadcast single or multichannel standard-definition digital programming.
4. Integrate existing analog signals necessary for the transition to the all-digital facility. Test analog and digital system off-line.
5. Cut over to the all-digital system and place on-air.
6. Re-purpose old analog system and components.

Having a plan that can move you from meeting the minimum requirements with a limited budget to creating a state-of-the-art facility capable of handling almost anything will ultimately save you time, money and what little hair you may have left.

• Transmission – You’re going to have to transmit digital signals. If you don’t already have a plan in place, it’s time to get moving. Many, if not most, broadcast facilities will have to add new antennas, transmitters and towers in addition to their analog transmission system in order to remain on-air while you’re building the digital transmission path. It takes a long time to design, get approvals, and build those new towers, antennas and transmitters for stations across the country. Best to get in the queue now.

• The digital infrastructure - A good thing about DTV is that most of the signals the engineer will have to deal with are in a serialized digital format. It can travel down coaxial cable and is easy to terminate. While the various forms of DTV can include a wide range of data rates, the future-proof model is to design and build for the highest data rates that commonly exist today. At present, uncompressed serial digital data rates approach 1.5Gb/s with bandwidth requirements approaching 2.4GHz. Remember our goal is to create a digital island or digital facility that can handle anything that management or technology may throw at it. Luckily these cabling and components exist today and don’t cost much more than what we have been using in the past. In the installation of any cabling system, the largest cost will be labor. It costs the same to pull, dress and terminate a cable/connector regardless of the material cost or quality. So put in the best components that exist and you won’t have to do it again for a long time. Be careful replacing existing analog cable with digital cable in the same system, the cable has a higher velocity of propagation and different loss characteristics so you may not time or equalize properly with your existing equipment.

• Routers – If you already have an analog routing system in place and are happy with it, there is no need to replace it. Adding serial digital video and audio levels to your router may be possible if you purchased one that can be field upgraded and the frame can handle the data rates intended. You can always add these levels as additional frames but that will depend on the router control system and whether the manufacturer offers those components. Worst case, you can purchase a new control system that will work with your existing router frames and also the new digital ones you plan to add. Make sure the digital router can handle uncompressed HDTV data rates and also the Asynchronous Inputs (ASI) generated by digital compressed satellite systems. Because you may be working with your existing analog router frames and using A/Ds and D/As for integration with your new digital router/
frames, make sure your control system has good path finding and tie-line management abilities. The user interface and how the router releases these tie lines are important.

- Switchers - If adding a digital production or master control switcher, choose one that will allow for multi-channel/multiformat operation with a single control panel. Some are networkable which can prove to be useful. Choose a multichannel standard-definition DTV format having the ability to control them from one or more locations. A switcher that integrates tightly with your router will make for a more flexible system. Make sure the DVE will be tightly integrated with the switcher. The master control switcher is the one that will have to be the most flexible. You may need to switch your analog signal simultaneously with your DTV signal for a while. The HDTV signal may come as multiple standards from various sources that change throughout the day. Consider these possibilities when developing an initial plan and be sure the switcher will be flexible enough to handle these additions or changes.

- Networks - This is one area that will grow tremendously. Because Ethernet will be around for a while, you should build a solid, upgradeable 10/100Mb switched network. Use CAT 5 or better cabling and patching capability, which should handle most of the near-term applications. News systems are using Ethernet to browse ingested materials to servers from client workstations, perform low-resolution editing, control play-to-air functions and many other critical tasks. Higher bandwidth networks are emerging, each with its own set of assets and liabilities. Optical and copper Fibre Channel is evolving; however, it is peculiar to certain integrated systems. Production and graphic systems are making good use of it but, as an installed topology, I would add these capabilities as they are required. I foresee the Network Analyzer becoming as common a piece of test equipment as your present waveform monitor and vectorscope.

- Video servers - They are here to stay and will probably replace most VTRs for anything but portable use. Most use serial digital as standard I/Os with some offering analog as well. Use the analog I/Os today while you build your digital infrastructure. Transport streams are beginning to be more common for I/O. Multiple format compression codecs are in use and compatibility is necessary if you want to share. Think this through carefully and consider all of your applications such as image quality, editing and recording non-synchronous feeds — they all don't perform the same. Also part of this game is storage for the servers. You'll never have enough storage, so analyze your requirements carefully. Plan for the inevitable growth. Leave space and allow for the AC power requirements and heat loads. Storage Area Networks (SANs) are getting popular for server and nonlinear edit file storage. Speed is important. File format compatibility between devices that share that storage is necessary and not always apparent, even between products by the same manufacturer that perform similar functions.

Near online storage and archival storage is a must as your storage needs grow.

DTV is happening. Embrace it. You’ll love it once you’re in and it’s just the kind of change you’ve been looking for. Treat it just like any other project that must be managed - plan it, organize it, implement the plan and control (refine) it. Be flexible because technology is changing quickly with fewer standards. Design for and build a solid infrastructure that can handle most anything that comes your way. Keep the pipes big and everything should fit down them. Leave room for expansion, if things get smaller or concentrated you gain space, if they grow, you have already planned for it and will accommodate it easily. Use a qualified systems integrator that works with many types of systems; their experience can be invaluable. Develop your plan NOW and don’t wait until management wants it yesterday.

“Why seek the help of a systems integrator for a convention like NAB?”

BY J.T. DUGGIN
J.T. Duggin is executive vice president and chief operating officer of Digital System Technology, Inc.

For someone looking to begin serious research into any range of audio and video equipment purchases, shows like NAB can be, to put it mildly, overwhelming. It’s like going to New York City for three days and blindly searching for all the best restaurants without any restaurant guides. You, may stumble across one or two very good places, but your chances of hitting a great place at every meal greatly increase if you consult the experts beforehand.

Try to stick with a systems integrator that represents an industry-wide, all-inclusive complement of equipment.

And your investment in a meal is considerably less significant than one in equipment, so it pays to consult with people who do this every day. Good systems integrators are committed to maintaining close relationships with their customers, so customers are always kept up to date on promising new technologies.

While integrators have no ties to specific manufacturers, we are in frequent communication with them and know the ins and outs of their product ranges and overall mechanics of their companies. Try to stick with a systems
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Good systems integrators keep current on all the latest developments, know the players involved and are tied in to noted industry professionals. Chances are that they’ve recently worked on a project similar to the one you’re calling about. Whether large or small, broadcast or webcast, corporate or a fixed venue installation, systems integrators are trained to address a broad range of integration issues. And this does not always mean a large-scale facility design and construction. Select systems integrators are also called upon for research, consultation and financial planning services as well as smaller-scale bench repair services.

Systems integrators perform a myriad of tasks, including designing and installing Internet streaming systems, microwave systems, automation systems, satellite earth stations, post production facilities, mobile television vehicles, network operation centers, systems maintenance, training operators, pre-building systems off-site and financial planning. And with broadcasters throughout the nation making the digital transition, systems integrators can easily clear the way down that path because they’ve been there many times before. Qualified systems integrators will get you safely and efficiently through the digital path due to their attention to detail and experience leading others in exactly the same direction.

Speak with a respected systems integrator prior to NAB. I guarantee the show will prove significantly more productive than it would otherwise. It will be like having the top New York Times restaurant critic personally escort you to the best restaurants in Manhattan.

What does a station need to consider upgrading to 5.1 audio?

By Ken Hunold

Kenneth Hunold is a broadcast applications engineer for Dolby Laboratories, Inc. in New York.

As stations put together their DTV facilities, many key questions need to be answered about the topology and capabilities of the system. These are often called “core” decisions, because they define the basic design strategies of the DTV station.

Consumers are being exposed to high quality audio via CD, DVD and now DTV and digital cable. Increasingly, these programs are multichannel (beyond stereo) particularly in the case of feature films, which have been almost routinely mixed in 5.1 over the past decade. Now, episodic shows for television are being released with 5.1-channel audio.

At the initial design stage, the choices between designing for minimal two-channel audio and designing for full six-channel audio (5.1 audio) are not that different. Tools exist (described below) to carry multichannel and/or multi-program audio over a traditional AES “pair.” These tools can also allow the DTV station to seamlessly integrate 5.1-channel audio into a nominally two-channel program stream.

For DTV audio, all stations should be implementing an AES digital audio infrastructure. A single “level” of AES digital routing is the minimum baseline capability that was assumed by the ATSC “Top Down” Committee in its examination of DTV station requirements. Often, stations will implement a two-level (four-channel) infrastructure because it matches the number of audio channels on broadcast VTRs. AES audio distribution allows for transparent and accurate audio distribution throughout the facility. It also future-proofs the station for further developments in audio and data transmission.

Dolby AC-3 is the audio standard in the ATSC television system. It is designed to carry from one to six (5.1) audio channels and can support multiple audio programs. This system is now called Dolby Digital, and consumers will often see references to this name on their DTV receivers as well as on their DVD players and cable set-top boxes. The station’s audio programs are encoded into Dolby Digital at (or near) the DTV video compression and transmission equipment. If the station is using the built-in encoder that is sometimes part of the video encoding system, these encoders are currently only two-channel encoders (i.e., mono or stereo.) If full 5.1-channel audio is desired, a separate 5.1-channel encoder (a Dolby DP569) will be required. It can encode any channel format from mono to 5.1 channels. The built-in encoder can still be used for encoding a second-language version of the program (similar to the SAP capabilities of the NTSC system) or any of the new auxiliary services such as descriptive video (visually impaired), hearing impaired, or emergency audio channels.

Program acquisition: If programs are delivered on videotape for local playback, this could exist as a separate multichannel audio tape (DA-88 or similar format) that must be synchronized to the video source (often a digital VTR). In this case, you must be able to lock the two transports to the same reference, and synchronize them using timecode or other means.

Multichannel audio programs could also be delivered on the same videotape as an encoded Dolby E signal. Dolby E allows up to eight channels of audio to be delivered via satellite or VTR, and can be carried on a single AES pair throughout your system. Broadcast networks and cable programmers are using the Dolby E format to store multichannel audio programs along with the video on the same videotape or video server. This simplifies routing, timing and synchronizing the combined elements throughout the system.

Monitoring: Monitoring the audio signal is important in any operation. Programs delivered to DTV stations by
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networks and others will almost certainly be delivered using digital sources (satellite, digital video server, etc.). Stations need to be able to monitor digital audio signals at many points in their facility, just as they monitor their programs today. Analog routing and distribution will not go away in the new DTV stations, it will just be relegated to "utility" routing and conference monitoring, rather than actual "on line" audio signals. Products are available from many manufacturers that handle monitoring of digital audio signals in ways that make the audio format transparent to the operator. Often it is as simple as ordering the digital version of the monitoring product. Stations that have made the transition to AES routing on their NTSC stations will already have experience with this. Products also exist to monitor and troubleshoot Dolby E, Dolby Digital and PCM signals carried on an AES link.

