JANUARY 2009

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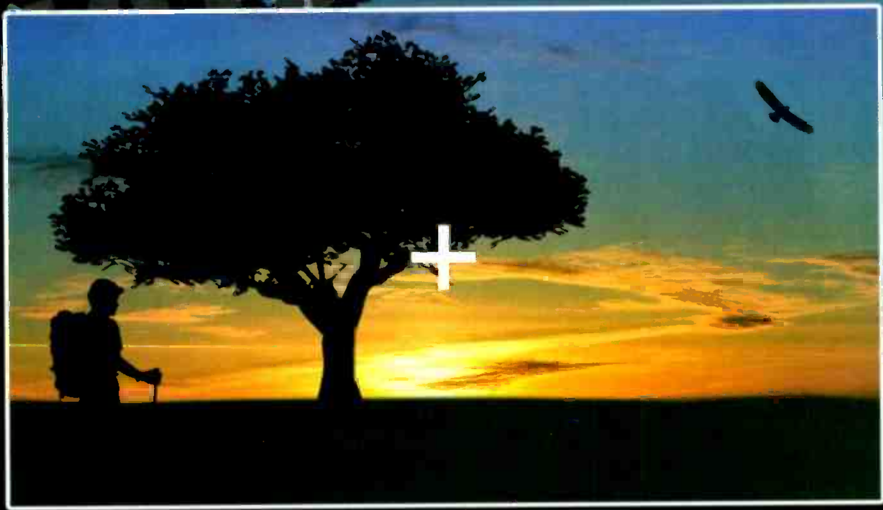
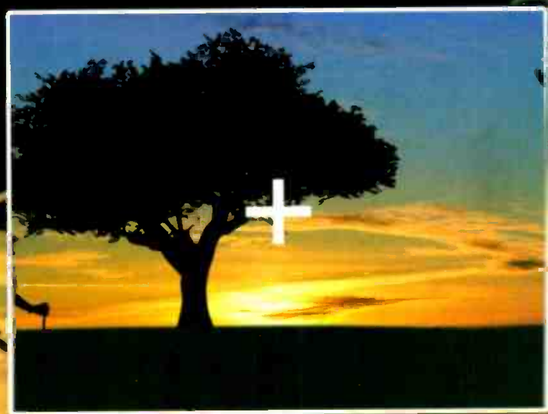


ACTIVE FORMAT DESCRIPTION

The key to correctly displayed images



ALSO INSIDE:

HD MONITORS, PART I
Understanding bob and weave in LCDs

MEDIA-AWARE STORAGE
New platforms to store video

MASTER CONTROL SYSTEMS
Close to "no lights" operation

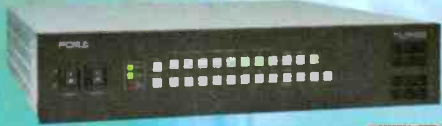
A PENTON MEDIA PUBLICATION

Imagination to Creation

INNOVATIONS IN VIDEO and AUDIO TECHNOLOGY

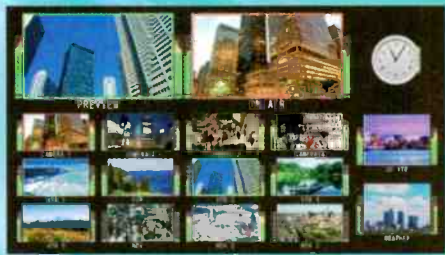
VIEW

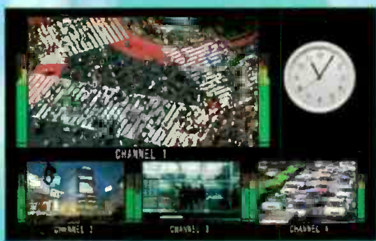
with FOR-A's High Resolution Multi Display Processors



MV-1610HS NEW

HD/SD/Analog (NTSC/PAL)/PC Max. 16 Mixed Input
WUXGA (1920 x 1200) DVI-I Output
Video Transfer Via Network
Layout Editor



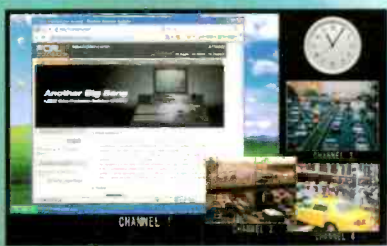


MV-410HS NEW

HD/SD/Analog (NTSC/PAL) 4 Mixed Input
WUXGA (1920 x 1200) DVI-I Output
Video Transfer Via Network
Layout Editor

MV-410RGB NEW

PC/Analog Composite 4 Mixed Input
WUXGA (1920 x 1200) DVI-I Output
Layout Editor



HD/SD Multi Display Processor

MV-1610HS NEW

- Max. 16 mixed input of HD-SDI, SD-SDI, analog composite, and PC (RGB) signals
- Supports mixed input of different frame rate signals
- WUXGA (1920 x 1200 pixels) DVI-I High-resolution output
- Includes layout editor
- Network video transfer function
- 8-channel audio level display
- Tally display, Title display, and Time display functions
- Video loss detection function
- Secondary DVI-I output (option)
- SNMP support (option)
- Redundant power supply (option)
- MV-1611HS : HD/SD-SDI output model also available

RGB/Video Multi Display Processor

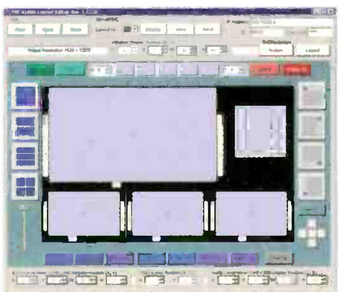
MV-410RGB NEW

- 4 mixed input of RGB signals and analog composite signals
- Total 8 inputs: 4 DVI-I inputs and 4 analog composite inputs (choose any 4 channels)
- WUXGA (1920 x 1200) DVI-I outputs
- Including layout editor
- Title display and analog clock display functions

HD/SD Multi Display Processor

MV-410HS NEW

- 4 mixed input of HD-SDI, SD-SDI, and analog composite signals
- Supports mixed input of different frame rate signals
- WUXGA (1920 x 1200 pixels) DVI-I High-resolution output
- Includes layout editor
- Network video transfer function
- 8-channel audio level display
- Tally display, Title display, and Time display functions
- Video loss detection function
- Redundant power supply (option)



Layout Editor GUI

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CBS SPORTS
PEYTON MANNING
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SONY

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BroadcastEngineering®

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BEYOND THE HEADLINES

DIGITAL HANDBOOK

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ON THE COVER:
AFD allows content providers to ensure their programming is correctly displayed on any type of television. Cover concept created by art director Robin Metheny.

JANUARY FREEZEFRAME QUESTION

Match the definition to the proper term.

Terms:	Definitions:
Router	A device that receives a transmission from one of its ports and echoes that transmission to all of its other ports
Bridge	Associates each port with the physical address of the adapter connected to that port
Firewall	A device placed in the network pathway, forwards packets to the network based on owner-generated rules
Switch	Intercepts requests for Internet resources from a client and forwards them, acting as an intermediary between client and the target server
Hub	A device that filters traffic by logical address; it operates at the Internet layer (Layer 3).
Proxy server	A device that filters and forwards packets by physical address

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JANUARY FREEZEFRAME ANSWER

The answers can be found in "Sams Teach Yourself TCP/IP in 24 Hours" by Joe Casad.

Bridge: A device that filters and forwards packets by physical address

Hub: A device that receives a transmission from one of its ports and echoes that transmission to all of its other ports

Switch: Associates each port with the physical address of the adapter connected to that port

Router: A device that filters traffic by logical address; it operates at the Internet layer (Layer 3).

Proxy server: Intercepts requests for Internet resources from a client and forwards them, acting as an intermediary between client and the target server

Firewall: A device placed in the network pathway, forwards packets to the network based on owner-generated rules

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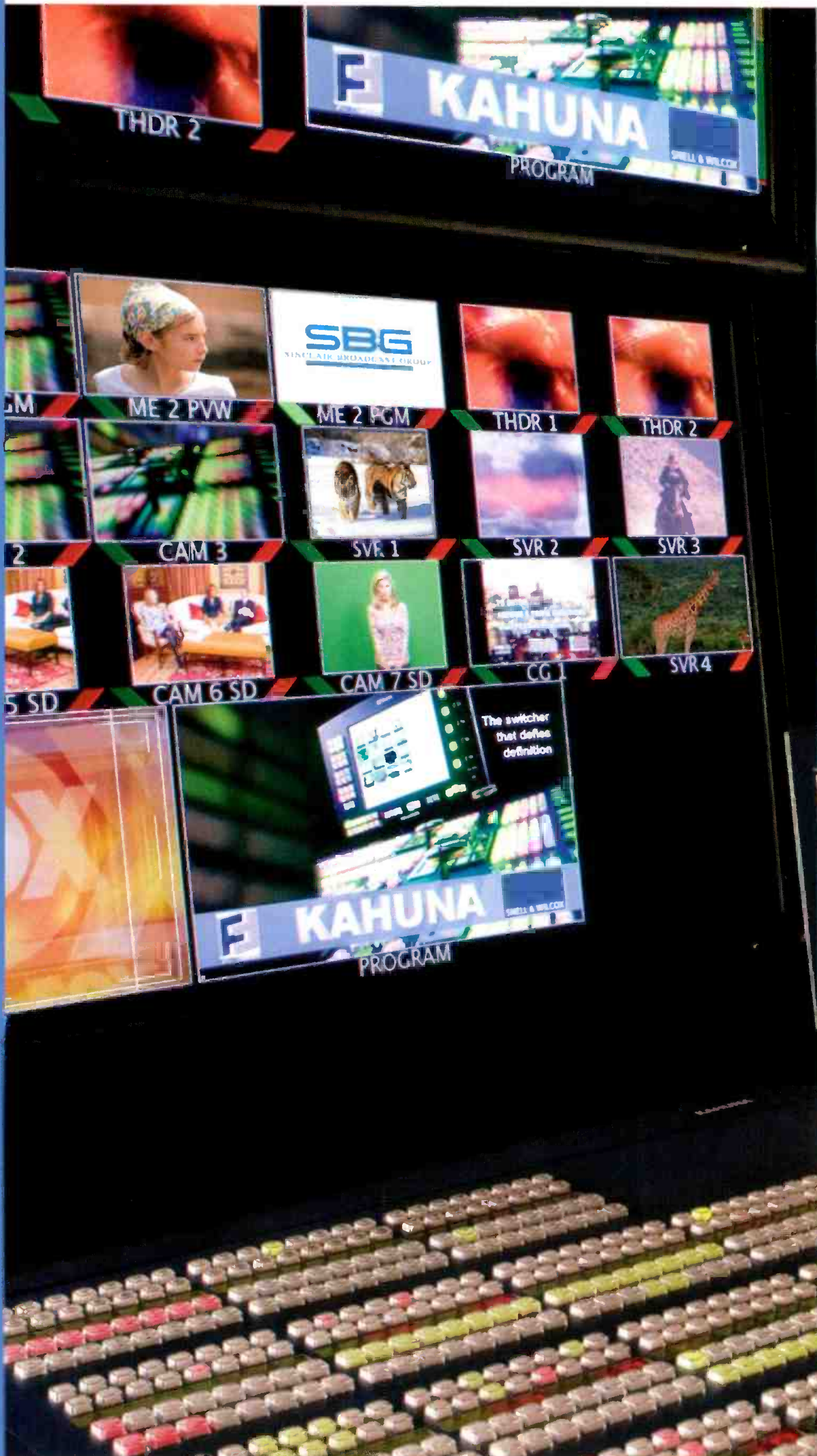


When you're responsible for the transition to HD news for one of the country's largest TV station groups, you need to ensure seamless integration of SD and HD material. That's why Sinclair's Mark Nadeau put Kahuna™ at the heart of his HD transition strategy.