Local production and MCR: If the station wishes to do local 5.1-channel audio production, then traditional multichannel mixing and recording equipment could be used, along with a "widening" of the audio infrastructure within those operational areas.

The audio signals, whether they are 5.1 or stereo, only get encoded into Dolby Digital immediately before transmission to the viewer/listener. A full description of the Dolby Digital encoding process is beyond the scope of the question, but it is important that the programs be encoded with a "channel configuration" that accurately describes the program type. Stereo programs should be encoded as "2/0" and 5.1-channel programs should be encoded as "3/2L" (the "L" signifies the "0.1" LFE channel). This, and other encoder settings, aids the operation of the consumer's Dolby Digital decoder, routing the number of audio channels in the program to the (possibly fewer) number of speakers the consumer may have installed in their home. This could vary anywhere from mono or stereo speakers built into the DTV set to a full-blown Home Theatre installation.

If the station chooses to implement Dolby E, there are some unique capabilities of the DP572 Dolby E decoder that have special significance in Master Control operations. The "Voice Over" feature of the DP572 allows local voicecovers to be inserted over the 5.1 audio signal, or the audio source can be switched completely to a separate two-channel source. This is usually the station's normal stereo audio, and this can be used for local inserts, news or commercials. When the decoder has been told to switch to an external two-channel source, the Dolby Digital metadata will be changed to the proper mode for stereo operation. The voicecover feature can allow the Dolby E decoder to function as the audio section of the MCR switcher, delaying the requirement for full multichannel audio production facilities, at least in Master Control.

Audio monitoring in Master Control should be set up with a professional Dolby Digital decoder to properly monitor the signal in any format the listener may have. This includes mono, through stereo and surround, all the way up to 5.1, with a subwoofer. There are also graphic displays available to visually monitor the content and relative phase of the multichannel audio signal. If you feel that your master control area is not suitable for critical listening, consider outfitting a conference room (in addition to your control room) with a 5.1 monitoring system. If this is the same room where you entertain clients and screen their programs, it gives you a chance to view their programs and to demonstrate your audio capabilities in their best light.

The average station does not need to alter their planning all that much to include 5.1-channel audio programming as part of their schedule. As viewers are exposed to more and more 5.1-channel programs via DVD and digital cable, any lack of such programming on the DTV station will become apparent. As the infrastructure requirements are very similar, it is not that difficult to add 5.1-channel audio capability to your DTV station. By specifying the proper equipment now, you future-proof your facility by supporting 5.1-channel programs today.

More information about implementing the Dolby Digital DTV audio standard can be found in the Broadcast Implementation Guidelines, available from Dolby at www.dolby.com/tech/ddbigpr.pdf

For DTV audio, all stations should be implementing an AES digital audio infrastructure.

What should broadcasters do now to enter the world of streaming?

BY STEVE SULLIVAN

Steve Sullivan, co-founder of the Advanced Interactive Media Group, LLC, frequently writes about media trends and technology for various publications. He can be reached at sullivan@aim.com.

Back in September 1999 I was hired by a client to take a look at the concept of video streaming and the promise it held for television and radio news. A year and a half later, the project drags on like a bad cold, having been rewritten and revised multiple times as companies surge, merge and purge. If someone starting a similar study today came to me for advice, the best tip I could offer would be to make sure his or her pencil has a big eraser on it.

I began researching the issue at a convention where the
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exhibit floor was teeming with vendors eager to take a television or radio station's content and put it online for free. Each vendor earnestly and enthusiastically touted streaming media's potential in general and their company's plans to cash in on it in particular. The pitches were similar: Putting your news content online would be a great way to extend your brand into a new medium, expanding your audience and introducing bountiful new revenue streams.

By December 1999, out of the myriad search engines and aggregate sites, I had identified four companies to profile. Each had a distinctly different way it was going to handle streaming media and how it was going to monetize it. The four companies were FasTV, Zatso, BroadcastAmerica.com and Broadcast.com, which had just been sold to Yahoo for $5 billion.

Conceptually, all the companies had exciting ideas. Each planned to take an on-air product and make it available, either in whole or in part, via the Internet. In some cases the product was streamed live. In some cases the on-air product was archived for playback on demand in its entirety. In some cases the on-air product was repackaged for customized on-demand playback. In all cases, these companies felt there would be great and growing demand for any of these products, and they were willing to take the risk to give away the technology and manpower in exchange for the chance to make money with it.

The greatest risk for a television or radio station was to do nothing. Getting involved meant very little effort other than handing over content. The services would do all or most of the work to get the product online and would even sell or help sell it to advertisers.

There was tremendous interest from the content providers. Broadcast.com and BroadcastAmerica.com boasted streams from hundreds of stations. Unfortunately, there was not tremendous interest from advertisers or viewers. FasTV went down first, in July 2000. Zatso ceased operations last October. BroadcastAmerica.com declared bankruptcy in December. And while Broadcast.com still exists, Yahoo has relegated it to white-elephant status, seeming not to know what to do with it.

The past year's mayhem sends two clear messages. First, audiences have thus far been slow to embrace video in the online world. Second, investors are much less likely to wait patiently for advertisers to warm up to the concept.

The slow deployment of broadband hasn't helped matters. For instance, I live four miles outside the city limits of Austin, TX, one of the most wired high-tech cities in the world. But neither my telco nor my cable company has yet to provide high-speed service to my neighborhood.

Even the availability of broadband doesn't guarantee an audience. While online video is intriguing for a while, it's not very compelling. It's not fun to sit there looking at a monitor with a two-inch by two-inch streaming video on it. Advertisers are content playing a waiting game. Because

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there isn’t a mass audience, you’re not going to get the attention of branding-type companies like Coca-Cola that would spend a half million dollars just to get their name out. So you’re left trying to compete for advertising with other sites that are just as screwed as you are.

Although I’m a lot less naïve than I was a year and a half ago when I began looking at the issue, I still think that one day streaming media will play a strategically valuable role for broadcasters. Until that day arrives, however, you simply can’t kick back and ignore it. This is the perfect time for you to be doing your homework. Here are a few things you can do:

Keep an eye on what others are doing with their streaming: Make notes on who’s doing it, how they’re doing it and where they’re doing it. Good places to start are supersites like CNN.com and MSNBC.com. Both use plenty of video and often creatively package it. And don’t limit yourself to television sites. Newspaper and radio sites are drooling at the chance to add video to their traditional content. Take a look at a major site like washingtonpost.com and a small-market radio site like wjsm.com in Benton Harbor, MI. Both destinations frequently put video content front and center and are anxiously awaiting the opportunity to do more.

Check status of broadband deployment in your area: Have either the telephone company or the cable providers saturated your community with high-speed connectivity? If not, do they have a timetable for doing so?

Know your local demographics: Even if broadband is widely available, are the locals likely to use it?

Determine what you would stream: Streaming, like multicasting, becomes a benefit to you only if you have something to offer. Do you simply want to simulcast or rerun your on-air product? Will you repack your material you’ve already aired? Will you create something new expressly for the stream?

Get your contracts in order: Under your current contracts do you even have the right to stream your content? What can you use and what’s off limits? Make sure you fully understand how streaming might impact your current contracts with content services, freelancers and stringers, talent and even advertisers.

There was tremendous interest from the content providers. Unfortunately, there was not tremendous interest from advertisers or viewers.

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Weigh the expense of doing it against the return: The Internet is tough to sell in the best of times and requires a new and different mindset on the part of your sales staff. In the absence of vendors who will stream your signal for free, you get stuck with the costs for encoding, servers and bandwidth, plus any dedicated personnel. Will it be worth the investment?

Keep an eye on developments in technology: This ties into broadband penetration, as well as improvements in player platforms and developments in mobile technology. There's a real possibility that streaming video may ultimately be a more viable product on a PDA than a PC.

And again, the most important advice of all is keep that eraser handy.

What benefits do interactive and enhanced TV services provide?

BY JEREMY THORP
Jeremy Thorp is chief technology officer of Tandberg Television.

While the number of viewers engaged in interactive or enhanced television programming has not yet achieved a considerable mass throughout the world, it is an application whose time has clearly come. The benefits are clear, with new revenue generating services and increasingly more attractive and targeted advertising meaning that the payoff to broadcasters and their advertising clients will be huge. Currently, the delay in making this dollar-inducing nirvana available is in equal parts a content and a technology issue.

Internet or TV?

When we talk about interactive and enhanced TV content there really are two areas: Internet-type applications on TV and TV programming enhanced with interactivity.

Many pundits are exploring how can we transfer the two-way user experience of the Web, to make the Internet work on TV. I would ask the question “does the Internet work on the Internet?” Interactive TV does offer the opportunity to convert Internet content into interactive TV content, but only good Internet content will make compelling interactive TV. Further, does Internet on TV equal TV on Internet? It certainly provides an opportunity for broadcasters to be portals and use identical business models to ISP/portals with transaction-based activity and Web-style advertising, which can be targeted according to personal profile.

The challenge of delivering Internet applications to TV is largely solved. The challenge of keeping up with the latest PC ‘plug-in’ technology in the low-cost set-top box platform will remain an ongoing one. The “PC or TV” debate will continue as content from the Internet is repurposed for TV in order to meet demand. Regional variations on the penetration of PCs and digital TV will be the major driver. Usage scenarios for in-depth information/Internet browsing starts to preclude living room-based, shared entertainment devices (i.e. TVs) and the integrated home network will see a number of different devices linked to provide solutions for different types of interaction.

Enhanced programming

TV programming enhanced with interactivity is a whole new TV genre, extending choice into a new dimension and offering time-based data/information/transactional services. Rather than numbers of programs you get more functionality, for example different views for a sports events. Rather than being able to look at an online catalog and buy a CD, you can buy the actual CD being plugged on MTV or the watches worn by actors in sitcoms. Instead of one ad being delivered to the whole audience the advertising may be targeted according to your profile derived from your viewing, online and response activity.

Technically, enhanced interactive TV programming is a much greater challenge because of the synchronization of different content types. In traditional TV it is annoying when sound and video get disjointed — but how are TV viewers going to feel if they click to order the fine wine Frasier is drinking and receive his father’s beer? The need to synchronize and integrate video and audio with data, middleware and back-end T-commerce solutions becomes imperative.

None of the areas have proven to be solid revenue models and the challenge to the interactive TV community is to create major stickiness factors, not just transfer the Internet onto TV. If the appeal is not there, viewers may choose to stick to a company who gives them great movies, offers good internet access, helps them quickly find data services (weather, shares, traffic) using a nice portal, and deals with their e-mail swiftly. Broadcasters will lose out on the enhanced appeal of multiview services and the revenue opportunities that program driven impulse buys provide.

The need to create once, distribute everywhere requires a high degree of integration.

Moreover, with an increasingly segmented viewership, content for each audience base must be created, making the sheer volume of content needed difficult in terms of cost and time to produce. There will surely be faster, less expensive ways to produce advertisements...
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and programming catered to interactive TV in the future. Advertising must be designed to work in a hybrid, integrated environment that incorporates the best of advertising with the best of broadcast television. Responses will be generated and fed back to the advertiser with technology developed specifically for this application. The bottom line is that advertisers are trying to deliver the greatest impact to as many people as possible at minimum cost, something which traditional analog TV is pretty good at, but with maximum targeting, which old TV wasn’t good at.

The shift from mass market advertising to a more focused and response-based process represents a fundamental change in the companies that will advertise and the way consumers will see advertising in the future. Up until six months ago, advertising agencies seemed to have taken a low-key approach to interactivity. Now I clearly see that they have begun speaking to this arena, analyzing the value that interactive advertising can deliver and working with interactive broadcasters to develop creative campaigns for their clients.

On the entertainment side, the advantages of interactivity to the viewer are great. They receive an enhanced, more participatory experience and can tailor it to provide the type of programming and information they request. But because there is very little large-scale deployment of services offering enhanced programming to customers, we can only speculate today about what viewers want. A diverse range of programs will be created, but only the quality content that catches the imagination of the audience will survive.

Technology solutions through partnerships

From a technology perspective the challenges for delivering interactive content are complex. TV channels run on multiple distribution systems, satellite, terrestrial, cable and broadband IP and these must be integrated to make the enhanced broadcast on an individual channel work for the whole audience. The need to create, distribute everywhere requires a high degree of integration. It still contains the same complexities of a single broadcast but adds into the equation delivery over different platforms and the management of multiple two-way response paths. In addition, just as traditional broadcast requires frame accurate insertion of advertising, so does interactive television.

One of the new benefits of interactive TV will be to forge alliances between previously un-thought-of partners. Technology providers will work closer than ever with content owners, TV producers and broadcasters, middleware developers will create alliances with compression experts, and Internet companies will partner with broadcast specialists to harness the potential of broadcast television.

Now that the COFDM/8VSB debate is over, what roadblocks remain for large-scale consumer acceptance of DTV? Will the 2006 deadline remain or are delays looming?

BY RICHARD M. LEWIS

Richard M. Lewis is senior vice president of technology and research for Zenith Electronics Corp.

With the certainty of a single digital television (DTV) broadcast standard in place, all industries need to move forward cooperatively to make DTV a reality for U.S. consumers.

As one of the original developers of DTV technology in general and inventor of the vestigial sideband (VSB) transmission system in particular, we were understandably pleased by the recent reaffirmation of the ATSC standard by broadcasters and the FCC. That is not to say that we should not continue to explore possible enhancements in VS performance or address broadcasters’ changing needs. Indeed, a number of U.S. receiver manufacturers and chip making labs are moving full speed ahead with improved designs for standard applications as well as proposing extensions to provide additional robustness and flexibility. And, because the ATSC standard was designed to offer plenty of headroom, we are confident that future VSB enhancements will be adopted.

With the transmission standards dispute behind us, what are the remaining roadblocks to widespread DTV acceptance? There are four: (1) the lack of compelling digital content; (2) affordability of consumer equipment; (3) cable carriage and interoperability issues, and (4) the digital copyright protection situation. Not surprisingly, these issues cut across multiple industries — broadcast, consumer electronics, cable and programming — and therefore pose some thorny challenges for both the private sector and U.S. policymakers.

Broadcaster momentum

U.S. broadcasters have made impressive strides in terms of investing in digital TV transmission equipment. With more than 180 stations currently broadcasting a digital television signal, the industry is far outpacing the DTV transition timetable established by the FCC. While some stations have encountered problems relating to tower siting, construction and the like, the vast majority of major network affiliates in the 30 largest media markets are broadcasting in digital. And special credit goes to the growing number of stations in smaller markets — such as Quincy, IL. (number 161) and Salisbury, MD. (number
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162) — that have begun DTV broadcasting well in advance of the government-mandated schedule.

The 2006 deadline for effecting the digital conversion remains possible, at least theoretically and assuming that the key industries come together to reach agreement on the previously listed issues. The real barrier to this timetable is that the transition has not yet captured the hearts and minds of American consumers. Consumers need a reason and the means to adopt this new technology. Without compelling content, be it HDTV or datacasting or other new applications, DTV will flounder. Without equipment that the average consumer can afford, DTV will become a footnote in the digital age.

Content is king
Where broadcasters can do their part is in the all-important area of digital programming, a critical element in the overall DTV equation. Despite the leadership provided by CBS, which accounts for the lion's share of high-definition television (HDTV) programming, the major commercial networks have yet to feed, let alone originate, their fair share of digital content. In addition to its commitment to prime-time programs in HD, CBS has offered an unequaled amount of HDTV sports programming, including the AFC playoffs, the Super Bowl, the Masters and the NCAA Final Four.

Were it not for the efforts of CBS, PBS and a small number of independents, the early adopter would have virtually nothing to watch in true HDTV. Besides HDTV, innovative applications of multiple standard-definition television (SDTV) and datacasting may also prove compelling and help drive the DTV market. The larger point is that absent far greater amounts of compelling digital content, consumers have little incentive to make the investment in digital television equipment, especially at today's price points.

More-affordable receivers coming
Given the paucity of digital programming, it is nothing less than remarkable that initial sales of consumer DTV equipment have posted such respectable numbers. According to the Consumer Electronics Association (CEA), nearly 650,000 DTV displays and receivers were sold last year, and CEA predicts the figure will top 1 million units this year. This sales curve compares favorably with that of color TV, for example, which needed a full decade to reach sales of a million units annually. Many will point to the small number of tuners as an indication of DTV's failure, but we feel that the high number of sales of digital-ready sets proves consumers are ready and want DTV. The industry just needs to give them a reason to go out and buy that tuner or integrated set.

Cable, Hollywood cooperation needed
With some 70 percent of all U.S. TV households getting their local, over-the-air stations via cable, the cable industry also needs to be on board if the digital television transition is to prove successful. Headway is being made on the issue of compatibility between cable equipment and consumer electronics products.

The digital must-carry controversy, on the other hand, has proven far more difficult. Ignoring the pleas of broadcasters that cable companies should be required to carry each station's analog and digital signals during the transition, the FCC ruled preliminarily that cable operators must carry only one or the other. Logically, if a broadcaster is only upconverting analog content it is hard to understand why a cable company should be required to carry two versions of the same content. On the other hand, if the broadcaster is providing HDTV or SD with additional data content, the consumer is provided with benefit beyond analog television. In this case it is hard to see why the cable company should not provide the full, undiluted benefits of broadcast-quality DTV or true digital HDTV. This paradox represents a huge potential barrier on the road to digital television.

No one said that the transition to digital television would be easy. We have known all along that broadcasters, manufacturers, cable operators and Hollywood would have to work together to shape the kinds of lasting solutions that will allow this fledging medium to succeed. Now that the transmission standards debate is behind us, resolving these few remaining issues will help deliver digital television to consumers who, in the end, will determine the true success of the DTV transition.

ATSC initiatives for the DTV buildout

BY MARK RICHER
Mark Richer is the executive director, ATSC, Washington, D.C.

Although the basic standards that define DTV were completed several years ago, work continues to refine the system and expand the suite of functions and features enabled by the digital television system. The Advanced Television Systems Committee has a number of major initiatives underway now intended to increase the competitive edge of DTV. The ATSC, an international non-profit organization developing voluntary standards for digital television, has over 200 member organizations representing the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

The work of the ATSC is carried out by scores of top engineers from companies around the world who dedicate their time to develop and refine standards for the DTV environment. More than a dozen committees are active within the ATSC, addressing a wide array of subjects. At present, the three most visible efforts include:
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The DTV Application Software Environment (DASE) is a classic example of the flexibility of the ATSC DTV system. The DASE standard will define a software layer (middleware) that allows programming content and applications to run on a "common receiver." Interactive and enhanced applications need access to common receiver features in a platform-independent manner. This standard will provide enhanced and interactive content creators the specifications necessary to ensure that their applications and data will run uniformly on all brands and models of receivers. Manufacturers will be able to choose hardware platforms and operating systems for receivers, but provide the commonality necessary to support applications made by many content creators.

The DASE undertaking is enormous; the effort — which began three years ago — is nearing completion. The DASE standard is composed of a suite of standards documents. Five of the eight documents have been developed and are now in their first ballot/comment period. It is expected that the entire DASE suite will be finalized and approved by the full ATSC membership later this year.

**Interactive services**

The work on interactive services is intended to define session-level protocols carried over interaction channels associated with interactive services. The interaction channel may be one- or two-way and connects a user (operating through a DTV receiver) with a service provider. The ATSC Interactive Services Protocols are intended to operate on a variety of physical networks, by focusing on higher layer protocols but not addressing specific applications. Work on this project is ongoing, with completion slated for later this year.

**VSB enhancements**

Recent studies have proven that the 8VSB modulation system is clearly the best choice for broadcasters. Still, the need for better receivers and — possibly — enhancements to the transmitted signal itself have been identified as an important area for further study. Responding to the evolving needs of broadcasters, the ATSC has initiated standards activity aimed at enhancing the VSB modulation specifications that
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are a part of the ATSC Digital Television standard (document A/53 and others). The new effort, being carried out by specialist group T3/S9, is intended to improve reception by fixed and indoor receivers, and to give broadcasters additional flexibility — including the ability to transmit programming and data to portable and mobile receivers. The effort by T3/S9 is moving forward in parallel with the DTV implementation process already well underway.

The first step in this effort was the issuance of a request for proposals (RFP) that seeks to identify possible approaches. A number of DTV receiver and chipset manufacturers, among others, have indicated they will respond with formal submissions.

While the RFP applies to compatible through non-compatible VSB enhancements, the highest priority is placed on compatible 8VSB enhancements. The RFP invites proposals covering a wide range of technologies involving modulation and/or payload enhancements; for example, adding training signals or other data intended to improve performance of the overall system. The compatible improvement of fixed and indoor 8VSB terrestrial DTV service is the top priority of this work.

In addition to fixed and indoor service, other service modes have been identified as desirable, including:

- **Portable service:** a transmission/reception system that will allow the receiving device to be moved from place-to-place, using a self-contained antenna, but which remains essentially stationary during operation.
- **Pedestrian service:** a transmission/reception system that will allow a receiver with a self-contained antenna to operate successfully while the receiver is moving at speeds up to 5 kilometers per hour.
- **Mobile service:** a transmission/reception system that will allow successful operation of a receiving device at speeds greater than 5 kilometers per hour.
- **On-channel signal boosters and repeaters:** systems that permit the reception of DTV signals in areas where signal shading from terrain or man-made objects make reception difficult.