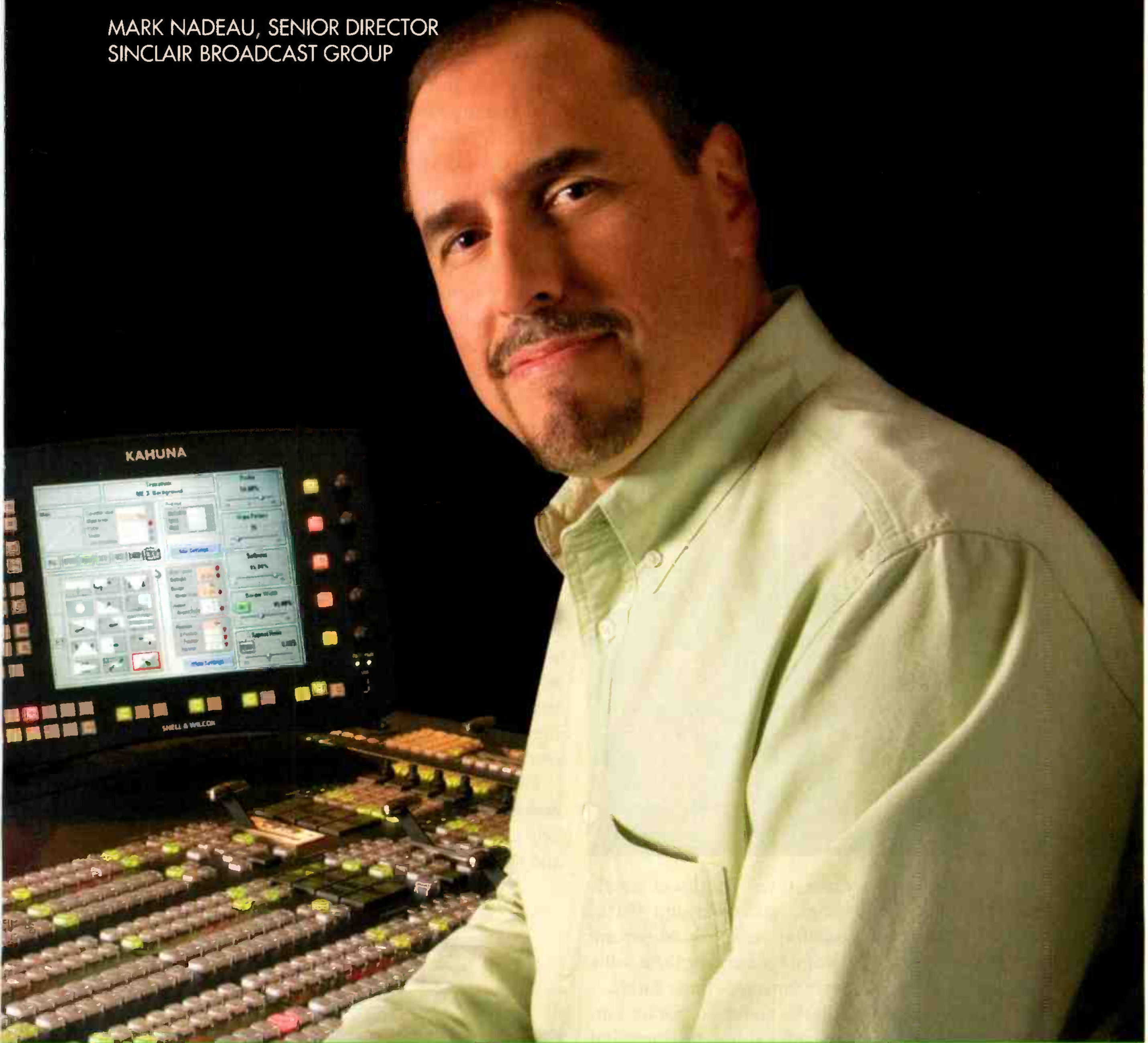
Kahuna combines unmatched switcher and DVE power with FormatFusion™, a revolutionary Snell & Wilcox technology that enables the seamless integration of SD material, such as graphics, camera feeds and archives into HD productions. All without the video delay and cost associated with external converters.

To find out why Sinclair chose Kahuna, visit snellwilcox.com/sinclair

KAHUNA™

" THIS SWITCHER IS LOADED...IT'S AMAZING."

MARK NADEAU, SENIOR DIRECTOR
SINCLAIR BROADCAST GROUP



SINCLAIR BROADCAST GROUP STANDARDIZES ON KAHUNA FOR MOVE TO HD NEWS PRODUCTION

This too shall pass

How's your station doing, economically speaking? Are sales above last year? If your station is like most other companies, times are probably tough.

For most *Broadcast Engineering* readers, these are the worst economic conditions they have ever experienced. Jobs have been lost, companies and offices closed, and savings decimated. While this has yet to become the economic depression our parents experienced, it still hurts.

In a recent post to my blog, Brad on Broadcast (*http://blog.broadcastengineering.com/brad*), I described the effects the financial crisis is having on baby boomers. (Read the full post at *http://tinyurl.com/6tdf9o*). These events

couldn't have come at a worse time. The boomers are nearing retirement. The savings, retirement and 401(k) accounts they spent years building have lost 40 percent or more of their value. And, unfortunately for these folks, they don't have another 20 years to replace those funds.

Headline after headline speaks about corporate cutbacks. From the car makers to coffee shops, no one is immune from layoffs, cutbacks and even shutdowns.

Does this mean we should all wring our hands and hang our heads? Is it time to simply give up or hold out our hands crying, "Bail me out!"? While I too wouldn't mind a piece of that $1 trillion Uncle Sam seems so willing to throw at banks, car makers and unions, I say, "No way!" The broadcast industry has a bright future. We will recover, and times will get better. Here's why:

First, we are just weeks from ending a highly successful 68-year run of analog transmission. Next month, this industry is launching the highest technology digital broadcast system in the world. It's capable of providing a vast array of new services, including mobile video, multiple channels and high-definition images with 5.1 channels of surround audio. The industry has spent $20 billion of private money building this new platform, and broadcasters are ready to build their futures upon it.

Second, broadcasters remain the most important link between viewers and news. Local stations are the linchpin to communicating with viewers. When it comes to providing local news and local weather with local and liked personalities, television remains king.

Yes, TV newsroom staffs are being cut back, but so what? Will your station stop producing news? No, you'll just do it differently with new technology. The world didn't end when videotape replaced film. The sky didn't fall when video servers and automation reduced the number of tape and MCR operators a TV station needed. Everyone equates bigger with better. However, a larger staff does not equate to a better staff or more productive staff.

Even if your station is reducing the number of employees, it's not going dark. It will be open for business tomorrow. I receive a ton of press releases, and not one has announced the bankruptcy of a TV station. Compare that to recent stories about the newspaper industry. Broadcasting is still one of the most vibrant businesses in which to work. The industry is not going away.

Finally, experts say that the economic turmoil like we're now experiencing occurs about every 100 years. That may not help us feel any better. But like the weather, change is coming, and the bad times in which we now find ourselves will pass.

Brad Dick
EDITORIAL DIRECTOR
Send comments to: editor@broadcastengineering.com

Audio still an afterthought?

Dear editor:

I'm writing in regard to the December "Understanding TV audio systems" webcast presented by NBC's Jim Starzynksi and sponsored by Wheatstone. If there is not a complete reversal of the industry's thinking, TV audio — whether for simple programming, sporting events, etc. — will continue to be horrible at best.

Audio isn't an afterthought for Danmarks Radio, which employs Miranda's Densité series for its audio and video signal processing.

If you've never had the opportunity to visit a TV truck, you may not understand the severity of the issue. I'm retired now at 72, but audio has been my life. The audio mix position in the last truck I visited was for all practical purposes the same (and bad) thing I worked in some 30 years ago. Usually the audio console is in the back of the truck, and the mixer is so close to the rear wall that it's almost impossible to move behind him. The mixer is required to wear a headset over one ear to hear director cues. The list goes on and on with things like cooling fans running, a plethora of headset traffic, etc. Attempting a reasonable mono mix was difficult.

The only conceivable way to do a reasonable 5.1 stereo mix on a remote broadcast would be to give the audio mixer his own truck with an environment similar to the one most people have in their homes. The mixer needs this space to understand how the mix is working. He would need an assistant to monitor the communications system for cues to be able to do the mix job properly. With broadcasting's minimalist approach to audio, it's safe to say this will never happen.

With broadcasters unable to simply keep a constant audio level on, say, a local newscast between the video inserts, announcers and commercials, expecting them to do a good job with 5.1 is never going to happen for the same reason.

Over the years, Dolby Labs has brought many innovations to both the recording industry and broadcasting community. Examples such as dialnorm, Dolby Metadata and Dolby Media Meter are but a few. Metadata is a useful tool to control overall loudness, but there are ways to bypass this function. Additionally, there are way too many people with knobs; they don't really understand between the viewer and the program's point of origin.

If cable provides the way you watch television, just notice the different audio levels between your cable TV channels. This occurs even after the audio portion has been beaten to death with all the limiters and compressors in the various TV and cable stations. The cable company doesn't give a damn because if the VU meters are wiggling, it's okay by them.

If you have even a reasonable 5.1 surround system at home, watch a sporting event and notice how loud some commercials are. Notice how the audio level varies between spots in the same break. Occasionally, you'll get a commercial broadcast in 5.1, and you can barely hear the announcer.

Especially with the consolidation of ownership, broadcasters today are concerned only with the bottom line. Nothing else matters. If you haven't had the opportunity to read Eric Klinenberg's book "Fighting for Air," please do; it's a real eye opener.

Again, your webinar was great, and Jim was unquestionably brilliant. Unfortunately, it's going to take a lot more of a push for broadcasters to get off their duff and do what's right.

Mike King
Barrington, IL

Additional tweaking needed

Dear editor:

The 20th century saw many awe-inspiring developments. In your October 2008 editorial on flying, you made the comment that the interior of a Boeing 747 was longer than the Wright Brother's first flight in 1903. Just think for a moment: From that date until we landed on the moon was only 66 years! So many technical refinements in so short a time, much like broadcasting. Both the airline and broadcast industries can use additional tweaking to improve their service and public respect.

Jay R. Conley
Pittsburgh, PA

See the Freezeframe question of the month on page 6.

Flipping the switch

General Sarnoff, if you could only see me now!

BY ANTHONY R. GARGANO

We are days away from completing the long journey to the promise of DTV. Originally, the great analog switch-off was never planned to be such. The initiative began under FCC directives in the late 1980s to implement an analog HDTV system that was fully compatible with existing SD NTSC receivers.

However, by 1990, the short-lived compatible analog system concept was dead. Rapid new developments in digital technology convinced the FCC that the new HDTV system needed to be digital. Thus was born the concept of an analog-to-digital transition period where the two would be broadcast simultaneously on separate channels. Interestingly, it was not a broadcast company but an equipment supplier to the cable and satellite industries, General Instrument, that initially and successfully drove the shift from analog to digital technology. The formation of the Grand Alliance by competing companies and consortia that had been each vying for the adoption of their own technology into a proposed DTV standard was the final step needed to facilitate a technology standard.

That technology standard was adopted by the FCC in December 1996, and a transition timetable was released several months later. The original FCC timetable was a DTV transmission phase-in plan that was supposed to begin in May 1999 and be completed in May 2003, with analog signals shut off at the end 2006. With high set prices limiting consumer uptake and many broadcasters unable to meet the original timetable, the political hot potato of a switchover date was delayed to February 2009.

Despite that original slow start, according to the Leichtman Research Group's annual study released in November 2008, HDTV penetration stood at 34 percent of U.S. households, with one-third of those households owning more than one set. The CEA reports the number more aggressively at 47 percent. Notwithstanding which is closer in accuracy, penetration is significant, and it occurred during a period of albeit declining but still relatively high set prices. Today, a 42in 1080p LCD receiver costs less than $800, and prices continue to drop.

The Leichtman Research Group is currently forecasting HD set penetration to double to 80 million homes within four years. That represents a 75 percent adoption rate in just over a decade, or a rate one-third faster than that originally of color television. Next month, DTV will take its place as another major milestone on the history-rich timeline of the television industry.

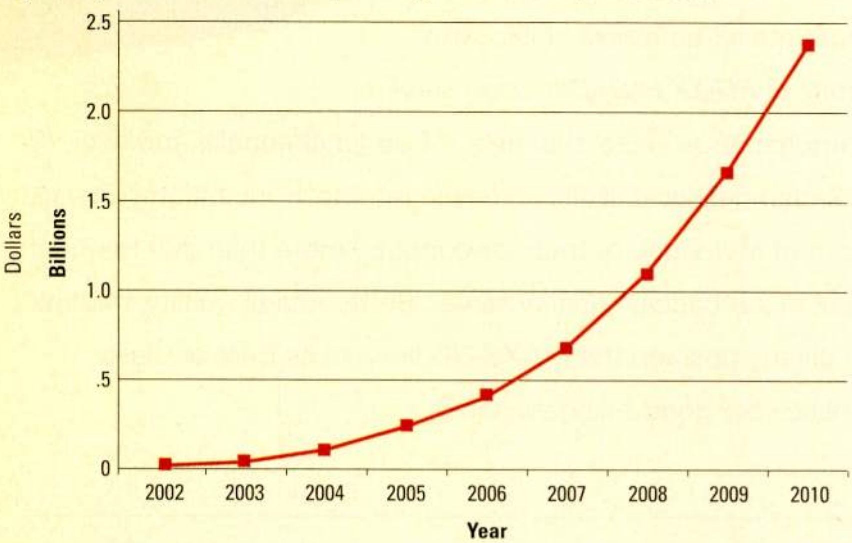
At the beginning

Clouded in the dueling claims and patents of Philo Farnsworth and RCA's Vladimir Zworykin, the title of father of television can arguably be ascribed to either of these renowned inventors of early electronic television technology. (Electronic is the operative word for those familiar with John Logie Baird and his successful mechanical disk experiments that predate both Farnsworth and Zworykin.) But it took a visionary marketer and industrialist or, as he is thought of in some circles, a devious and ruthless business entrepreneur, David Sarnoff, to evolve this technology into an industry and social influence, a communications medium and a source of entertainment that has changed modern civilization. There are several good books chronicling the epic battles between Sarnoff and Farnsworth in those exciting, pioneering days of the industry. One of these in particular, "The Boy Genius and the Mogul" by Daniel Stashower, is a great read for any industry aficionado.

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

Online video advertising continues to increase

By 2010, online video ad spending will reach $2.4 billion.



Source: Lehman Brothers *www.lehman.com*

Technology's four phases

All great technologies go through four major phases as they progress from birth to maturity: experimentation, demonstration, commercialization and innovation. Initially, there is experimentation, which is based on the underlying theoretical assumptions developed by those visionary scientists and engineers who often through brilliance, though sometimes through accident, prove a particular hypothesis. This then leads to demonstration, usually designed to create public awareness and excitement and to help stoke up potential investors.