The T3/S9 VSB enhancement project is on an aggressive schedule. Critical landmarks include the following:

- **Invitation to present proposals sent to proponents:** May 2, 2001
  - Selection of technology for field tests: Sept. 14, 2001
  - Field tests begin: Nov. 14, 2001
  - Review of field tests: Jan. 15, 2002
  - Adoption of Standard or Revision to A/53 by T3/S9: Jan. 31, 2002

It should be noted that this schedule will be reviewed on a regular basis by T3/S9 and may be amended, if necessary.

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800-ACDC-LUX; 805-482-4820; fax: 805-482-0736; www.cool-lux.com

\textbf{Booth: R2009 Circle (508) on Free Info Card}

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Designed for chromakey, set wall lighting or cyclorama lighting applications; ideal for low grid and ceiling installations; 110-watt light uses an asymmetric throw of light for smooth even lighting; unit utilizes two 55-watt T-5 Biax lamps; available with analog or DMX dimming or non-dimming.

650-356-0921; fax: 650-356-0931; www.videssence.tv

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microwave, fiber optic, telco

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858-450-0143; fax: 858-450-0155; www.opticomm.com
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Thomson Broadcast/Nextream DBX 4300 Broadmux:
Re-multiplexing solution for Digital Broadcasting Centre and Distribution applications such as DVB-S, DVB-C, DVB-T; multiplexes up to 26 MPEG-2 single or multiple service transport stream to form a multiple program transport stream.
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www.pinnaclesys.com
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949-757-0488; fax: 949-757-0489; www.tandbergtv.com
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PORTABLE MEDIA DELIVERY SYSTEM

Telestream ClipRemote:
Allows for the transmission of broadcast-quality video and audio directly from remote sites to receiving stations; housed in a rugged, lightweight, shock/weather-resistant case for use in the field; system acquires media from standard news-gathering sources and encodes it to MPEG files; uses synchronous serial data interfaces for direct connection to remote transmission systems.

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413-569-0116; fax: 413-569-0679; www.thomcastcom.com
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Thomcast Communications Amethyst:
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413-569-0116; fax: 413-569-0679; www.thomcastcom.com
Booth: L9000 Circle (532) on Free Info Card

ENCODER

Thomson Broadcast/Nextream DBE 4140:
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800-882-1824; 201-569-1650; fax: 201-569-1511;
www.thomsonbroad.com
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Triveni Digital SkyScraper DB-10:
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800-824-5127; fax: 530-487-3755; www.grassvalleygroup.com
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The Primatte RT process is a revolutionary concept in video signal compositing, providing quality not possible using conventional 'chromakey' techniques. Primatte's straightforward controls allow even first time users to execute high quality chroma mattes.

Primatte Explorer will be demonstrated during NAB 2001 at the Las Vegas Hilton. Check your NAB program for Intelligent Paradigm's suite number.

Demonstrations are open to show attendees. For a private demo, or more information, please fax a request on company stationery to Intelligent Paradigm at 847-413-1828 or e-mail a request to maes@intelligentparadigm.com

Available in HD and SD, both models shipping March 31, 2001.

Primatte™ is a registered trademark of IMAGICA Corp. Explorer™ is a trademark of Intelligent Paradigm, Inc.

INTELLIGENT PARADIGM

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800-775-3314; 859-371-5533; fax: 859-371-3729; www.dps.com
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Digital Voodoo D1 Desktop Series:
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Leitch NewsFlash II:
Nonlinear editor is fully integrated with Leitch’s VR Technology servers; display included BrowseCutter journalist workstation and access to archival media via DVD archiving; newsroom integration is complete from news service to scalable playout transmission server systems.
800-231-9673; fax: 757-548-4088; www.leitch.com
Booth: L8620 Circle (541) on Free Info Card

VIDEO EDITING SYSTEMS

DPS Digital Processing System dpsReality HD:
Allows users to create productions in HD and SD, as well as for DVD and Internet distribution; system allows transitions and effects to be previewed in real-time to the VGA screen or any SD monitor capable of 16:9.
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Freed from the limitations of analog technology, DML crews keep the focus on moving images with fast setup and high quality feeds from almost any location.

Now NEC introduces Spectrum Stretch for DML: two digital microwave feeds on the same channel, at the same time, from trucks in different locations.

Visit Booth L-6043 at NAB 2001 for a live demo of DML with Spectrum Stretch, or contact NEC Broadcast at (888)383-4DTV, or sales@necbroadcast.com.

CodeRunner digital radios for Spectrum Stretch demo, courtesy of MRC Broadcast, Booth L-6420
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Sony DSR-70A:
Enhanced revision of DSR-70 DVCAM field editing recorder/player; provides full range of analog and digital interfaces, as well as a search dial function and a built-in 6.4-inch VGA LCD screen; also features playback compatibility with DV family formats (25Mbs) including consumer DV and DVCPro; DVCAM format uses eight-bit digital component recording with a 5:1 compression ratio and sampling rate of 4:1:1.
800-686-SONY; 201-930-1000; fax: 201-930-4752;
www.sony.com/professional
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Chyron Duet HD:
Also available as a standard definition system, this platform supports 56 simultaneous, full bandwidth video streams along with an object-oriented 2D/3D graphics engine that is scalable to support all DTV/HDTV resolutions and scan rates; also features the Chyron Abstraction Layer (CAL), a network interface API that provides hardware independence and a high-level programming environment for development of third party applications to interact with Chyron hardware platforms.
631-845-2000; fax 631-845-3867;
www.chyron.com
Booth 16631 and L12300 Circle (548) on Free Info Card

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Intelligent Paradigm Primatte Explorer RT/HD:
HD native product allows production and post production matting to be accomplished in real-time; software is based on IMAGICA’s research and development in blue screen matting processes and color processing; core is the Video Explorer 2 video processing system.
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**Accom Abekas Dveous/HD:**
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**Advanced Rendering Technology RenderPipe for Maya interface:**
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**SuperSwitcher** series:
Series includes three new models and two new options, DV and Webcasting; feature an integrated NT workstation and control panel; Webcasting option streams switcher’s output to the Internet; switchers feature illuminated source names, reassignable inputs, 2.5M/EUs with full re-entry and six keys.

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**Inscriber Technology CG-FX**
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800-363-3400; 519-570-9111; fax: 519-570-9140; www.inscriber.com

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ASPECT RATIO CONVERTER
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310-544-9343; fax: 310-544-9363; www.yem.com

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Triveni Digital StreamScope MT-20:
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video routing

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Issue advertisers are shown in BLUE. Listings are based on information provided to Broadcast Engineering by manufacturers. Good hunting, and we’ll see you there.

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Which type of facility or operation best describes your primary business classification? (Check only ONE box.)

20 TV Station (including Networks & Low-Power TV)
26 Combination TV & Radio Station
30 Cable (including Networks)
45 Telcos
29 Recording Studio
30 Teleproduction Facility/Independent Program Producer
40 Post-Production Facility
50 Streaming Media — Network Provider/ISP/IDC/Teleco, Internet Content Provider/Web Publisher, Services, Software Provider
31 Microwave, Relay Station or Satellite Company for TV and Cable
33 TV Consultant/Engineering/Management
34 TV Dealer or Distributor
35 Other (please specify):

Which of the following best describes your title? (Check only ONE box.)

A. Company Management: 01 Chairman of the Board 02 President 03 Owner 04 Partner 05 Director 06 Vice President 07 General Manager (other than in charge of Engineering or Station Operations)
08 Other Corporate/Financial Official

B. Technical Management & Engineering: 09 Technical Director/Manager 10 Chief Engineer 11 Other Engineering or Technical Title

C. Operations & Station Management/Production & Programming: 12 Vice President Operations 13 Operations/Manager/Director 14 Station Manager 15 Production Manager 16 Program Manager 17 News Director 18 Other Operations Title

D. Other (please specify):

Which statement best describes your role in the purchase of equipment, components and accessories? (Check only ONE box.)

A) Make final decision to buy specific makes, models, services or programs
B) Specify or make recommendations on makes, models, services or programs
C) Have no part in specifying or buying

What is the budget for equipment and services you are evaluating for purchase in the next 12 months? (Check ALL that apply.)

1 □ Less than $24,999
2 $25,000 - $99,999
3 □ $100,000 - $299,999
4 $300,000 - $499,999
5 □ $500,000 - $999,999
6 □ $1,000,000 - $1,999,999
7 □ $2,000,000 and up

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The new flavors of MPEGs

By Peter Symes

Compression standards have become a matter of great importance in the television broadcast community. Most television industry activity revolves around Motion JPEG, MPEG-2 and DV compression, with MPEG-2 being used almost exclusively for final delivery to the consumer.

We hear of MPEG-4 and MPEGs beyond that, and some engineers and managers wonder if the new work will supplant MPEG-2.
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systems that enabled nonlinear editing, broadcast-quality disk-based servers and more. Unfortunately there was no standard for adjusting JPEG compression to fit an image sequence within bandwidth limits, so each manufacturer's solution was different, and there was no possibility of interchange of compressed signals.

The first international compression standard for motion imagery, MPEG-1, was developed between 1988 and 1992 and included motion compensation for temporal compression. MPEG-1 represented a remarkable technical achievement, but had little direct impact on the television broadcast industry. It was, by design, limited to CIF picture size (352x240 pixels), to approximately 1.5 Mb/s compressed data rate and had no tools to handle interlaced images.

It should be noted that the tool set and syntax developed for MPEG-1 was vastly more powerful than was represented by the constraints of the standard. MPEG-1 syntax was used for direct-to-home satellite broadcasting, and to compress HDTV by one of the proponents during the competitive phase of the Advanced Television Service proceedings.

MPEG-1 was also noteworthy for its approach to interoperability. The MPEG-2 process was started, and MPEG-2 became a standard in 1995. The initial goals were simple — there was a need for a standard that would accommodate broadcast-quality video, including interlace.

In many ways, MPEG-2 represents the "coming-of-age" of MPEG. The greater flexibility of MPEG-2, combined with the increased availability of large-scale integrated circuits, meant that MPEG-2 could be used in a vast number of applications.

The success of MPEG-2 is best highlighted by the demise of MPEG-3. It was intended for high-definition television. MPEG-3 was soon abandoned when it became apparent that MPEG-2 embraced this application with ease. MPEG-2 is the basis for both the ATSC and DVB broadcast standards and the compression system used by DVD.

Perhaps the most fundamental change brought by MPEG-2 is the number of compliance points. MPEG-1 defined a single compliance point. Every MPEG-1 compliant decoder had to decode any MPEG-1 compliant bit stream. MPEG-2 capabilities include a vast range of image sizes, encoding tools and data rates, suitable for different applications. A decoder capable of handling every possible MPEG-2 bit stream would be enormously complex and expensive, and enforcing this generality would preclude the use of the standard in most environments.

The MPEG committee decided on a structure of profiles and levels. Profiles define the tools and syntactical elements that may be used; levels define the permissible ranges of parameters. Various combinations of profile and level are provided to allow practical subsets to be implemented in a standard manner, as shown in Figure 1. For standard definition television we generally use Main Profile at Main Level (MP@ML) or the studio 4:2:2 Profile at Main Level (4:2:2@ML). For high-definition television we use the same profiles at High Level (MP@HL and 4:2:2@HL).

![Figure 1. The combinations of profile and level in MPEG-2. Standard definition has generally used Main Profile at Main Level, while HD uses the same profile at High Level.](image-url)
MPEG-4

The wheels of international standardization grind slowly, and to ensure a standard is eventually achieved there are strict rules that prohibit substantive change after a certain point in the process. By the time a standard is officially adopted, there is often a backlog of desired enhancements and extensions — as it was with MPEG-2. As discussed above, MPEG-3 had been started and abandoned, so the next project became MPEG-4. Two versions of MPEG-4 are already complete and work is continuing on further extensions.

At first, the main focus of MPEG-4 was the encoding of video and audio at very low rates. In fact, the standard was explicitly optimized for three bit rate ranges:
- Below 64kb/s
- 64- to 384kb/s
- 384kb/s to 4Mb/s

Performance at low bit rates remained a major objective and some creative ideas contributed to this end. Great attention was also paid to error resilience, making MPEG-4 suitable for use in error-prone environments such as transmission to personal handheld devices. However, other profiles and levels use bit rates up to 38.4Mb/s, and work is still proceeding on studio-quality profiles and levels using data rates up to 1.2Gb/s.

More importantly, MPEG-4 evolved into a new concept of multimedia encoding with powerful tools for interactivity and a vast range of applications. This article can provide only the briefest of introductions to the system as the official "overview" of this standard spans 67 pages.

Object coding

The most significant departure from conventional transmission systems is the concept of objects. Different parts of the final scene can be coded and transmitted separately as video objects and audio objects to be brought together, or composited, by the decoder. Different object types may be coded with the tools most appropriate for the job. The objects may be generated independently, or a scene may be analyzed to separate, for example, foreground and background objects. In one interesting demonstration, video coverage of a soccer game was processed to separate the ball from the rest of the scene. The background (the scene without the ball) was transmitted as a "teaser" to attract a pay-per-view audience. Anyone could see the players and the field, but only those who paid could see the ball.

The object-oriented approach leads to three key characteristics of MPEG-4 streams:
- Multiple objects may be encoded using different techniques and then composited at the decoder.
- Objects may be of natural origin, such as scenes from a camera, or synthetic, such as text; and,
- Instructions in the bit stream, and/or user choice, may enable several different presentations from the same bit stream.

The generalized system for object coding in MPEG-4 is shown in Figure 2. This diagram also emphasizes the opportunities for user interaction within MPEG-4 systems — a powerful feature, particularly for video game designers.

---

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These capabilities do not have to be used. MPEG-4 provides traditional coding of video and audio and improves on MPEG-2 by offering enhanced efficiency and resilience to errors. However, the true power of MPEG-4 comes from the architecture described above. The coding of objects independently offers a number of advantages. Each object may be coded in the most efficient manner, and different spatial or temporal scaling (see below) may be used as appropriate.

Video coding
Many of the video coding tools in MPEG-4 are similar to those of MPEG-2, but are enhanced by better use of predictive coding and more efficient entropy coding. However, the application of the tools may differ significantly from earlier standards.

MPEG-4 codes video objects. In the simplest model a video is coded in much the same way as in MPEG-2, but it is described as a single video object with a rectangular shape. The representation of the image is known as texture coding. Where there is more than one video object, some may have irregular shapes, and generally all will be smaller than a full-screen background object. This means only the active area of the object needs to be coded, but the shape and position must also be represented. The standard includes tools for shape coding of rectangular and irregular objects, in either binary or gray-scale representations (similar to an alpha channel).

Scalability
In the context of media compression, scalability means the ability to distribute content at more than one quality level within the same bit stream. MPEG-2 and MPEG-4 both provide scalable profiles using a conventional model; the encoder generates a base layer and one or more enhancement layers. The enhancement layer(s) may be discarded for transmission or decoding if insufficient resources are available. This approach works, but all decisions about quality levels have to be made at the time of encoding, and in practice the number of enhancement layers is severely limited (usually to one).

Later versions of MPEG-4 include the fine grain scalability (FGS) profile. This technique generates a single bit stream representing the highest quality level, but allows for lower-quality versions to be extracted downstream. FGS uses bit-plane encoding. The quantized coefficients are "sliced" one bit at a time, starting with the most significant bit. This provides a coarse representation of the largest (and most significant) coefficient(s). Subsequent slices provide more accurate representations of the most significant coefficients, and coarse approximations of the next most significant and so on.

Spatial scaling, including FGS, may be combined with temporal scaling that permits the transmission and/or decoding of lower frame rates when resources are limited. As mentioned above, objects may be scaled differently. It may be appropriate to retain full temporal resolution for an important foreground object, but to update to the background as a lower rate.

Other aspects of MPEG-4
MPEG-4 is enormous, and the comments above touch on only a few of the many aspects of the standard. There are studio profiles for high-quality encoding that, in conjunction with object coding, will permit structured storage of all the separate elements of a video composite. Facial and body animation profiles will permit a stored face to "read" text in many languages. Further extensions of MPEG-4 may even provide solutions for digital cinema. Figure 3 shows the MPEG-4 profiles defined today.

Some describe MPEG-4 as the standard for video games, and certainly many of the constructs are ideally suited to that industry. However, even a cursory examination of the standard reveals such a wealth of capabilities, historical 1-2-4 as the start of a predefined binary sequence, and wanted the new work to be MPEG-8. Finally, it was concluded that any simple sequence would fail to signal the fundamental difference from the work of MPEG-1 through MPEG-4, and MPEG-7 was chosen.

MPEG-7 is not about compression; it is about metadata, also known as the "bits about the bits." Metadata is digital information that describes the content of other digital data. In modern parlance, the program material or content, the actual image, video, audio or data objects that convey the information, are known as data essence. The metadata tells the world all it needs to know about what is in the essence.

Anyone who has been involved with the storage of information, be it videotapes, books, music, whatever, knows the importance and the difficulty of accurate cataloging and indexing. Stored information is useful only if its existence is known, and if it can be retrieved in a timely manner when needed.

This problem has always been with us and is addressed in the analog domain by a combination of labels, catalogs, card indexes, etc. More recently, the computer industry has given us efficient, cost-effective, relational databases that permit powerful search engines to access stored information.
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in remarkable ways—provided the information is present in a form the search engine can use.

The real problem is that the world is generating new media content at an enormous and ever-increasing rate. With the increasing quantity and decreasing cost of digital storage media, more and more content can be stored. Local and wide-area networks can make the content accessible and deliverable if it can be found. The search engines can find what we want and the databases can be linked to the material itself, but we need to get the necessary indexing information into the database in a form suitable for the search engine.

We might guess from knowledge of earlier standards that the MPEG committee would not concern itself unduly with mechanisms for generating data. MPEG rightly takes the view that if it creates a standardized structure, and if there is a market need, the technological gaps will be filled. In previous MPEG standards, the syntax and the decoder were specified by the standard. In MPEG-7, only the syntax is standardized. The generation of the metadata is unspecified, as are the applications that may use it. MPEG-7 specifies how metadata should be expressed. This means the fields that should go into a database are specified, and anyone designing a search engine knows what descriptive elements may be present and how they will be encoded.

MPEG-7 defines a structure of descriptors and description schemes that can characterize almost anything. In theory, primitive elements such as color histograms and shapes can be combined to represent complex entities such as individual faces. It may be possible to index material automatically such that the database can be searched for scenes that show, for example, George Burns and Ella Fitzgerald together.

The constructs are not confined to images. To paraphrase the official FAQ, it should be possible to use a voice sample to search for recordings by, or images of, Pavarotti, or to play a few notes on a keyboard to find matching or similar melodies.

The rapid advance of storage and networking systems will enable access to vast quantities of digital content. As technology advances to satisfy the needs of MPEG-7, we will be able to index and retrieve items in ways unimaginable a few years ago. We will then need a system to control access, privacy and commercial transactions associated with this content. This is where MPEG-21 is targeted.

**MPEG-21**

MPEG-21 again differs from the earlier work of the committee. The basic concept is fairly simple—though wide reaching. MPEG-21 seeks to create a complete structure for the management and use of digital assets, including all the infrastructure support for the commercial transactions and rights management that must accompany this structure. The vision statement is “to enable transparent and augmented use of multimedia resources across a wide range of networks and devices.”

The work is at an early stage, but a committee draft is planned by December 2001. As with other MPEG projects, we can expect an initial standard with increased sophistication and flexibility contained in later amendments.

**Conclusions**

MPEG-2 is firmly established in the consumer market. Millions of MPEG-2 decoders already exist in DVD players and digital cable, satellite and terrestrial television receivers. In a sense, this simple fact answers one of the questions posed: The new MPEGs will not replace MPEG-2 as the definitive standard for

---

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delivery of video to consumers by these mechanisms.

However, MPEG-4 may still be important to broadcasters for a number of reasons. Digital broadcasting will include program-related data, and may be targeted at devices other than conventional television receivers. MPEG-4 constructs may use MPEG-2 compression and may be carried on MPEG-2 transport streams so this could be a viable mechanism for data-enhanced programming.

Probably more important, however, is the use of MPEG-4 on the Internet. Most broadcasters now see streaming media as an essential part of their operations and are obliged to support popular streaming formats. The efficiency for low-bit rate applications, documenta-

tion as an international standard and the flexibility of the FGS option all suggest MPEG-4 will be a major factor in the future of streaming media.

MPEG-7 and MPEG-21 will likely be of great importance to broadcasters in the future, but neither is a compression standard. The advent of these standards will impact many aspects of facility design and operational models, but not in ways that will devalue investments made today. In contrast, if MPEG-7 and -21 are successful, they will together provide a tremendous boost to e-commerce, and greatly enhance the value of digital assets.

This article includes material extracted and adapted from Video Compression Demystified by Peter Symes (McGraw-Hill, 2001) by permission of the publisher. Details at www.symes.tv. Peter Symes is Manager, Advanced Technology, and a Fellow of Grass Valley Group.