The next phase is commercialization, and it is here that the technology begins to give birth to an industry. Then, as the technology matures, innovation becomes the hallmark, where the base technology is further enhanced in scope, and applications are usually well beyond the basic ideas of the original inventors.

Whether it is Eastman's photography, Bell's telephone or the Wright brothers' airplane, innovation precludes obsolescence. Innovation extends the life of a technology by making it continually relevant and intrinsic to the world of today — no matter when today is. Electronic television, too, progressed through these phases and did so roughly in decades. The major decade for experimentation was the 1920s. For demonstration, it was the 1930s, with a signature exhibition event taking place at the opening of the 1939 World's Fair. President Roosevelt's opening address was broadcast through NBC's 12kW station in New York City, W2XBS, to an estimated 200 TV receivers. But a World War delayed the commercialization phase to well into the 1940s. At war's end in 1945, there were nine stations on-air broadcasting to fewer than 7000 TV receivers. However, the next five years saw a virtual TV explosion. By 1950, there were 1 million television households being served by 96 television stations, with an additional 14 CPs waiting in the wings. Just three scant years later, the number of TV households grew an additional twentyfold. TV had indeed arrived in a big way. It wasn't long before the 1950s began television's era of large-scale innovation that continues to this day.

Innovation precludes obsolescence and extends the life of a technology by making it continually relevant and intrinsic to the world of today — no matter when today is.

That mechanical disk again

The first major innovation was the introduction of compatible color in the 1950s. The development of color TV had more twists, turns and intrigue than a Robert Ludlum novel.

The first color broadcasts were conducted by CBS in 1951, but the technology's roots were based on Baird's old spinning mechanical disk. The disk was spun in front of the display synchronously with a like disk being spun in front of the camera pickup device. The disk was divided in three to accommodate red, green and blue colored filters, requiring the disk to be three times the size of the picture area.

Sava Jacobson is best remembered for his invention of the modern telephone answering machine. He was also a chief engineer for one of CBS' television manufacturing allies. During that time, he described the problems with the mechanical disk in an unpublished article now in the archives at the Sarnoff Research Center (*http://tinyurl.com/3v33pu*). He wrote: "Originally developed by Peter Goldmark for five-inch kinescopes, this approach has serious technical problems when used with larger picture diameters. For example, the horsepower needed to drive a disk rises nearly as the fifth power of the diameter; the control circuitry for maintaining synchronism becomes vastly more complex for more massive disks and drives; the sheer size of the disk becomes mind-boggling: a 19" picture requires a nearly five-foot diameter disk, driven by a ten-horsepower motor."

The General goes back to war

Sarnoff served as a communications consultant to Eisenhower during the war. Once he was commissioned as a brigadier general, Sarnoff was forever simply "The General." Marshalling his forces, strategizing with his lieutenants, The General once again went to war. This time it was the industrial wars and the battle with CBS over the color system that was to be adopted.

Initially, the FCC adopted the CBS system, but the politically shrewd General battled in the courts and with the NTSC standards body, and proceeded to develop a color system that was compatible with the millions of black-and-white sets then in use. Eventually, the incompatibility issue caused CBS to abandon its efforts, and the FCC was forced to rescind its earlier adoption in favor of the RCA system. Chalk up another one for The General.

Modern day innovation

After color, innovation continued, but not in such epic proportions. Stereo audio and closed captioning are two examples that come to mind. Another form of innovation is the integration of other technologies. Ampex's development of video recording technology on tape dramatically changed the face of TV. The launch of the first Telstar communications satellite was also the introduction of TV as a truly global medium. These new technologies were not without challenges.

Thanks to differing broadcast schemes, global TV highlighted the need for standards conversion. The BBC responded with the world's first standards TV converter. It took two 6ft-racks-worth of electronics to accomplish what today resides in a chip. And, in an age where even your home

PC is capable of nonlinear video editing, it is difficult to imagine those early videotape editors actually doing it with razor blades. Presently, we are in the midst of another epic innovation: the launch of DTV.

Digital opportunities and challenges

The road to February 2009, not without its speed bumps, began in 1936. That's the year the BBC launched the "world's first, regular, public high-definition service." Using the Beeb's original 405-line standard, this high-definition service left a bit to be desired. For example, in the broadcast of a tennis match from Wimbledon, the players could be seen, but the moving ball was beyond the system's resolution capability and could not be seen on the screen.

In contrast, the first CCD camera was introduced by RCA at the 1985 NAB. When initially used by NBC for a baseball telecast, the announcers were astounded with the motion resolution that captured the seams of the baseball. And this was standard-definition NTSC. So, it seems high definition is a relative term.

In our modern day, the conversion to DTV has not only opened up the world of true high-resolution HDTV entertainment but also a cornucopia of services that digital-based technology can deliver. An early one is television content delivered to mobile and hand-held devices. Currently making its way through the standardization process is an added opportunity for the broadcaster to monetize local content and deliver information and entertainment to today's viewer on the go. Certainly it is not without its competition, but therein lies the opportunity. Who else but a broadcaster knows how to best deliver a television entertainment experience vis-à-vis simply a cell phone?

An area of current experimentation is 3-D. The NFL recently performed a 3-D broadcast of a football game to select digital theaters. The NBA has experimented with broadcasting basketball in 3-D and showed the result off quite effectively in a special theater demonstration at the 2008 NAB show.

Sports, it seems, has a special attraction to 3-D. In an experimental broadcast in March 2008, the BBC showed an international rugby game in 3-D. In Japan — which was first with regularly scheduled HDTV broadcasts starting in November 1991 — Korean manufacturer Hyundai markets a $5000 3-D receiver, and there is already a regularly scheduled one-hour-a-day 3-D broadcast via satellite being provided by Nippon BS Broadcasting. Viewing requires the special receiver and 3-D glasses as well.

Philips has developed a 3-D signal processing engine that it pairs with a special lenticular display, resulting in a 3-D receiver that eliminates the need for special glasses. Calling this technology WOWvx, it now offers an end-to-end 3-D content creation and display solution currently aimed at point-of-sale, gaming and specialized visualization applications, but clearly the 300lb gorilla in the room is home television.

Further into the future is holographic television, a technology that's in the Stone Age today. During its recent presidential election reporting, CNN used a scheme requiring 35 high-definition cameras to capture not a true hologram but a 360-degree image of a single reporter to transport her to the studio set. Was it holographic video? No, but it's certainly food for thought. Clearly, we are in the early stages, taking small steps on the road to delivering the virtual reality of 360-degree holographic video to the home.

With pioneering efforts in HDTV and now 3-D TV, the Communications Ministry in Japan has challenged the Japanese electronics industry to create holographic television by 2020. But, America, too, is well into that race. The

MIT Media Lab has demonstrated the rendering of full color holograms as 1in cubic images that are updatable at video rates of 20fps. A research group at the University of Arizona demonstrated updatable monochromatic holograms at the size of a 4in cube.

Key challenges in progressing true holographic television are the sheer amount of high-speed memory and the computational horsepower required to generate motion video. Given that many of today's cell phones have more computer power than the first space shuttle, clearly it's not a matter of if but just a matter of when you can watch that Sunday NFL game with 3-D players running on top of your coffee table-like imager as you walk around it checking the action and the views from end zone to end zone.

As we throw those transmitter switches next month and complete the transition to digital, the original promise of the ATSC standard will have been fully realized. However, this is not an ending; it's a beginning. The sheer expansiveness of a digital technology base facilitates new vistas of innovation for the future and allows rapid updating of the present. Already, ATSC 2.0 is in the wings. When building out new plants, broadcasters are creating 3Gb/s infrastructures to accommodate 1080p. Will there be a redefined transmission standard for it? What about transmission applications for MPEG-4? Now that home television is on a digital platform, will consumers — if motivated by dynamic new display experiences — adopt a PC industry set replacement model? How would that drive technology considerations? These are just some of the many issues to be considered that were not particularly a concern for broadcasters at the time of the original standard. ATSC 2.0 will need to take all of this and more into account.

It has been said that the golden age of TV has passed. If this is true, it must be the platinum era for our industry. What a delight to be a part of it. BE

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

New white space rules

The FCC's approval of WSDs could put the fuzz on your DTV signals.

BY HARRY C. MARTIN

Just before Thanksgiving, the FCC issued a comprehensive order authorizing unlicensed devices on TV frequencies. This lengthy order includes multiple justifications intended to protect against the inevitable court appeals. The rules are 15 single-spaced pages long, making this by far the most complex regulatory regime for any unlicensed service.

What the rules entail

The broadcast industry has long been doubtful that any workable set of rules could adequately protect TV stations and wireless microphones from interference. Poor device performance in recent engineering tests only deepened that skepticism.

Nevertheless, the basic regulatory structure for unlicensed white space usage seems workable. In actual practice, whether the manufacture, marketing and use of these devices can provide adequate protection for licensed operations remains the big question. It will take a year or two to see how this plays out.

A rulemaking like this one — dropping new users into an occupied band — always involves a delicate trade-off between adequate power and flexibility for the newcomer versus protection for the incumbent. Having made the decision to allow the devices at all, the FCC seems to have resolved most doubts in favor of the incumbent TV stations. The new rules are intended to protect, among others:

- TV service (full-power digital, Class A and low-power digital and analog, translators, and boosters);
- wireless microphones (and other low-power auxiliary devices);
- TV translator receive sites;
- cable headends; and
- broadcast auxiliary service fixed links.

Potential interference to these services, and many others in nonbroadcast services, necessarily puts a lot of constraints on TV band devices (TVBDs), as unlicensed white space devices are now known. These are the three main constraints:

- Operation is flatly prohibited on certain channels in specific areas and on some channels in particular areas.
- Every TVBD must know where it is and have a current list of open channels for that location, or else it must operate under the direct control of a TVBD having that information.
- Every TVBD must sense the spectrum for incumbents on the channel it is using.

Device locations must be determined to within 164ft, a requirement that only GPS can fulfill today. The catalog of available channels should be updated at least daily. Sensing must achieve a detection level of -114dBm, equivalent to 0.004 trillionths of a watt, yet even this sensitivity could miss TV signals that are viewable with a good outdoor antenna.

The FCC seems to have resolved most doubts in favor of incumbent TV stations.

In this proceeding, the FCC is being unusually sensitive to the starkly differing interpretations that TVBD advocates and their opponents have put on past sensing-only test data used in the equipment certification process. Rather than simply trusting an applicant's own test results, the FCC will rerun the tests itself, not only in the laboratory, but also in the field. The testing will be open to the public. And the FCC will put the test results on public notice and invite comment.

The last two proceedings for new, unlicensed services — ultrawideband and broadband over power line — prevailed despite vehement opposition. But both fell short of expectations in the marketplace. Because TVBDs are closer to existing successful products, such as Wi-Fi, they may have an easier route to breaking that pattern. BE

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

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

Dateline

- Feb. 1 is the deadline for TV stations in the following states to file their biennial ownership reports: Arkansas, Louisiana, Mississippi, New Jersey and New York.
- Feb.1 is the deadline for TV stations and Class A stations in the following states and territories to place their 2008 EEO public file reports in their public files and post them on their Web sites: Arkansas, Kansas, Louisiana, Mississippi, Nebraska, New Jersey, New York and Oklahoma. LPTV stations originating programming in these states, which are not required to have public files, must post these reports on their Web sites and keep them in their station records.

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DTV reception

Make sure you understand what your viewers need in order to see your signal.

BY ALDO CUGNINI

Many factors contribute to the successful delivery of services to over-the-air digital television viewers. In addition to the different technologies involved, each delivery platform has its own requirements. DTV receivers come in many forms, including set-top boxes, integrated receivers, handheld devices, professional receivers and even PC adapters. Because of the different environments in which these operate, their characteristics are diverse. This month, we'll take a look at a number of the technical and logistical issues that affect DTV reception and display. (See Figure 1.)

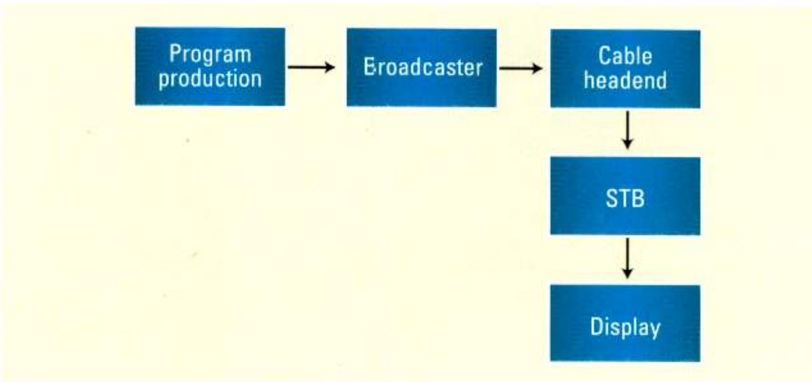

Figure 1. Format conversion can take place at many parts of a distribution chain, sometimes resulting in a poor presentation of video.

Where conversion happens

Integrated receivers are by far the most widely deployed DTV receiving devices. Front-end (tuner and demodulator) performance has evolved quickly in the past 10 years, with some designs having passed five or more generations. As a result, early concerns about multipath performance have largely disappeared. On the video side, because receivers incorporate both decoders and displays, and the displays are of fixed resolution, the user generally will not have a choice as to how video is upconverted (or downconverted) for display. This makes the quality of the final format conversion entirely up to the manufacturer, for better or worse.