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Acterna’s DTS-400: MPEG-2 monitoring at EchoStar

BY JEFF MCSCHOOLER

In May of 1996, EchoStar Communications Corp. launched DISH Network, our direct broadcast satellite (DBS) system. Since then, the service has grown exponentially, and today it boasts more than five million customers across the U.S. To the team of experts who run EchoStar’s primary satellite uplink facility in Cheyenne, WY, the success of the DISH Network system is not an accident. EchoStar’s Uplink Engineering groups are responsible for processing, encoding and multiplexing all content and contribution feeds in the EchoStar facility.

At EchoStar, customer service is our number one responsibility. We are not looking to be second best, and we are not looking to be just OK; we want to be the best. The only way to be the best is to know what’s going on in our system at all times.

In the burgeoning digital age, we work to shield our customers from the vulnerabilities of MPEG-2 compression and transmission. Key to our success is Acterna’s DTS-400 MPEG-2 Digital Broadcast Monitoring System.

EchoStar’s need for MPEG-2 monitoring became urgent a few years after the initial deployment of DISH Network. When DISH Network first began, we had a limited ability to monitor the stream from the time it was encoded to the time the set-top box decoded it. We needed to ensure that the set-top boxes at the customers’ homes were decoding the television signals properly.

More specifically, many common errors in the MPEG-2 system layer aren’t immediately visible on a set of video monitors. Dropped packets, corrupt tables or missing Packet IDs (PDIs) can cause degradation in picture quality or complete channel loss. These errors are more easily detectable when using the right MPEG-2 monitoring tool.

Many common errors in the MPEG-2 system layer aren’t immediately visible on a set of video monitors.

Evaluating systems

To combat these issues, we began evaluating MPEG-2 monitoring systems. We needed a system that provided continuous network-wide monitoring while at the same time giving us access to real-time analysis of each individual transport stream in the network. The system had to be both smart and easy to use. The DTS-400 monitoring system provides EchoStar with a global supervision system for all 500 channels on our primary service. The entire network is monitored from a single screen of top-level status indicators representing the current health of all uplink and downlink transport streams. When an indicator changes from the normal green color to yellow or red, denoting that an error has occurred, operators begin immediate real-time analysis of the problem stream at the click of a button. Thus the monitoring system allows users to
Examine every element in every transport stream across the network in real time.

With its comprehensive real-time analysis capability, the DTS-400 completely opens any transport stream on the network to the operator's view. Using the network, program and PID information displays, operators can view network parameters or check the status of each program or PID in the stream. With PSI/SI table and descriptor views and the timing display, users can examine the full decode of all tables and descriptors, as well as analyze spacing and jitter on all PCR PDUs. In addition, the ETR290 screen and event log provide at-a-glance troubleshooting and diagnosis. These extensive real-time capabilities eliminate the hassle and delay of capturing files for offline analysis.

The system's real-time analysis tool uses the familiar Windows NT interface, so novice users quickly become familiar with the software. All analysis windows are available at a single click, and a hierarchy tree structure allows for rapid navigation through table and descriptor decodes. This intuitive and easy-to-use structure has made the DTS-400 a natural training tool.

EchoStar has been able to drastically reduce the impact of errors on its customers.

Results
In the two years since its implementation, the fully scalable DTS-400 system has grown to support DISH Network's success. As EchoStar expanded to broadcast additional services, the DTS-400 system was doubled in size to support the new services. The DTS-400 has enabled EchoStar personnel to quickly identify, troubleshoot and resolve errors in the MPEG-2 system layer. With the DTS-400 system, we have been able to drastically reduce the impact of errors on our customers, even eliminating many problems before they reach the viewer.

Jeff McSchooler is director of technical operations for EchoStar, Cheyenne, WY.
TechTV flips for Telestream’s FlipFactory

BY MARK R. SMITH

For the TechTV engineering department, the time for change was now. It was past time, really, to find a better way to repurpose video from TechTV’s on-air broadcasts for use on the network’s website (www.techtv.com). The second exposure provided by the Internet was great, but manually converting the video for the Web was a debacle, given the various encoders employed by Internet users.

According to David Seedall, who serves as vice president of engineering and operations for TechTV, a San Francisco-based on-air and online network dedicated to the digital lifestyle, the network had been having trouble doing its encoding manually. They determined that a better way to handle encoding would be to employ an automated system.

What the TechTV doctor ordered was FlipFactory, a new technology from Nevada City, CA-based Telestream (www.telestream.net). Telestream’s ClipMail Pro is used to encode video content into MPEG-2 files, which are delivered to FlipFactory via FTP and then transcoded into multiple stream-contracts to support the Real Media, Windows and Quick Time codecs. This requirement made distribution three times more difficult, because they had to create three streams at differing bit rates.

The need came about because, unlike broadcast TV, there was no single, universal format to view streaming media on the Internet. This allows users like TechTV access to their broadest possible viewing audience.

TechTV partnered with Telestream to help provide input as a beta site during the final stages of product development. TechTV pointed out particular difficulty streaming media because they had As a result, every clip of video produced at the studio must become six bit streams.

Why automation?

Since the process of encoding streaming media is very repetitive and tedious, employing the manual method means people get bored, and when the volume is high, that’s inviting costly mistakes. Settings get changed inadvertently and there are quality control issues that can be avoided by using an automated system.

It’s the same on the distribution side. The system assumes the functions of the FTP service as well as the
encoding. The system is scalable. CPUs can be added as needed to support the number of streams desired. Each CPU supports one stream. TechTV has an eight-processor Windows NT/2000 server, providing them with the capability to run dozens of Flips at once.

Automation in the encoding and distribution of streaming media is necessary because, unlike broadcast TV, there is no single universal format to view streaming media on the Internet. Similarly, because of the various speeds of Internet connections, there are different bit rates for the formats. Also, streaming media must be viewable on a number of platforms, such as handheld devices, laptops and new Net appliances. So broadcasters wishing to reach their largest potential audience must produce multiple formats with varying bit rates.

Prior to the advent of FlipFactory, creating multiple formats and bit rates was a manual process, using basically single-seat software on PCs and Macs.

The system's automation software creates all the streaming formats and bit rates the user specifies, and automatically delivers those files to streaming servers for access from a website. The software can be integrated with content management systems. TechTV's facility is being integrated with a Virage indexing system called Videologger, which makes the video on the network's website searchable. The integration makes the work flow that much more seamless for the operator. The system provides more consistent results as well, by using the same source file for multiple outputs. Encoding is an ideal process for a computer to take over, because of its repetitiveness.

FlipFactory solved the quandary at TechTV by encoding its video content for use on the Web in whatever flavor the viewers opted to use. For encoding now, the system can be set and run without needing adjustments for weeks at a time, rather than requiring the man-hours that were necessary before.

TechTV has been able to reduce the time needed to create streams by 75 percent by implementing the automated system.

For more information on Telestream's Flipfactory, circle (450) on the Free Info Card.

Mark R. Smith is a freelance writer and has covered broadcasting and post production for a decade. He resides in Odenton, MD, and can be reached at msmit1277@aol.com.
Streaming media products: Moving from software to hardware
BY JOHN LUFF

In the early 1970s I remember trying to understand the papers given at the SMPTE Winter Television Conference on “Bit Rate Reduction.” The ideas seemed foreign — taking perfectly good video and squashing it into digital form and then wringing out the excess content to make it smaller for storage and digital transmission. Of course today we would find nothing out of the ordinary, BRR — video compression — is used in consumer camcorders, hard disk personal video recorders, and perhaps most ubiquitously in little windows (and big windows) on our PC screens. The basic technology stems from research into removing redundancy in complex data.

It can be shown that mathematically loss-less compression can achieve something slightly less than a 3:1 compression ratio. Typical professional video recorders generally operate at closer to 10:1 compression. Satellite transmission for program backhaul is done at about 25:1 reduction. DBS signals are at almost 50:1 compression.

Then there is streaming media, which operates at a tiny fraction of the data rate of other uses. Try a 700:1 compression ratio for 300Kb/s. If you have only a dial-up connection, the ratio becomes an astounding 6000:1. It is against this backdrop that we consider the issues related to hardware and software solutions for streaming media.

Compression for streaming

When the concept of streaming video to the Web was created a few years ago, it sufficed for most purposes to simply show a “changing” picture, for moving images would seem to dictate a frame rate in positive numbers. The quality of compression for streaming has improved from both major vendors (Microsoft Windows Media and Real Networks RealVideo), and the ability of the Internet and private networks to handle high bandwidth media has improved at the same time, multiplying the net effect to consumers. As both the technology and bandwidth continue to improve the quality of the delivered application should become quite good.

It is clear from the compression ratios that must be achieved that every opportunity to make the job easier ought to be taken.

The process of streaming involves two distinctly independent processes: encoding and delivery. Encoding requires an input card for audio and video, the compression software and storage for the output file, unless it is passed immediately to the delivery system in a live broadcast. Delivery usually involves passing the file to a server from which it is accessed by the consumer. This server could be a single point source for content not expected to require wide distribution or a considerable number of concurrent users, or a distributed network of servers which cache the stream nearer to the users’ location, a scenario illustrated in Figure 1. This method enables delivery to multiple users, while avoiding often-clogged segments of the Internet.

The media to be streamed must be converted from analog (or digital) video to the appropriate compressed format. This process is not at all different from ingesting for a broadcast playout server. Until recently this process was generally done in a computer with an appropriate input card, loaded with software that completed the appropriate compression. It is clear from the compression ratios that must be achieved that every opportunity to make the job easier ought to be taken.

Feed lousy, noisy video in, and get a “less than stellar” result. It is also important to make sure that the intended target bit rate is one that can be delivered end-to-end to the consumer. Poor video, made worse by dropped frames and constant recovery from network errors, will make what might have been a successful experience one the consumer will reject as a failure. Anecdotally, I marvel that users who would not tolerate a VHS tape stopping periodically will actually watch video on a computer that seems to suffer from too much cholesterol.

Products for streaming compression

In the last year several manufacturers have introduced products intended solely to compress and either store or forward to the delivery server video from professional formats. Indeed a recent issue of a consumer computer industry magazine reviewed such products. They tested quality and features and pronounced their judgments.

These products include simple systems intended to perform only one type of compression at a time (usually selectable between Windows Media Player and Real Video formats). But the marketplace has moved considerably beyond making the ingest computer more user friendly. Some products allow both formats to be created at the same time. Others provide the ability to combine the compressed stream with other elements, automating the assembly of a coherent and locally branded webpage. One carries it much further, with control of cameras,
switching and effects, character generation, web advertisements, and other elements in a very sophisticated presentation. This might be viewed as TV studio in a box, with the output dedicated to Web access.

At the extreme edge is a system from one manufacturer that combines all of the above plus user interactivity that allows users to assemble a newscast from their choice of stories. While one might question the journalistic value of some people's judgment, it is a natural extension of the freedom of choice on the Web. Such streaming on demand playlists may well demonstrate a major change in the way users interact with streaming media in the future, allowing a user to assemble a virtual broadcast channel for seamless viewing, provided bandwidth was not an issue, which of course it still is.

Various factors need to be considered when picking streaming media products for installation into a broadcast station. I encourage customers to look back down the wire from the consumer's viewpoint. If the customer can reasonably be expected to accept all streaming formats, it is clear that support for a single format would be a limitation you should avoid. If you are placing your newscast on the Web you may be able to select a single format, for your viewers will likely come back regularly and therefore take the time to load the appropriate codec. On the other hand, if your product has wide use, or is one which viewers are less likely to visit regularly, you should consider support for all likely target formats. If the time sensitivity of your content is such that you cannot take the time to sequentially encode in multiple formats you should consider either a single solution which does both simultaneously, or perhaps redundant systems, which will allow you to create two streams at the same time from separate encoders.

The input side of the encoder is very important to the engineer who must implement the system. Some systems are built with unbalanced audio inputs and poor quality NTSC decoders. Others have component digital and AES inputs. Streaming encoders work very much like more mainstream compression products, and perform significantly better if you can deliver either component digital video or at least NTSC that has been decoded well (assuming a component input on the streaming encoder). Some encoders allow you to control the source tape deck when encoding from a VTR, so you might look for an RS-422 port. A few permit 1394 inputs (DV streams), which would allow a simple and very effective interface.

It is important to recognize the issues that affect the ease of use and ultimate quality of the product at the output of the encoder. The size (pixel map) of the encoded image, bit depth, encoded bit rate and encoded frame rate are all linked in complex ways to allow the end user the most effective image possible. Some encoders using lower quality decoders suffer from being unnecessarily soft, or do not adequately remove NTSC artifacts from the signal prior to encoding. Others do not maximize the potential quality of the encoding process. Some allow two-pass encoding, analyzing the complexity of the material and then tweaking the encoding to apply the largest number of bits from the target bit rate to the most challenging portions of the content.

As with many things in our industry, buying by brand name has become difficult. Some of the manufacturers of streaming products come from the computing industry and have added video-based products only recently. Others who have roots in video graphics have leveraged their television expertise to move towards Web-centric products. The best advice possible with these products is to be sure the company you pick understands how you run your business, can support you well and has the financial stability to remain in business as the com bust proceeds.

John Luff is vice president of business development for AZCAR USA.
Keops Broadcast, a developer of DMAM (digital media asset management) solutions for the broadcast, post-production and corporate markets, announced it is changing its corporate name to Keyvia Inc. The name change follows the company's transformation from a fully-owned subsidiary of Keops Technologies Inc. to an independent business entity.

Sony Electronics Inc. has become a worldwide distributor of The Bulldog Group, Inc.'s Bulldog software and will act as the exclusive distributor for the United States and Japanese broadcast markets with minority investment.

EMMIS Communications, an owner and operator of radio, television and magazine entities in U.S. markets, has purchased Omneon Video Networks' Omneon Networked Content Server System as its infrastructure for recording and playback of Sony HDCAM material.

Inscriber Technology Corporation announced that Quantel is now shipping the new iQ system that integrates Inscriber's text and graphics technology into Quantel's new platform.

Sierra Video Systems recently supplied Cox Communications with a routing switcher built at their Grass Valley Plant. The facility will utilize the Yosemite 128 x 256 fully-populated video plus stereo audio router to distribute video and audio feeds and commercial insertions to Cox's network stations.

NEC America Inc.'s parts and support division has moved. Full sales and support can be obtained at their new address: NEC America Broadcast Equipment Department; 6335 N. State Highway 161; Irving, TX 75039-2402; 888-383-4DTV (toll free); 214-262-3642 (main); 214-262-3687 (fax).

Azteca America, the U.S. Hispanic television network that will be launched next quarter by partners Pappas Telecasting and TV Azteca, has made a $1,150,000 investment in Panasonic DVCPRO50 4:2:2 digital video equipment to support network operations at its new operations center in Dallas.

Harris Corporation announced an agreement to provide Hearst-Argyle Television, Inc. with a full range of DTV transmission equipment, furthering Hearst's digital build-out.

Technology Rentals and Services (TRS), a division of The CIT Group, has purchased six new Ikegami HDK-79D cameras and a TDP-360HD video switcher, giving TRS the tools for broadcast-quality production in HD or SD.

Canon Broadcast, a division of Canon USA, has officially changed its name to Canon Broadcast and Communications. The division is responsible for three product lines: Broadcast lenses, the Canon-beam optical beam communication system and Closed Circuit TV lenses.

Avid Technology, Inc. announced its Avid Media Solutions division has formed a new broadcast group to be headed by Matt Danilowicz, the former president and CEO of iNEWS, L.L.C.

Clarity: The photographer for the January cover photo of NMT's all digital truck was incorrectly identified. The photo was actually taken by Concept; Deborah Rice and John Benson.

Screen Shot
Canon lenses deliver presidential inauguration
SWTV, mobile production specialists, selected the HD and SD-ready Canon 6X lens for its Image Stabilizer system to cover the 2001 presidential inauguration. Providing the feed for national network coverage, the lenses were on Ikegami cameras that were on scaffolding 50 yards from the podium and about 50 feet in the air. With the lens optical shift Image Stabilizer and the Power Optical System, the crew had a lens that matched the highest zoom ratio to shake-free shooting.

NEC's Digital Microwave Link covers Inaugural Parade
CBS News Washington used NEC's Digital Microwave Link (DML) during the inaugural parade as part of their inauguration coverage. This was the first use of a COFDM moving shot by the News division in Washington, whose shots were called by CBS News in New York.
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- 1/3" true 320K pixel image sensors 320K pixels (320K effective) CCD's that allow camcorder modes: 400 progressive (for titles or inter- view suit) and 250 interlace (DV mode) with increased resolution and sensitivity at reduced noise and vertical smear. This three CCDs, with their individual AE/AF system assures recording with crisp focus. 
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- 1/3” true 320K pixel image sensors.
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- Advanced optical stabilization allowing for a high-quality digital image output to 24x, with a maximum digital zoom out to 4x.
- 1/3” true 320K pixel image sensors.
- Built-in circuitry to enable a high-quality digital image output to 24x, with a maximum digital zoom out to 4x.

Panasonic

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The industry's first DV camcorder to utilize large DVC cassettes.

The AG-DVC200/1 1/2" 410,000-pixel IT 3-CCD ESP color CCDs record with an astounding 4:1 (270 minutes) and offers an attributable bajillion megapixel lens that permits users to use the 10x/20x 1/3" lens. With the resolution ability to shoot in JPEG at 150 and 200 lines, the AG-DVC200 delivers an astounding 800 lines of horizontal resolution, an IEEE 1394 interface, a signal-to-noise ratio of 80dB, and very low noise.

The 11-speed shoulder-style camcorder delivers many features offered in Panasonic’s more-popular DVCAM/DVCAM camcorders, including a 1/3" CCD色彩 matrix, the ability to increase image size to 16x/32x zooming in dim light. Use Scene Memory Storage, and a 2-speed shutter with siren locates the ticket first-night shooting of GFC displays.
Sony Batteries

- HyTRON 80 Battery: Designed for high-quality audio equipment, with a low self-discharge rate and long-lasting performance. Ideal for field recording and other professional applications.

- DSR-20/40 Digital Camcorder/Recorders: These camcorders are equipped with a high-sensitivity CMOS sensor and a large aperture f/1.8 lens, providing excellent recording performance even in low light conditions. They also feature a built-in microphone and a 3.5mm headphone jack for monitoring sound.

- iPod/iPhone/iPad/iPod Touch/iPod Shuffle/iPod nano/iPod Classic/iPod Video/iPod Nano/iPod Touch/iPod Classic/iPod Video:iPod Nano/iPod Classic/iPod Video: These devices are equipped with a high-quality audio output, allowing for high-quality sound reproduction during playback. They feature a built-in microphone and a 3.5mm headphone jack for monitoring sound.

- B&H Photo Video: Offers a wide range of professional photographic equipment, including cameras, lenses, lighting, and accessories. They also carry a selection of professional audio equipment, including microphones, mixing consoles, and recording equipment. B&H Photo Video provides expert advice and support to help you make the best choices for your needs.

- Most Recent Headphones: B&H Photo Video carries a wide selection of the latest headphones, including Bluetooth headphones, wireless headphones, and in-ear headphones. They feature high-quality sound reproduction, long battery life, and comfortable fit.

- Most Recent Cameras: B&H Photo Video carries the latest cameras from leading manufacturers, including DSLRs, mirrorless cameras, and compact cameras. They feature high-quality image sensors, advanced autofocus systems, and versatile shooting options.

- Most Recent Lenses: B&H Photo Video carries a wide selection of the latest lenses from leading manufacturers, including prime lenses, zoom lenses, and wide-angle lenses. They feature high-quality image sensors, advanced autofocus systems, and versatile shooting options.

- Most Recent Tripods: B&H Photo Video carries a wide selection of the latest tripods and monopods from leading manufacturers, including lightweight and portable options. They feature adjustable height and stability, making them ideal for use in a variety of shooting situations.

- Most Recent Monitors: B&H Photo Video carries a wide selection of the latest monitors from leading manufacturers, including large-screen monitors, high-quality color monitors, and portable monitors. They feature high-quality image sensors, advanced autofocus systems, and versatile shooting options.

- Most Recent Lighting: B&H Photo Video carries a wide selection of the latest lighting equipment from leading manufacturers, including studio lights, location lights, and portable lighting kits. They feature high-quality image sensors, advanced autofocus systems, and versatile shooting options.

- Most Recent Microphones: B&H Photo Video carries a wide selection of the latest microphones from leading manufacturers, including condenser microphones, dynamic microphones, and wireless microphones. They feature high-quality image sensors, advanced autofocus systems, and versatile shooting options.

- Most Recent Batteries: B&H Photo Video carries a wide selection of the latest batteries from leading manufacturers, including rechargeable batteries, alkaline batteries, and lithium-ion batteries. They feature high-quality image sensors, advanced autofocus systems, and versatile shooting options.

- Most Recent Memory Cards: B&H Photo Video carries a wide selection of the latest memory cards from leading manufacturers, including SD cards, CF cards, and microSD cards. They feature high-quality image sensors, advanced autofocus systems, and versatile shooting options.

- Most Recent Camcorders: B&H Photo Video carries a wide selection of the latest camcorders from leading manufacturers, including professional camcorders, entry-level camcorders, and compact camcorders. They feature high-quality image sensors, advanced autofocus systems, and versatile shooting options.
Avid Xpress DV

Avid Xpress DV software combines powerful video and audio editing tools, digital signal processing, and feathering effects. It provides the complete solution for capturing, editing, and mastering. Avid Xpress DV provides a complete set of tools for capture, edit, and delivery. It integrates seamlessly with other Avid solutions for a comprehensive workflow. Avid Xpress DV is available exclusively for Macintosh.