The DTV set-top box (STB) offers existing analog viewers a simple way to upgrade to digital reception. While STBs have been available for several years, popularity until recently was rather low, owing to a relatively high cost. Through the efforts of Congress, affordable subsidized coupon-eligible converter boxes are now widely available. At press time, more than 13 million converter box coupons have been redeemed as part of NTIA's TV converter box program, and an uncounted number of nonsubsidized STBs have been purchased as well.

Beyond coupon-eligible functionality, DTV tuners have also found their way into advanced STBs, as well as cable and satellite STBs. With HD output capability, one confusing aspect of this arrangement is that the upconversion of non-HD material can take place either in the STB or in the TV display (acting here simply as a monitor). In fact, the service provider often will perform its own upconversion of SD material, adding yet one more place for reformatting to occur.

The introduction and use of active format description (AFD) and bar data signaling in the transmitted bit stream can help this situation, so that HD 16:9 originated content is rendered correctly on SD 4:3 displays. It is important that this information is handled appropriately, as well as the cable and satellite reinsertion of closed captions, Nielsen data, TV Guide data and V-Chip program rating information.

For cable headends, DTV converters

FRAME GRAB

A look at tomorrow's technology

TV networks experiencing strong Web growth

In September, NBC.com online video viewers grew 312 percent.

Name	Unique viewers	Unique viewer percent change from August
NBC.com	5,557,000	312
ABC.com	5,246,000	105
CBS Television	3,296,000	38
FOX Broadcasting	1,371,000	165

Source: Nielsen Online/VideoCensus *www.nielsenmedia.com*

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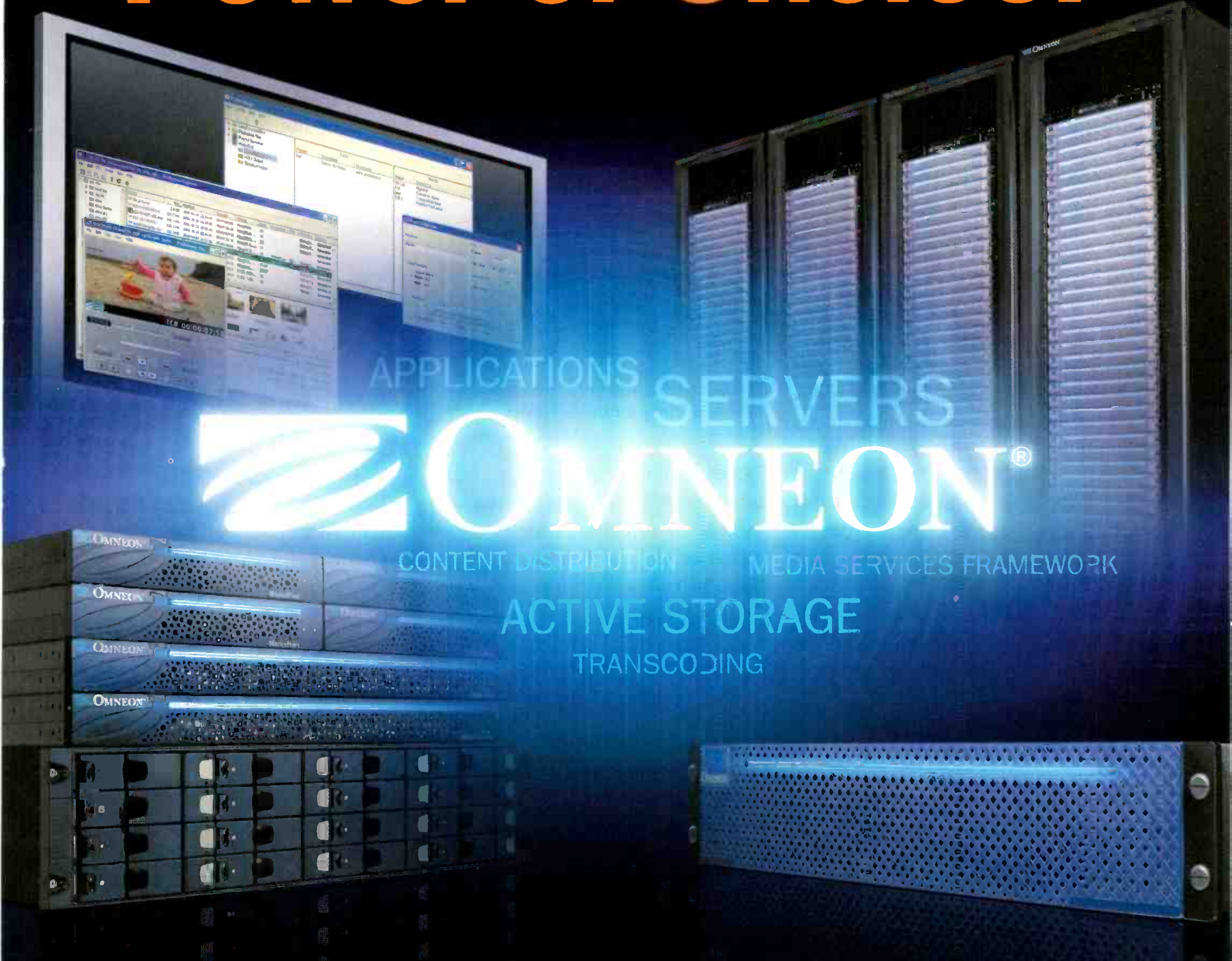

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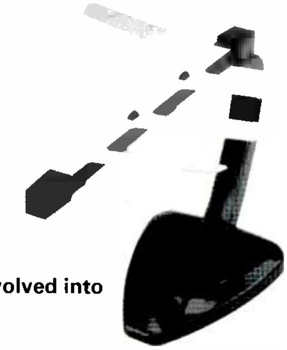
are required for retransmission of ATSC signals. Often set up to convert many channels at once, the signals can be taken to analog or digital baseband or transconverted from VSB to QAM. In addition to the emergence of digital-to-analog STB converters, a new type of customer-premises device has also become available, the wideband cable receiver. Capable of simultaneously tuning and demodulating up to 16 6MHz channels, these units allow the consumer to operate multiple TVs all from the same STB or home-server device.

Mobile DTV

Various mobile DTV standards have emerged that enable DTV reception on handheld devices. Power management is a critical issue, as conventional DTV silicon can draw more than 2W of power. To address this, mobile standards such as DVB-H and MediaFLO use time-division multiplex (TDM) and frame slicing to allow the receiver to turn on, download data and then go to sleep. ATSC-M/H (a candidate standard at press time) is also expected to use this or a similar method for power efficiency. The A-VSB proposal (one of the contributing elements to ATSC-M/H) also defined a virtual reference signal, which provides a way for the receiver's equalizer to lock on to the signal quickly, additionally preserving receiver power.

DVB-T (and therefore DVB-H) and MediaFLO are capable of hierarchical modulation, where the signal constellation can be segmented into high- and low-priority streams. This would allow high- and low-resolution versions of programs to be sent with different levels of transmission robustness. (ATSC-M/H and ISDB-T, while not using constellation-segmented hierarchical modulation, can nonetheless also be configured to support similar multiple-priority operation.)

For the PC, DTV reception adapters come in two flavors: USB and PCI tuners. PC adapters use software to decode the ATSC (MPEG-2) video, so the performance of the host PC will usually determine the quality of the video decoding. One consequence of this can be dropped frames if there is not enough CPU horsepower to decode and render the video. The adapters often house both a VSB and QAM tuner, and some include an analog NTSC tuner as well. The digital tuners transfer the MPEG-2 transport stream over a USB-2 or PCI interface to the PC, where it is demultiplexed, decoded and delivered to the display. Those offering NTSC reception must also include an internal analog-to-digital converter to deliver the video to the PC, which often adds an external video capture function.



The once-ubiquitous TV antennas have evolved into newer, better-performing units.

Antennas revisited

Antenna design has staged a comeback thanks to the DTV transition. Conventional antennas are experiencing a resurgence in sales, and small-footprint indoor yagis and smart antennas are gaining attention as aids to problematic reception conditions.

Viewers in fringe areas will benefit from high-gain antennas and/or mast-mounted preamplifiers. Here, low-noise, high-gain preamplifiers will offer the best performance, but at a price sometimes exceeding that of a converter box, especially a subsidized one. A preamp that covers both VHF and UHF bands, when needed, with separate amplification in each band, along with a switchable FM trap, will lessen the likelihood of overload from strong signals.

Viewers in rental properties may not fully appreciate their rights to install outdoor antennas. As directed by Congress in the Telecommunications Act of 1996, the FCC adopted the over-the-air reception devices (OTARD) rule concerning governmental and nongovernmental restrictions on viewers' ability to receive video programming signals from DBS, broadband radio service providers and television broadcast stations. The rule prohibits restrictions that impair the installation, maintenance or use of antennas to receive video programming, and applies to video antennas that are less than about 3ft in diameter (or of any size in Alaska) and TV antennas. In 1999, the commission amended the rule so that it also applies to rental properties where the renter has an exclusive use area, such as a balcony or patio. In 2000, the rule was further amended so that it applies to customer-end antennas that receive and transmit fixed wireless signals.

The consumer's first reference for reception issues is usually the point of purchase of their DTV product. However, many of the elements affecting the delivery of high-quality over-the-air video to the viewer's home are beyond the consumer's and retailer's grasp. Broadcasters should pay close attention to these numerous factors as a system — and not just when the equipment is installed. A successful DTV transition means handling all of the post-transition service issues with the same care that all customer service requires. BE

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Putting it all together

Follow these steps to build a solid IT infrastructure.

BY BRAD GILMER

Broadcasters are becoming more dependent on their IT-based infrastructures every day. It is increasingly important to have a solid network to support professional applications.

Given that this is a January column, it seems appropriate to look back at topics covered over the course of the previous year, but from the perspective of building an overall infrastructure to support your professional broadcast applications.

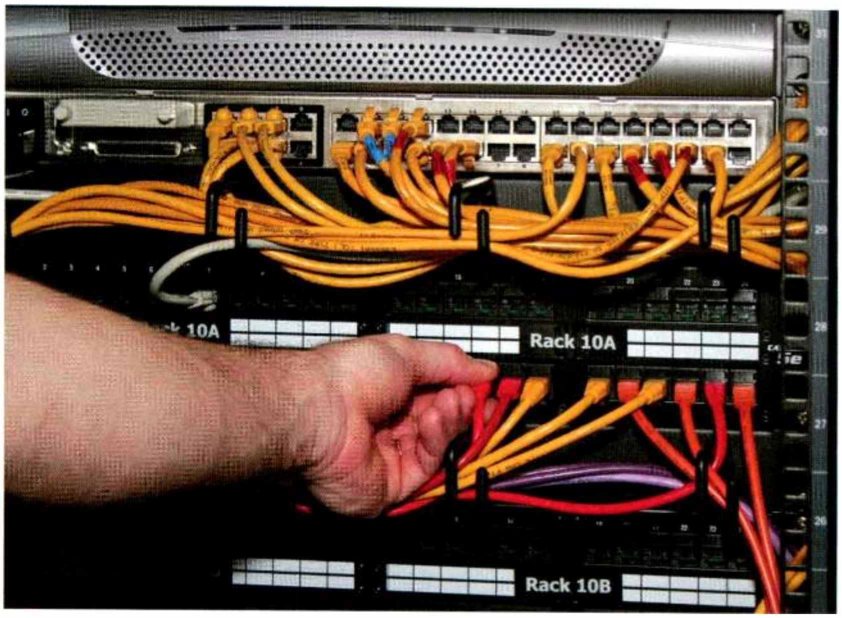
When evaluating a network for professional applications, it is critical to consider the overall network design. For most broadcasters, this means evaluating a network that is already in place. That said, the following points apply even if you are building a new facility.

Cable, wall jacks, patch panels and jumpers

In a facility that evolves over time, it is not uncommon to find a mix of cabling technologies. Given that network speeds have increased tremendously over the last five years, it is entirely possible to have a mix of media types and terminations in your facility. If there is Cat 6 rated cable throughout the facility, but there is an old Cat 3 patch panel somewhere in the critical path, the overall network performance will suffer. If you have not done so recently, conduct a survey of wiring, wall jacks, patch panels and jumpers, and other network cabling infrastructure to get the maximum performance out of your networks.

Rogue switches and unauthorized components

In facilities that have been in use for some time, it is not uncommon to find a switch or some other network component has been added without consideration of its effect on network performance. If the switch is old, or does not have capabilities needed in the network, you can experience significant performance issues. Look for equipment that is added haphazardly after the initial network design. On critical broadcast networks, create and enforce a policy that reduces the likelihood of the introduction of rogue network components.



Broadcasters should ensure that patch panels, patch cords and other basic network infrastructure components are rated for the appropriate network speeds. Frequently, older components may cause errors on a network and loss of performance.

Of course, sometimes in the rush to get a new facility on the air, broadcasters may grab whatever equipment they can get their hands on. They intend to replace that equipment as soon as things calm down, but frequently the initial equipment may stay in place for years, even if it was a temporary fix.

Level of redundancy

Everyone is under cost pressure these days. Furthermore, not every element in your networks is critical. Evaluate the design of your network, and employ appropriate redundancy plans for the business value being supported by the network. Network design allows you a great deal of flexibility in deploying redundancy only where it is needed. Just because you have a critical application on a network does not mean that every connection on the network should be protected from failure to the same extent.