Avid Xpress DV offers:
- Real-time video editing
- Audio editing and mixing
- Compositing and effects
- Color grading and adjustments
- Professional output formats

Professional Video Editing Software

Professional Video Editing Software is a comprehensive suite of tools designed to meet the needs of professional video editors. It includes advanced editing features such as timeline editing, color correction, and audio processing. It supports a wide range of professional output formats, including HD, SD, and 4K.

Professional Video Editing Software offers:
- Advanced timeline editing
- Color correction and grading
- Audio processing and effects
- Professional output formats

Canopus DV-Rex 3X

Canopus DV-Rex 3X is a complete Real-Time DV Editing Workstation. It includes a powerful DV Card, a DV-Link Interface, and a DV-Link Interface software bundle. Canopus DV-Rex 3X allows you to work with DV footage in real time, providing a seamless workflow.

Canopus DV-Rex 3X offers:
- Powerful DV Card
- DV-Link Interface
- DV-Link Interface software bundle

Velocity Real-Time Non-Linear Editor

Velocity Real-Time Non-Linear Editor (RT-NE) is a powerful real-time non-linear editor that allows you to work with DV footage in real time. It provides a comprehensive set of tools for editing, effects, and output.

Velocity Real-Time Non-Linear Editor offers:
- Powerful real-time non-linear editing
- Effects and transitions
- Professional output formats

Aurora Igniter

Aurora Igniter is a complete video capture board for Mac. It includes a built-in video capture card, a USB interface, and a comprehensive set of features for video capture and editing.

Aurora Igniter offers:
- Built-in video capture card
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- Comprehensive set of features for video capture and editing

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Quality, reliability, and performance are the hallmarks of Avid Xpress DV and Canopus DV-Rex 3X. They are designed to meet the needs of professional video editors and provide a complete solution for video production.

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<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
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<tbody>
<tr>
<td>Leitch/DPS Digital Processing System</td>
<td>The Leitch/DPS dpsVelocity 8.0 allows real-time streaming directly from the timeline. New features include multicamera editing and real-time support for video files with alpha channel and multiple timeline support.</td>
</tr>
<tr>
<td>Seachange International Broadcast MediaCluster</td>
<td>The Broadcast MediaCluster server system from SeaChange International can store more than 4.2 terabytes of video. It supports up to 42 I/Os delivering 30Mb/s MPEG-2 4:2:2 long-GOP video, with two AES audio channels each.</td>
</tr>
<tr>
<td>Chyron Duet HD</td>
<td>Chyron's Duet HD supports 56 simultaneous, full-bandwidth video streams along an object-oriented 2D/3D graphics engine. The platform also features the Chyron Abstraction Layer (CAL), a network interface API that provides hardware independence.</td>
</tr>
<tr>
<td>Pinnacle Systems StreamFactory</td>
<td>The StreamFactory web media encoder from Pinnacle Systems provides MultiStream architecture, supporting Internet broadcasters with real-time web encoding of multiple and independently resized concurrent streams.</td>
</tr>
<tr>
<td>Inscriber Technology LIVE!Clips</td>
<td>Inscriber Technology's LIVE!Clips is designed for use in 24-hour broadcast channels. It offers increased board support and a media management module, and is available separately as software and board bundle or as software only as Inscriber E-Clips.</td>
</tr>
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<tr>
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<td>JVC-GYDV-500 USED</td>
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<td>$4150.00</td>
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<tr>
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<th>Average High Temp for February</th>
<th>Average Low Temp for February</th>
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<td>Chicago, Illinois</td>
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<td>Atlanta, Georgia</td>
<td>56°F</td>
<td>36°F</td>
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CHIEF ENGINEER: FOX-13 WHBQ. FOX O&O in Memphis is seeking a Chief Engineer to lead our conversion to Digital Broadcasting and to direct the station’s overall technical operation and manage the technical staff. This position interfaces with department heads and works closely with the News Department. Degree in electrical engineering and Technical SBE certification is preferred. If you are a manager looking for a rewarding and exciting challenge, send your resume to: HUMAN RESOURCES FOX 13 WHBQ, 485 S HIGHLAND AVENUE, MEMPHIS, TN. 38111 OR FAX TO: 901-320-1252. WHBQ-FOX-13 IS AN EQUAL OPPORTUNITY EMPLOYER

RF TRANSMITTER ENGINEER: WLWT-TV has an opening for a full time RF Transmitter Engineer with a minimum of 5 years experience in transmitter maintenance. This position requires maintenance, troubleshooting and repair to the component level of a VHF and DTV UHF transmitter and associated equipment. Also oversee installation and maintenance of all RF microwave equipment. High school plus tech/college and a valid driver’s license and proof of insurance are required. EOE Send resumes to: 1700 Young St. Cincinnati OH 45210

EARTH STATION ENGINEERS

Turner Teleport in Atlanta has career opportunities for experienced Satellite Communications Engineers. These positions demand an extensive background in fixed based and SNG engineering. Equipment maintenance and operational experience is required. Please mail or fax your resume and cover letter to:

Jim Brown, Assistant Vice President of Engineering Services
Turner Broadcasting System, Inc.
One CNN Center, P. O. Box 105366
Atlanta, GA 30348-5366
Phone: 404-827-1638
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MIS Engineer: Work for the best broadcast company in Southern California! Qualified candidates will have experience with NT. MS Office, back-office and possess a degree in a related field or have equivalent experience. Knowledge of AS/400. Unix. Macintosh. electronics and video preferred. Send references and resume attention Eddie Hernandez, Assistant Chief Engineer, Gulf-Carifornia Broadcast Co., 42-650 Melanie Place, Palm Desert, CA. 92211. No telephone calls please. EOE.

CHIEF TECHNICAL OFFICER: KLAS-TV, CBS, Las Vegas, is looking for an outstanding leader with one foot in the analog world and a demonstrated aptitude, willingness and record of effectively managing change in broadcasting, cable or a related field. Must have a demonstrated track record of acquired knowledge in electronics, broadcast transmitters, system design, digital technologies, broadband, wireless, server-based technologies, computers, Teico and cable sufficient to provide leadership for the station’s transition from an analog environment to digital. Solid, top-line knowledge of Information Technology. Minimum of five years experience as a Chief Engineer in medium to large television market or seven years as an Assistant Chief in a large market. To apply, send resume and references to: Dick Fraim, KLAS-TV, P.O. Box 15047, Las Vegas, NV 89114. EOE.

STUDIO MAINTENANCE ENGINEER: Must be able to perform the following duties: install and maintain studio transmission equipment including video switches, audio consoles. DVE, CG, SS, cameras, and robotics. Familiarity with automation systems and master control environment. Should possess a general computer/networking background. Must be able to work on a rotating shift schedule. Candidate should have an engineering degree or equivalent technical training. SBE/FCC certification a plus. If you want to be a part of the exciting transition to HDTV in the most exciting city in the world, please send your resume and cover letter: Kurt Hanson, Chief Engineer, WABC-TV, 7 Lincoln Square, New York, NY 10023. No telephone call or faxes please. We are equal opportunity employers.

BROADCAST MAINTENANCE TECHNICIAN: Requires self starter having experience with Beta, VPR-3. PC’s and other studio equipment maintenance. Experience with microwave, satellite, VHF & UHF transmitters, CAD 2 ability and FCC General Class License preferred. Contact Charles Holer, Manager of Engineering Maintenance, WTNH-TV, 8 Elm Street, New Haven, CT 06510. No phone calls please. EOE.

TECHNICAL DIRECTOR
St. Petersburg, FL

Duties: Responsible for operating and orchestrating the use of technical equipment to visually create live television shows. Uses a video switcher and digital effects machine to change visual elements. Plans and directs the efforts of the other control room positions: camera, graphics, audio, and video server in combination with staff on studio floor to create the character, look, and ambiance of a live show. Technical liaison and trainer for technical directors and associate producers. Edit and produce on Aud Express non-linear editors. Update promotions on Seatchange Video Server running Sundance software. Write, produce, and edit Spanish commercials. Technical advisor and trainer for the Sony BVS 7000 video switcher and SME; Robotic camera heads, Chyron Infinite. Work with several Digital Imaging platforms including Adobe After Effects, PhotoShop and Premiere. Responsible for providing the highest quality presentation, both aesthetically and technically for broadcast, always communicating with the Spanish programming and operations staff. Follows current program standards. Explores new and innovative ways to affect the visual look of the programming. Will supervise 7 employees.

Requirements: Bachelor’s degree or equivalent Visual Arts & 1 year in Digital Training & 6 years in the related occupation of Floor Director. Fluency in Spanish language.

Salary: $39,000/year.

Hours: 40 hr/week - 9am to 5:30pm

Contact: Send resumes to: Agency for Workforce Innovation, P.O. Box 10859, Tallahassee, FL 32302, JOFL2153485.
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Mergers and beehives

BY PAUL MCGOLDRICK

Having a title like *Industry Watcher* gives me an inherent right, I believe, to look over others' shoulders and criticize what they do — both good and poor. It is particularly interesting to compare my own observations with those of analysts who see the corporate world rather differently, jumping straight past the beehive to the anticipated jars of honey.

I am welcomed into maybe fifty companies a year to share with them their perceived direction of travel (their road maps) and to talk in some depth about products that are coming. But when I read analysts' reports of these same companies I often wonder if we've visited the same company, the picture painted is usually so different from what I see happening in the trenches.

This overview is a privilege and a curse, but in either case my adrenaline always spikes when companies that I know well are involved in mergers and acquisitions. Three in the last year showed a good spectrum of the various situations that can happen; to protect the innocent I should say that although all the businesses are in electronics industry, only one set is directly in broadcasting.

The first example is of a $7 billion acquisition. The cultures of these two companies were very different. One was an old player that had grown really product-smart in the last few years and was now big. The company it acquired was always run on a shoestring, but it had some talented designers and a market sense in the Far East that was brilliant. The merger was completed extremely quickly and the first fears of Goliath dominating the picture were totally squashed. Management wisely kept the larger company's original plans from dominating the picture. The best of both was retained, and the best employees were given the authority — regardless of the side of the fence they had originally been on. It was, a joy to watch, and both locations are still a pleasure to visit.

The second example was not so happy. The company acquired in this case was bought as the first in a number of transactions to build up a group of related operations. The money was from product crossovers and conflicts between the two operations, plus culture clashes galore. I see a disaster in the making.

The day this third announcement was made, a meeting was held with all the employees at the company being acquired. The new CEO made reassurances about stability, the future, etc.

When I read analysts' reports, I often wonder if we've visited the same company.

Paul McGoldrick is an industry consultant based on the West Coast.
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