Consideration for key network services

Most networks require certain services in order to function. In a typical broadcast facility, these might include Domain Name System (DNS) servers, Network Time Protocol (NTP) servers and Dynamic Host Configuration Protocol (DHCP) servers. If you are responsible for a core broadcast network, know where each of these servers is located and what impact, if any, there would be if they quit.

Current software revisions

Committing to a regular plan of preventative maintenance is critical to maintaining performance. You should view the overall network in the same way you view a news camera or broadcast switcher. Network components require maintenance as well.

Invest time in learning about and deploying logging and remote maintenance technologies.

While networks do not require much physical maintenance, it is critical to maintain a plan for the upgrade of routers, switches and computers on the network. In many cases, this means committing to testing and rolling out software or firmware revisions as they become available. But this must be a conscious decision that also takes into account the impact of deploying upgrades in mission-critical applications.

For example, I know some plants where the engineering managers refuse to deploy any new software until the first major maintenance release is available because they think at that point the manufacturer has identified the critical issues that need to be addressed. I am not advocating this position, but it does make the point that while in many cases it is important to maintain your systems at the most recent upgrade level, you may decide to temper that decision based on your own experience and level of expertise.

My personal experience has been that you should not wait too long to upgrade systems, because the work involved in moving from old software to the current version may be huge. In many cases, it is easier to do it in smaller increments.

Logging and network monitoring

I strongly encourage you to invest time in learning about and deploying logging and remote maintenance technologies. They can help you to maintain facilities in peak operating condition, make you more efficient, and most importantly, they can inform you of problems that are developing before they become critical.

Develop a security policy

Create a security policy, and communicate that security policy to everyone in your facility, especially to people who maintain the IT infrastructure. Periodically review the policy for effectiveness given the ever-changing nature of security threats in a connected world. Remember that ultimately, your role as an authority on networks in the facility is to help others get things done to achieve your businesses goals using the technology. Do not use your policy to bully others or to unreasonably deny access to resources that help people get their work done.

Internet access

These days, Internet access and security policy go hand in hand. In all professional broadcast facilities, employees need access to the Internet if they are going to do their jobs. How you give people the access they need, while protecting the core areas of the broadcast facility, is the critical question. You could adopt a policy of isolation, where you absolutely deny Internet access on the core network. Or, you could carefully allow Internet access for specific applications on certain workstations to precise people.

This is a critical business decision that has important impacts on workflow, security and flexibility in the facility.

In my experience, a conservative approach to allowing access to your broadcast core network is the best practice. But you may find that access to the core network is required by other business units within the company. How you grant access to this network both from a policy and from a technical standpoint is something you should think about.

Other areas to consider

In addition to building robust networks for professional broadcast applications, there are several other areas you might want to explore.

One of them is virtual private networks (VPNs). VPNs allow virtual segmentation of the network based on department, functionality, network requirements and security. They ease network management, reduce required equipment (compared with segmenting your network with several separate switches), and increase up-front management effort.

Storage area networks and network attached storage are critical components of a shared storage installation, and they're frequently included in systems that broadcasters buy from others. Spend time to understand what you have. You can find simple off-the-shelf IT solutions, but beware of design compromises that have been made to reduce cost.

Video over IP is a technology that's becoming commonplace. It's deployed for program and commercial content delivery, backhaul and emission. Now peer-to-peer networking is used in some professional applications (think Napster for broadcasters).

Forward error correction (FEC) methods for video over IP make a difference. Take the time to understand FEC options. Realize that FEC may not be required everywhere and that it has a cost in terms of bandwidth and latency.

Conclusion

I hope this review helps you see the diverse topics covered in this column in a more connected way. As with many other engineering efforts, different aspects of network design interact, and a decision about security, for example, may dramatically impact your position on deployment of VPNs. Looking at your IT systems as a whole will help you design better networks, be more effective and facilitate others to do their best work. **BE**

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

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HD monitors, part I

This tutorial reviews the issues on properly displaying progressive and interlaced images on HD monitors.

BY STEVE MULLEN

CRT-based monitors are no longer easy to acquire, thus the market has been forced to buy flat-panel displays. Driven by the economic downturn, high-end consumer HDTVs are also now of interest for some post applications.

Most discussions of the transition to plasma and LCD displays have focused on black level, gamma, colorimetry and artifacts of various types. Missing from these discussions is a consideration of the most fundamental difference between CRT and flat-panel monitors. The former presents video using interlaced scanning while the latter does not. Because the majority of video is and continues to be interlaced, the switch from interlaced to progressive displays is a critical post-production discontinuity.

A CRT-based HD monitor will, over a field time of 1/60sec, draw 540 lines on its screen. A full HD (1920 x 1080) flat-panel monitor functions differently. Every 1/60sec, it presents 1080 rows of progressive video. Potentially, therefore, a flat panel can display twice as much information each field time as can a CRT monitor.

This raises two questions. First, how much information can be made available to a panel's drive electronics each 1/60sec? And, second, when vertical resolution is measured, how much variation exits between monitors?

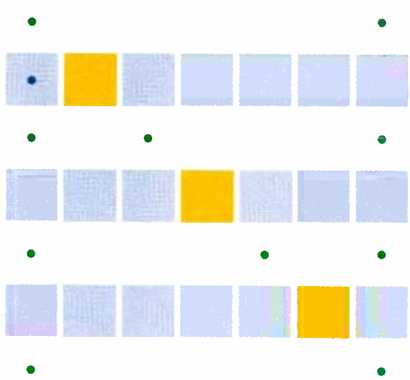


Figure 1. A line doubler generates the needed (blue) pixels from samples (green) available from lines (light blue) directly above and below the new synthetic lines (dark blue). Diagonals are not handled well because an interpolator cannot create a pixel when there are no samples above and below the locations where it will be placed (yellow cells).

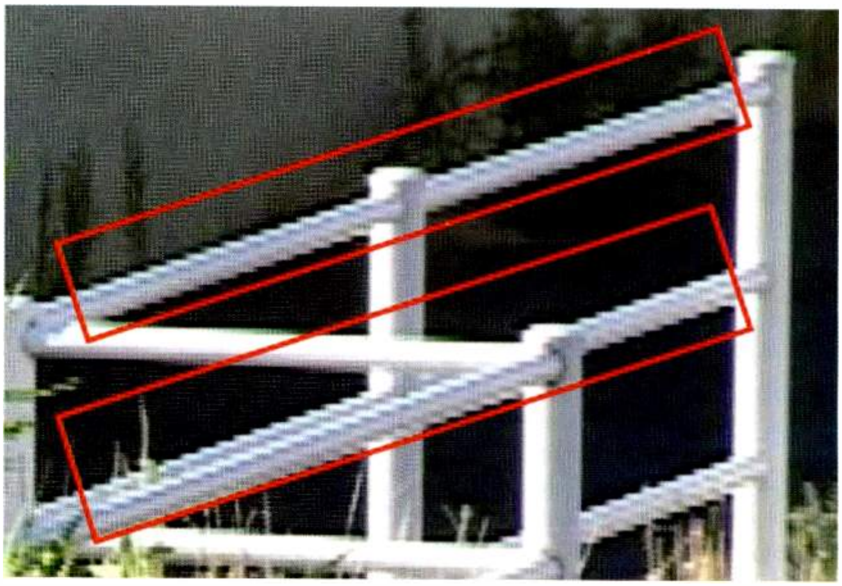


Figure 2. Jaggies created by a line doubler

Published tests of 78 full-HD HDTVs reveal a wide range of vertical resolution. (For more information, visit *http://tinyurl.com/6z8vcc.*) Measurements made with motion patterns from the FPD Benchmark Software Blu-ray disc ranged from a very low 260 lines to a perfect 1080 lines. Because all tested panels had 1080 rows, this measured range indicates significant differences in monitor electronics.

The deinterlacer in every flat-panel display is the circuit that converts interlaced to progressive video and thus determines how much information can be sent to a panel's drive circuits. The simplest deinterlacer uses each field.

Hello, bob

To convert fields to frames, a line doubler is employed. Each incoming field is used to generate a new field. Generated lines, plus the original lines, create a 1080-row frame. With 60i video, every second, 60 fields are deinterlaced to 60 frames. To some, the constructed image — especially graphics — seems to vibrate up and down; hence, this type of deinterlacing is often called bob.

A line doubler generates the needed pixels from samples available from lines directly above and below the new synthetic lines. (See Figure 1.) Diagonals are not handled well because an interpolator cannot create a pixel when there are no samples above and below the locations where it should be placed (yellow cells).

Grounding practices

Protect sensitive equipment with proper system design.

BY JAY ADAMS

With the analog cutoff deadline looming, broadcasters are putting the finishing touches on new digital transmitter and translator installations. What better time to review grounding systems to protect new expensive equipment and ensure years of reliable performance?

Although proper grounding practices may have been followed during initial site construction, problems could have been introduced over the years as either electrical service or equipment was added or modified. Grounding issues account for up to 40 percent of power-related problems and can cause unpleasant off-air or equipment damage situations.

In addition, transient over voltages — high voltage spikes or impulses of short duration — may cause other havoc if not adequately suppressed. The source of these transient surges can be natural, such as lightning. Another source of surges is power grid feeder line or capacitor bank switching. Finally, some surges originate from internal inductive loads.

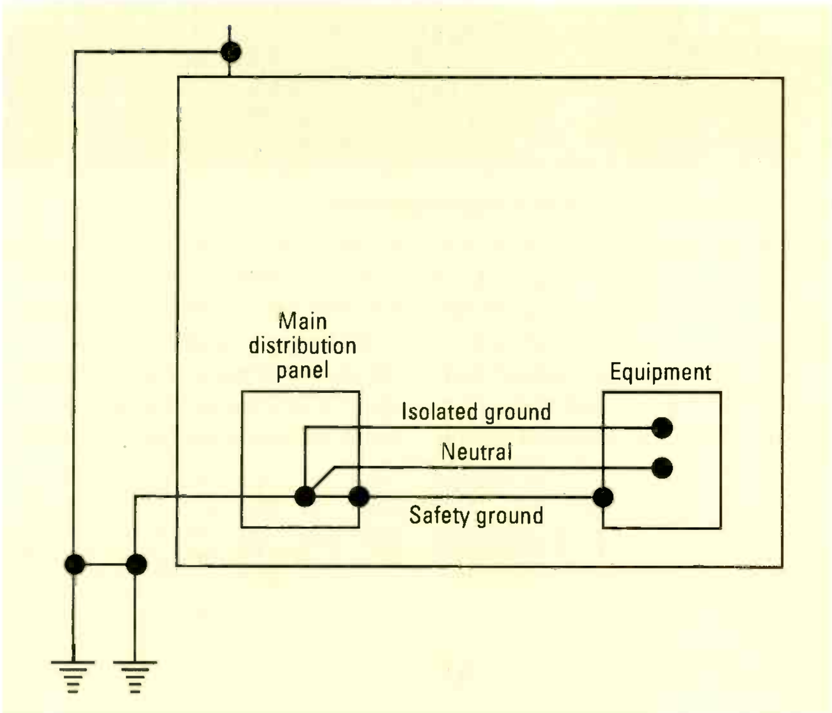


Figure 1. With single-point grounding, all references to the ground come to a single point in the facility before referencing the earth.

Regardless of the source, these damaging surge voltages may be injected into power and data circuits, causing equipment destruction and safety hazards.

Problems such as these may be avoided by implementing a single-point grounding system, following the National Electrical Code (NEC) when installing the safety ground and grounding electrode systems, and properly selecting the appropriate surge suppressors. (See Figure 1.)

Single-point grounding

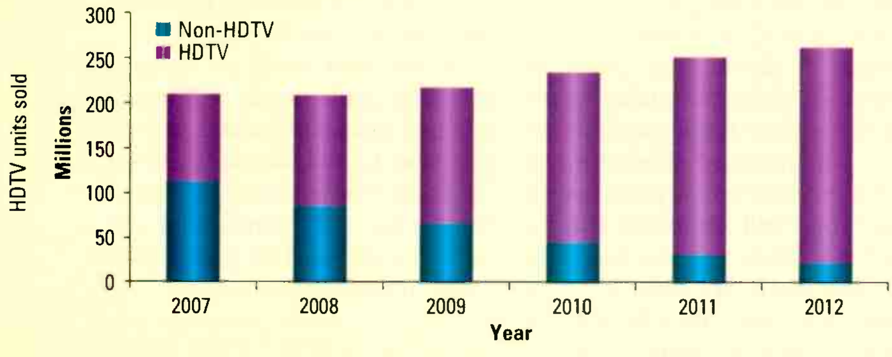
The worst scenario for your equipment, as well as your safety, is to reference each equipment cabinet at a telecommunications site to the earth at different points. Because the earth is a poor conductor, steady state and momentary voltage differences exist in the soil. If equipment cabinets have high-speed communication interfaces between them and each one connects to the earth at different points, representing a multipoint ground,

FRAME GRAB

A look at the consumer side of DTV

In 2008, HDTVs overtook SDTVs in sales

By 2012, an estimated 241.2 million HDTVs will be shipped globally.



Source: iSuppli *www.iSuppli.com*

Figure 4. Combing artifacts from weave deinterlacer

to obtain optimal performance is to incorporate motion-sensing logic to enable a deinterlacer to adapt its operation to the presence of motion.

A frame-adaptive deinterlacer transitions from weave to bob in the presence of motion. Monitors that use this type of simple adaptive deinterlacing deliver static video at 1080TVL. Motion video, unfortunately, has only 540TVL. Moreover, motion within any portion of a frame causes resolution to be reduced over the entire frame.

This problem can be reduced by more sophisticated adaptive deinterlacers. For example, a region-adaptive deinterlacer can measure the motion within a region smaller than the entire frame. The transition from weave to bob is made at the region level. Region-adaptive deinterlacers depend on the assumption the human eye will not notice the loss of vertical resolution on moving objects.

The smallest region is a pixel. Of course, the computational load required to work with up to 1920 x 1080 pixels is enormous. Nevertheless, several years ago, a pixel-adaptive version of the Teranex image processing algorithms was implemented in a single chip. Called PixelMotion, or HQV, it is a sophisticated form of motion-sensing deinterlacing. The Silicon Optix Reon-VX chip is the latest implementation of the Teranex technology. A moving window of four fields is used to determine which pixels are in motion and which are not. Static pixels from both fields are moved into a new frame.

Figure 5 shows how pixels in motion — within both fields (green and blue), which would create combing — are processed differently. Figure 6 shows how motion pixels (green) held in one field are moved into the new frame where they take their place with static pixels (not shown). Motion pixels (blue) held in the other field are discarded, thus preventing combing. Figure 7 shows how replacement pixels (red) are interpolated from pixels above and below each discarded pixel. Only pixels from the nondiscarded field — the one with motion pixels — are used as a source. Note that while combing is suppressed, some information is lost when pixels are discarded.

Because the pixel-adaptive process works somewhat like a one-pixel wide line doubler, diagonals will have jaggies. Therefore, as with a bob deinterlacer, a second-stage, multidirection, diagonal interpolator reconstructs pixels along diagonals.

Significant variations in flat-panel vertical resolution present a problem to those searching for a monitor because a buyer is too often unable to discern performance differences from information supplied by manufactures. For example, although the best performing LCD display in a test of flat-panel monitors refreshed at 120Hz, other 120Hz models delivered only one-third the vertical resolution. (To view a PDF of the test results, visit *http://tinyurl.com/66vgtv*.)

In our new world of flat-panel monitors, professionals will need to conduct extensive research prior to purchase. A good place to begin is the AV Science Forum, which has specific threads for LCD panels (*http://tinyurl.com/yuj27l*) and for plasma panels (*http://tinyurl.com/2sml7k*). BE

Figure 5. Simulated combining from two fields of moving pixels

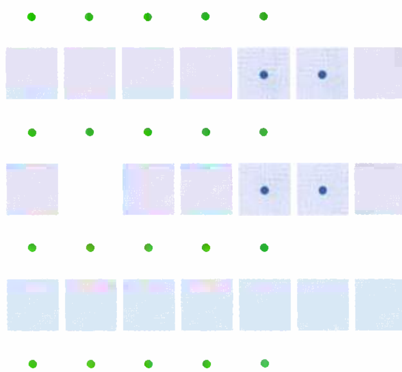


Figure 6. In this simulated PixelMotion, a field of motion pixels is discarded.

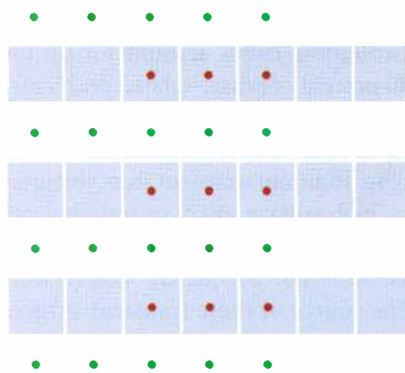


Figure 7. In this simulated PixelMotion, replacement pixels are interpolated into a new field.

Steve Mullen is owner of Digital Video Consulting, which provides consulting services and publishes a series of books on digital video technology.

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The GF series' tapeless GFPAK™ storage medium uses semiconductor-based Flash memory, which offers distinct advantages over optical-disc-based storage. GFPAK™ has no moving parts, is rugged, highly impact- and vibration-resistant, and provides problem-free operation under long periods of high G-force. The GFPAK™ is a long-life media, supporting tens of thousands of rewrite cycles, another significant factor in reducing running costs.

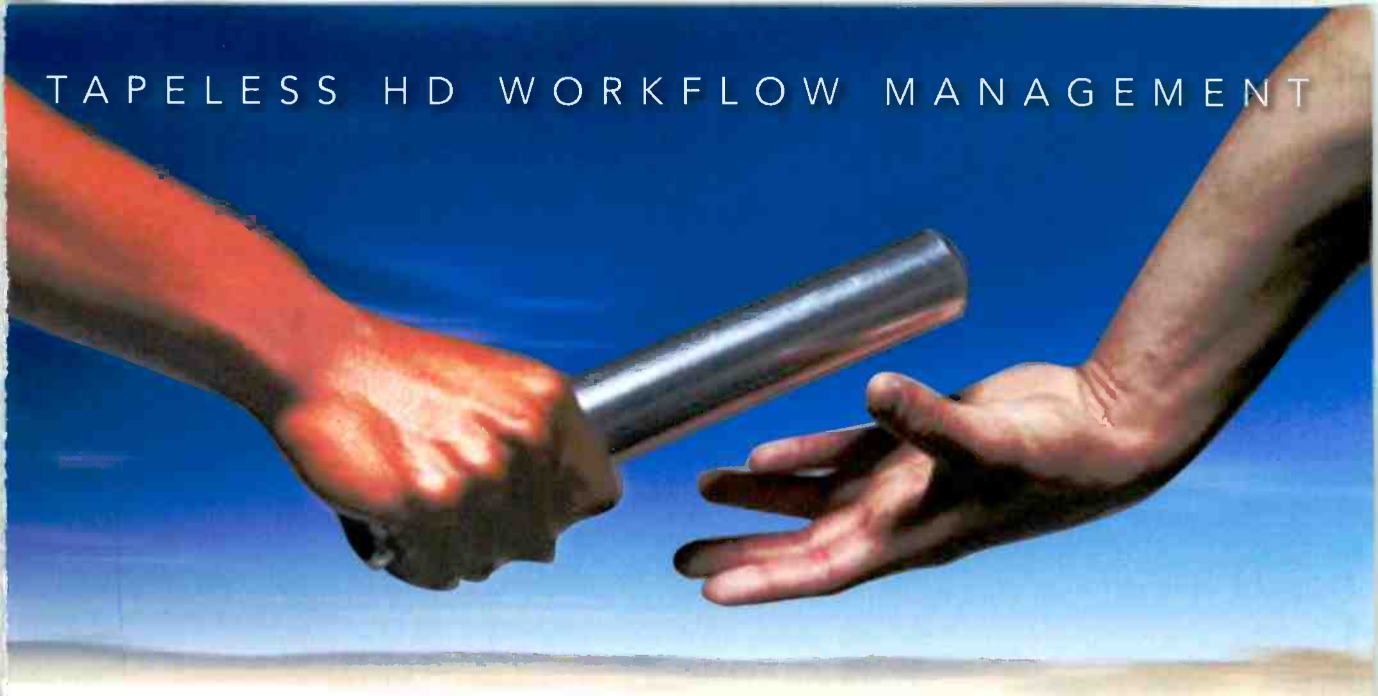
A single GFPAK™ can store around 120 minutes of HD images, affording ample field recording time. And GFCAM™ includes internal flash to permit uninterrupted recording when changing the GFPAK™.

Ikegami and Toshiba's GF series optimizes HD workflow for news, sports, and entertainment.

Ikegami and Toshiba have teamed up to deliver unprecedented levels of workflow innovation in the new GF series tapeless HD ENG system. From digital capture to fast, efficient non-linear editing, to instant IT networking, this revolutionary system features an open-codec HD/SD architecture, proxy video and meta data convenience. System components include the GFCAM™ HDS-V10 tapeless camcorder, the GFSTATION™ GFS-V10 Central Video Management/Player/Recorder studio deck (and a field version for added production versatility), and GFPAK™ high-capacity Flash media to record more than two hours of HD video.

Meta Data and Proxy Data Solutions

As the GFCAM™ records the full-resolution image and sound data, it can also simultaneously record proxy video and meta data. Proxy video, a low-resolution MPEG4 mirror of the full-resolution image and sound, has the same time code as the original and can be quickly delivered over a network or accessed on location for initial viewing and to support scripting and editing. Meta data recorded during acquisition supports workflow efficiency by logging key facts on the shoot, including the date, location, program name, and equipment used.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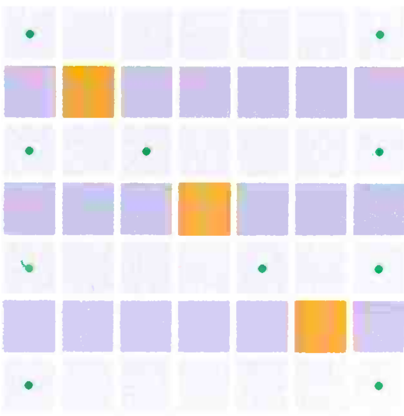

Figure 3. Diagonal interpolation

To reduce jaggies along diagonals (as shown in Figure 2 on page 32), a second-stage, multidirectional, diagonal interpolation filter can be used to reconstruct the missing pixels along diagonals. (See the purple dots in Figure 3.)

Maximum vertical resolution from a bob deinterlacer is that of one field — only 540TVL. (See the "Bob isn't always bad" sidebar.) To obtain up to twice the vertical resolution, a weave deinterlacer can be employed.

As its name suggests, a weave deinterlacer weaves lines from two fields together. Odd lines from the current frame are combined with even lines from the previous frame, and odd lines in the current frame are combined with even lines in the current frame. Because information from different moments in time is combined in each generated frame, moving objects have edge combing. (See Figure 4 on page 39.) Therefore, a second-stage, isotropic filter that smoothes all vertical edges within the image is necessary.

Motion-sensing logic

Employing a weave deinterlacer is not the only way of obtaining greater vertical resolution. A better way

Continued on page 39

Bob isn't always bad

Software deinterlacers typically employ bob because its simplicity enables rapid computation. Speed is critical in media players and when compressing video for streaming. Because only one field is obtained from a frame, the temporal sampling rate is cut in half — from 60i to 30p.

The low vertical resolution delivered by bob has not been an issue because, until recently, only SD video was available via the Internet. Likewise, only now are computer screens able to display full HD within a window.

Continued on page 39

Pro-Bel 3G Routing

576x576 From $220,000

Today's economic climate may be challenging but there's no need to compromise on your 3G rollout. Pro-Bel has announced it's best selling Cygnus router is now available from just $220,000* for 576 x 576, making it the most cost effective 3G routing solution in the industry.

The savings however don't stop with the competitive purchase price, Cygnus has been engineered to be extremely power efficient, running at less than 5mW per crosspoint**.

Cygnus is also fully integrated with Pro-Bel's enterprise wide management application, Morpheus Control and Monitoring, which provides enhanced command-and-control capabilities across the content production and delivery infrastructure.

Should your routing requirements run to a smaller scale, the Pro-Bel 3G range also includes the award winning Sirius and Pyxis families.

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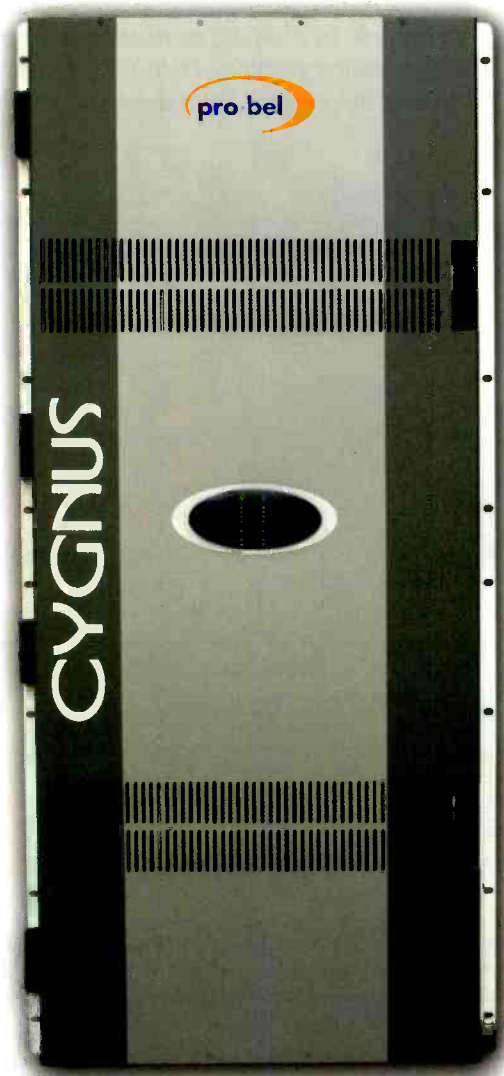

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Engineering The Broadcast Future

these voltage differences could cause ground loop currents (I_G) and equipment downtime, as well as pose a safety threat. (See Figure 2.)

Therefore, a single-point grounding system, where all references to the ground come to a single point in the facility before referencing the earth, is essential to any microprocessor-based installation. In most AC installations, it is normally a question of referencing back to the original neutral-ground bond in the building, or the secondary neutral-ground bond of an associated step-down or isolation transformer.

Whether it is an isolated ground, a neutral conductor or a safety ground connected to an equipment cabinet, all grounds come to a single point at the main distribution panel and then connect to the site's earth grounding system.

Lightning protection system ground

Both the NEC (NFPA 70) and the National Lightning Protection Code (NFPA 780) require a separate, physical lightning protection (air terminal) earth ground electrode bonded to the main entrance grounding electrode system.

The purpose of this is to direct the majority of current from a lightning discharge to a structure into the earth away from the building entrance grounding system, significantly reducing the lightning current into the building electrical grounding system. The required bonding of the two grounded systems maintains a reasonable degree of touch safety between the two grounding electrode systems during the lightning event.

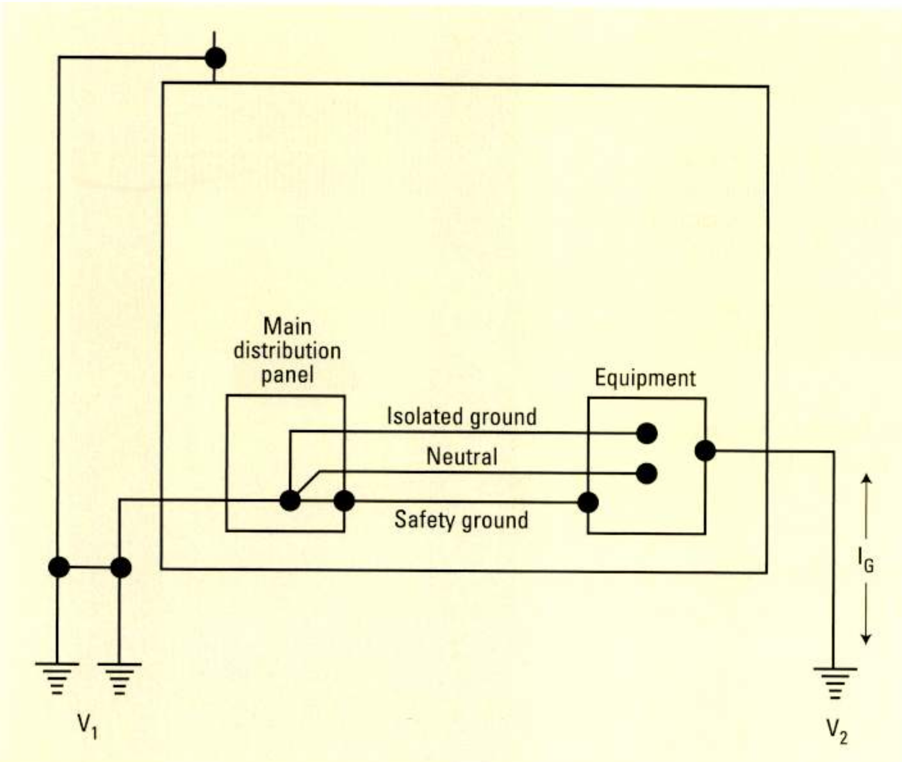

Figure 2. In this multipoint ground setup, V_1 and V_2 represent the value of a momentary voltage that can exist at each point. If the voltage levels differ (as is the case when a lightning surge sweeps through the earth), current begins to flow to equalize the differential in voltage potential.

Isolated ground

In addition to installing a single-point grounding system, the NEC allows an isolated ground — a term often misunderstood.

The computer industry has recognized for decades that metal conduit, which is allowed as a safety ground system for equipment cabinets by the NEC, often exhibits a great deal of electrical noise due to neutral-ground wire reversals, refrigeration and chilled water pump systems in buildings. Most electronic equipment uses the safety grounding conductor as a logical reference as well as a means to trip circuit breakers during fault conditions.

The isolated ground technique was developed and approved in the code several years ago as a means of establishing a quiet ground connection. Simply speaking, it means a sufficiently sized, insulated conductor, isolated from conduit and subpanel enclosures (that touch conduit). It references the earth only at the building entrance neutral-ground bond or the secondary neutral-ground bond of a step-down or isolation transformer that is part of the associated electrical distribution for the equipment. (See Figure 3 on page 44.)

Grounding techniques

The NEC allows a single-point grounding system to be connected to the earth in seven different ways.

Rod and pipe electrodes make up about 90 percent of all grounding electrode system installations. Generally, this is comprised of an 8ft to 10ft stake driven into the earth that extends up and connects to the neutral conductor at the first disconnecting means, which is often the main distribution power panel.

One of the misunderstandings associated with this type of system is that many facilities drive additional ground rods to clear up problems. The NEC requires that all earth ground references be directly bonded to the original neutral-ground bond at the building entrance. This is because if a person is touching one cabinet connected to an independent earth ground rod and something else connected to the main building ground system, the large voltage differences that exist in the earth may harm that individual (especially during lightning

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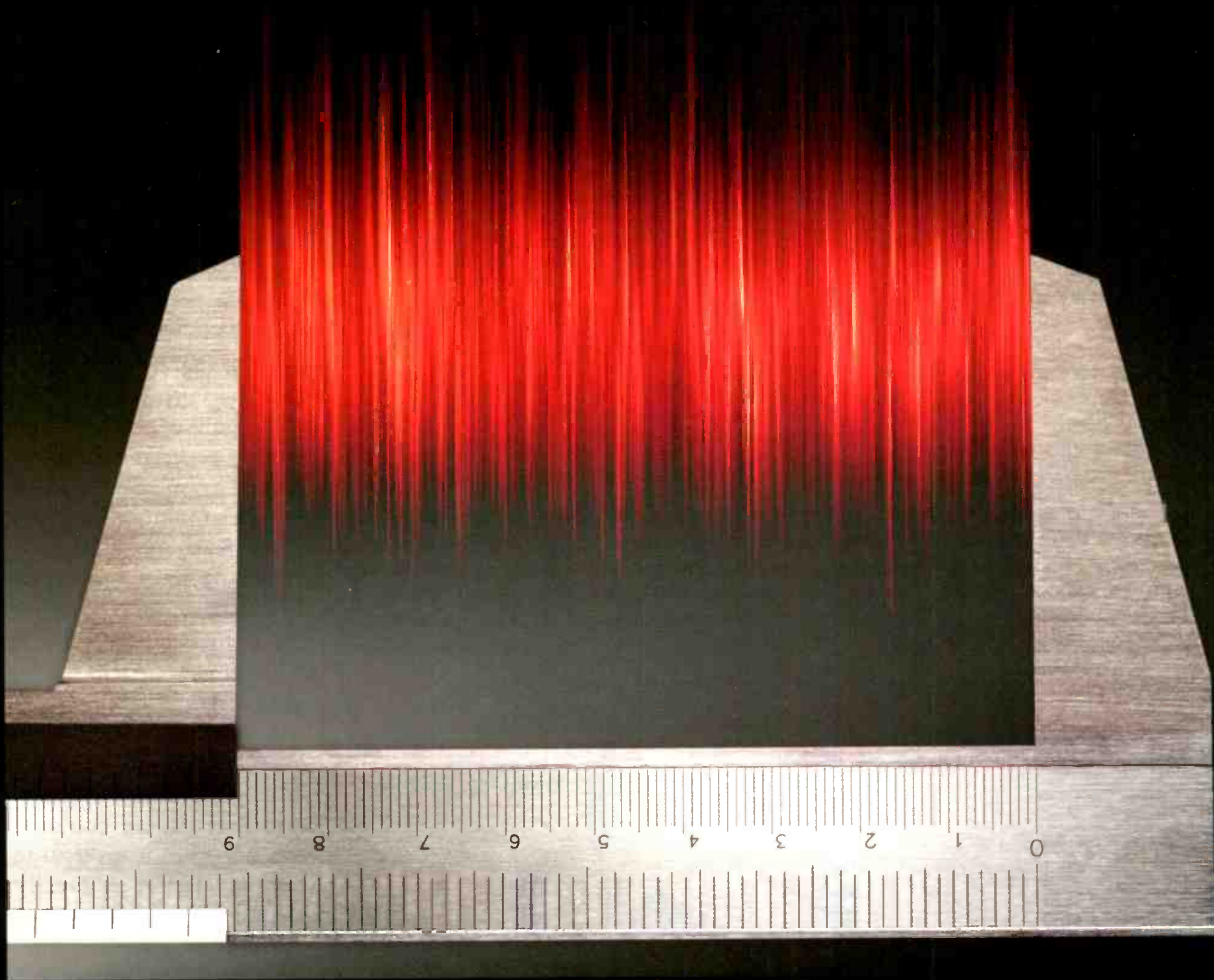

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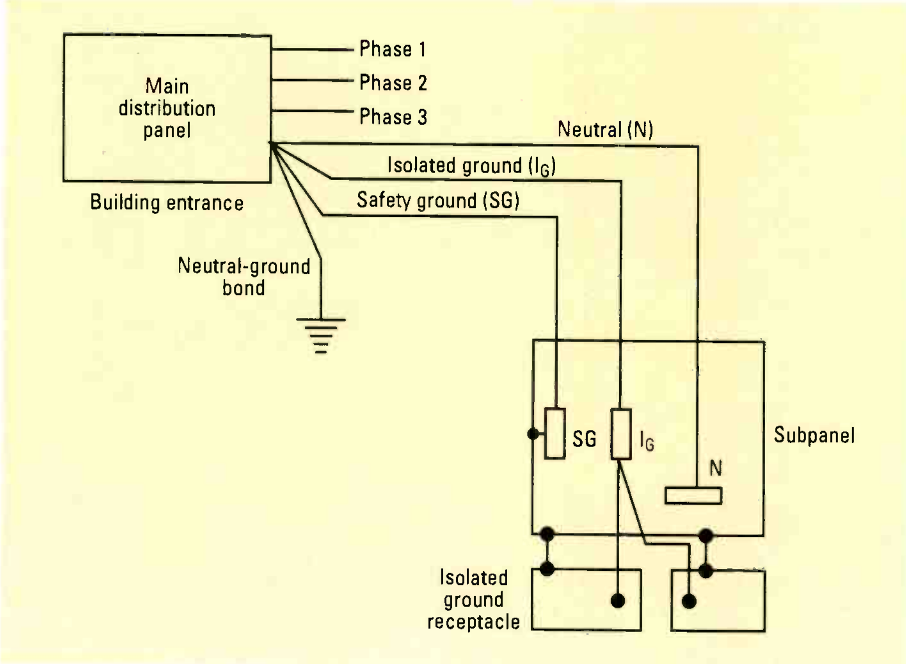


Figure 3. This illustration shows the three-phase electrical service and the differences between a dedicated isolated ground versus the standard safety ground. The grounding connection requires a sufficiently sized and insulated conductor, which is isolated from both the conduit and any electrically-connected subpanels. This ground should be referenced to earth only at the building entrance neutral-ground bond or the secondary neutral-ground bond of a step-down or isolation transformer that is part of the facility's electrical distribution.

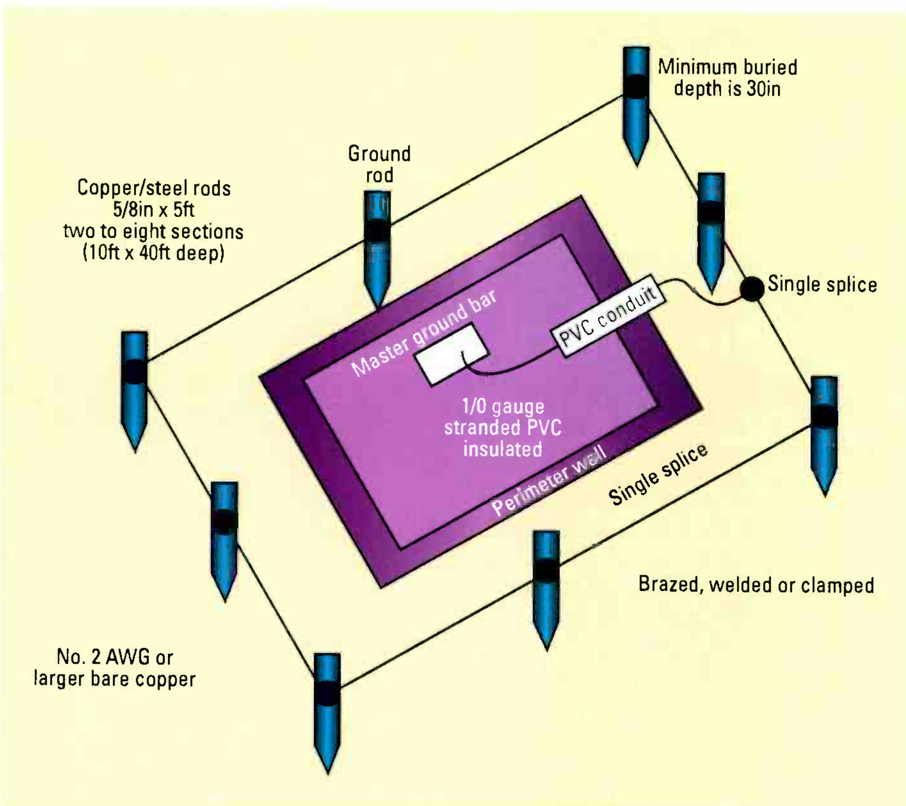


Figure 4. A ground ring consists of a minimum No. 2 AWG, bare wire buried no less than 30in under the ground surrounding the building. It gives more of an equal potential ground around the facility.

events or fault conditions). Remember, the main reason for connecting an electrical distribution system to the earth is for touch safety.

Driving additional rods (multiple grounding) can cause equipment downtime because they create ground loop currents to circulate throughout the equipment cabinets between the different grounds. Instead, the ground should be cleaned up within the structure to a single point coming from each cabinet back to the main building ground point or the nearest neutral-ground bond at the secondary of an associated transformer.

A common mistake that occurs when electricians install additional ground connections is that the resulting current in equipment may easily reach many amps. Changes in this objectionable current create voltage spikes or transient over voltages in the cabinets — any time there is a changing current in a wire, spiking occurs.

Keep in mind, it is legal to add another ground rod at a specific minimum distance and connect it to the original building entrance ground rod. However, it is illegal to ground equipment cabinets directly to separate earth grounding systems.

A second way to connect a single-point grouding system to the earth is with a gound ring. This system is comprised of a minimum No. 2 AWG, bare wire buried no less than 30in under the soil surrounding the building. The ring gives more of an equal potential ground around the facility. It is typically supplemented with multiple earth ground rods. Proper design dictates that there should be one point of contact between the ground ring and the equipment shelter.

Problems occur when installers unwittingly connect different equipment cabinets to various points around that ring. In this case, the inductive nature of the ground ring wire can result in large lightning voltage differences between the cabinets connected to

diverse points on the ring. (See Figure 4 on page 44.)

Other supplemental grounding electrode systems include:

- a concrete-encased electrode, consisting of metal bars encased in concrete, buried in the earth;
- a grounded metal building frame;
- plate electrodes, which are metal plates buried in the earth for a larger surface area;
- a supplemented metal underground water pipe (as a secondary or third connection to the earth); and
- underground local metal structures, with the exception of gas piping.

Tower lighting and controllers

Any time a power or data cable exits or enters a building, injected surge voltages could cause equipment destruction and safety hazards. Proper grounding and surge suppression limit the damage incurred. Another way that electronic equipment can be disrupted is through multigrounded cable shields.

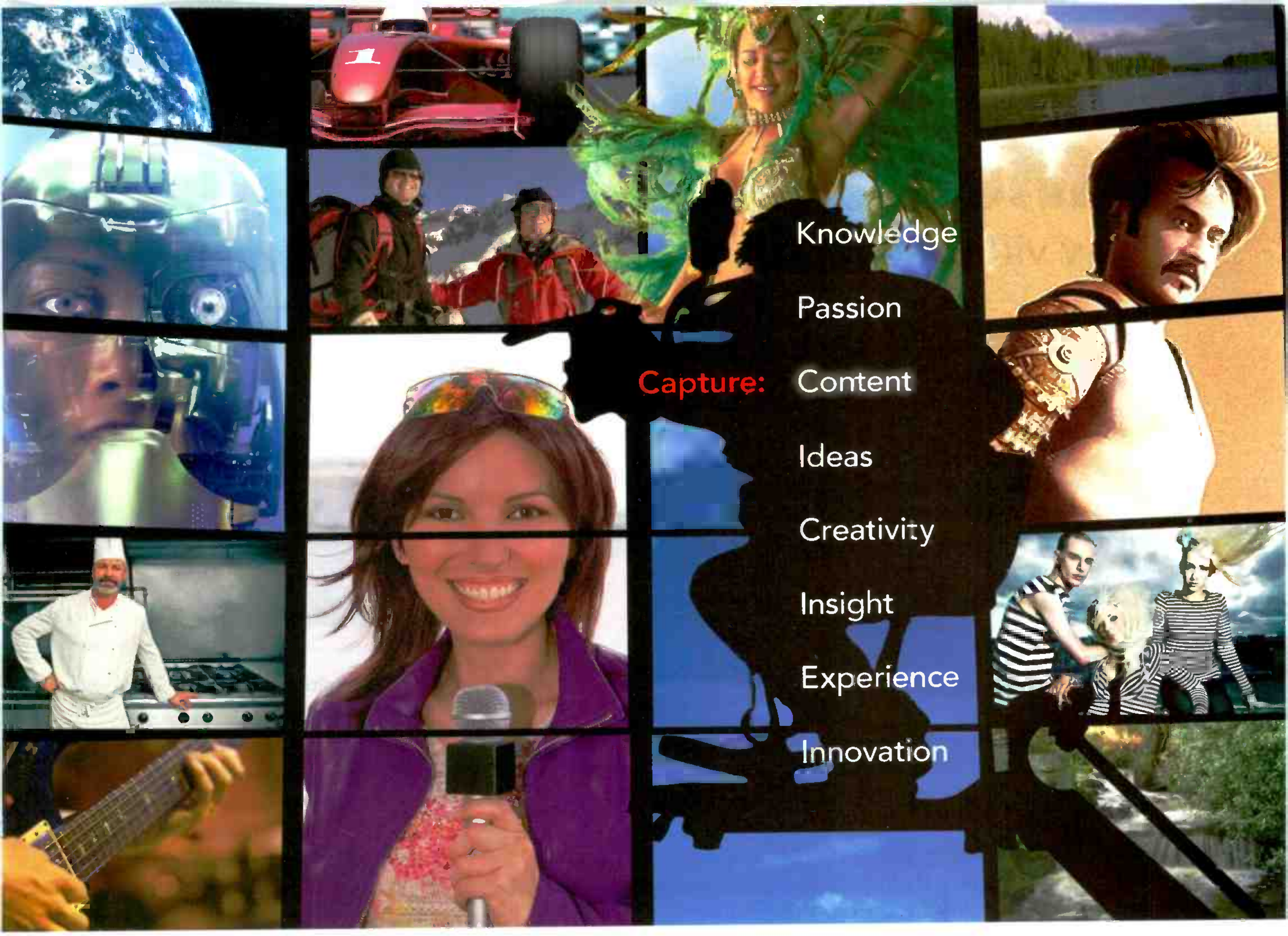
Shields are typically constructed of aluminum foil or mesh that wraps around twisted insulated wires — typically 22-gauge in size — to block undesirable AC and high-frequency fields. Low-frequency power distribution cables running parallel to data lines add noise or hum into low-amplitude signal circuits. In addition, high-frequency fields from colocated transmitters can cause data alterations. If the shield is grounded at more than one end, differing AC potentials in the soil create equalizing AC currents on the shield. These currents introduce unwanted noise into the signal circuit.

Broadcaster checklist

Here are a few steps you can take to protect your station:

- Measure the current on your equipment grounding conductor. Anything over 0.25A should be investigated.
- Measure the earth ground resistance, and do all you can to get it as low as possible.
- Verify there are no multiple neutral-ground bonds or earth ground connections.
- Challenge yourself to ensure a robust electrical environment for the new digital transmitters and studio equipment. **BE**

Jay Adams conducts educational seminars and site grounding audits for RO Associates.



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Media-aware storage

New video storage systems offer unique advantages.

BY JOEY FAUST

Storage from an IT perspective could be viewed as a bucket of bits in which one set of bits is treated equally to any other set. This works out fairly well for the traditional IT professional, to whom one set of bits is essentially indistinguishable from any other. However, whereas the IT professional is concerned with *data*, and getting data to those users or processes that need it in an effective way, the media professional is concerned with *content*, and so it is not just the communication paths, bandwidth or access that is important, but also the quality, timeliness and meaning behind the bits.

Because a media facility does not have the same goals as a traditional IT data center, there may be aspects of traditional IT storage that are not ideal for media. The main issues could be enumerated as follows:

- Media files are much larger than other types of files.
- Bandwidth into and out of storage systems needs to be greater when dealing with media content.
- Media activity is often not transactional in the same way that most IT activity can be. A single media file on a shared-storage network may need to be simultaneously accessed by multiple parties, so the same types of file locking that occur on shared business documents cannot occur here.
- The movement of media is a much more significant issue, due mostly to larger file sizes but also to the time-based nature of the content.
- Media files have significant amounts of metadata associated with them. This metadata is used in the daily operations of a media facility in a way that managers of traditional file systems are unaccustomed.
- Security and access control of media is always a challenge, and traditional IT security setups may hinder as much as they enable.

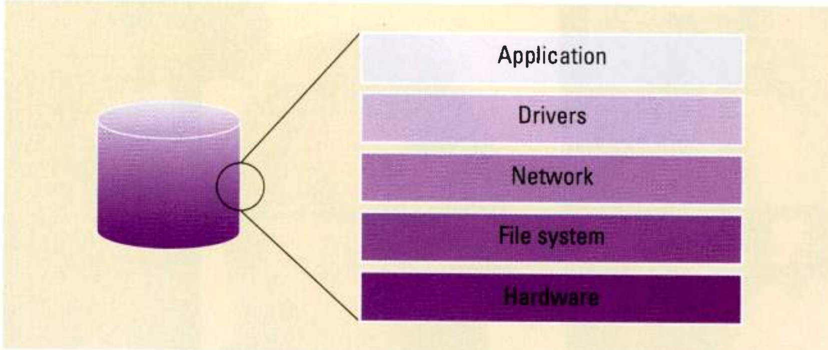


Figure 1. Shown here is a simplified model of the traditional IT storage stack, with the network present in shared-storage scenarios such as NAS.

Media-aware storage

Traditional IT storage is based on the assumption that data is heterogeneous — that it conforms to no particular pattern other than to be segmented into individual files. Media-specific storage, however, doesn't need to work from this same assumption. Media files are a subset of all types of files, and so storage that is intended to handle only media can make additional assumptions about the data that it stores, specifically that it is time-based in nature. Different assumptions mean a potentially different product. This could improve a file-based workflow.

While so-called "media-oriented storage" is widely available in the industry, "media-aware storage" as defined above has only just started to impact media workflows. Certain vendors have begun to experiment with the idea of extending IT storage concepts into the world of media to find efficiencies in dealing with the eccentricities of media files. Traditional IT technology has only recently truly stabilized its presence in the media industry, so this is a new area for media technologists.

Approaches and models

The concept of media-aware storage can mean different things when applied to different applications. There are many aspects to media management, just as there are many aspects to digital storage. Software that is used to manage storage systems can be "aware" of media in different ways. The following seven applications of the concept each have different repercussions on system design.

Specialized hardware and software stack

Storage file systems are application-layer constructs supported by many layers underneath — hardware, I/O connectivity, operating systems, presentation software, security, etc. (See Figure 1.) Efficiencies can be found at any of these layers by limiting bandwidth or by removing processor-intensive generic storage qualities, access prioritization or proprietary configurations.

For example, in media applications, providing data in a timely manner may be more important than providing data without error. If a storage system comes across data that has been corrupted or cannot be easily read, a traditional disk subsystem response would be to scan the data several times in an attempt to read it

with all errors corrected. The media need may, in fact, be to deliver the corrupted data quickly without rescanning it (perhaps using error concealment techniques) just to keep up a consistent bandwidth.

Partial file restoration

Media files offer a fixed number of file types for a storage vendor to consider. If a vendor knows that its storage is for media only, specific file extensions (wrappers) and formats (codecs) must be supported.

Partial file restoration leverages this to find workflow efficiencies. When there is little online storage space compared to the available nearline or offline storage space, restoring only a portion of a large media file can ensure that the most valuable space is used as effectively as possible.

Automatic media processing

A logical extension to partial file restoration is partial file storage, or storing only pieces of whole files that can be automatically assembled or otherwise processed when they are requested by the user.

There are challenges here, such as buffer management or dealing with GOP structures, but the benefit of storage that actively manages, assembles and disassembles clips for delivery to an application is undeniable. For example, this storage could be used to package an EDL automatically, below the application layer.

This type of system would be especially useful in facilities that have spent years perfecting a tape-based workflow and depend on the linear nature of tapes and certain video servers to prepare their media. This would also allow a facility to capture portions of a single asset over several sessions, or allow an editor to save just the changed portion of an asset.

Automatic cataloging

A storage system can also have an assumption of what metadata is useful to catalog. This would allow the metadata that can be automatically generated to collect at the storage layer instead of at the application or media asset management (MAM) layer. Media-aware storage could automatically catalog duration, format, source, frame rate, resolution, color depth or any data that live in the essence wrapper.

The best way to service the complex storage needs of media facilities is to combine streamlined IT storage with value-added media services.

Storing this data in the file system provides faster recall than a database-style MAM system, which would store data in a separate file that must be kept consistent with the file system. Databases have become more efficient in the past 30 years, but cataloging asset metadata with the storage system can simplify the design of media management applications and prevent the need for a separate database.

Video processing components can be used at the storage layer to gather more metadata automatically, and other wrappers or VANC data can be leveraged as well. Rights data that is associated with the media asset could automatically inform the access control of the storage system by mapping the rights in the media asset to the users/groups of the system.

Proxy workflow

The concept of a proxy workflow already is well-understood in the media industry. By expanding the concept to include more than simply a low-resolution and a full-resolution version, the concept becomes less about saving bandwidth and processor power and more about providing the right version of the asset to the right user or application. Business rules at the storage level could be used to present different-sized assets to different applications.

By combining a storage system that manages proxies with a rich security infrastructure, a facility would be able to prevent unauthorized users/applications from accessing or even knowing about other available resolutions or formats of an asset.

Format independence

The ultimate goal is this: Different applications requesting the same media asset get different versions of that asset, depending on the resolution and format that the application is expecting, and the storage system is responsible for generating and managing that versioning.

Format independence like this is especially useful for the exploding world of new media distribution. Contemporary production houses must generate tens or hundreds of differently formatted media assets as they hypersyndicate their content. Distribution requires not only SD and HD versions of TV material, but also streaming and electronic sell-through versions for online distribution. If the storage system knows how these assets are derived from one another, it can present the appropriate format to the appropriate distribution channel with minimal involvement from production staff.

Service-oriented storage

As the concepts of media-aware storage are explored, a trend begins to emerge: The best way to service the complex storage needs of media facilities is to combine streamlined IT storage with value-added media services. "Services" in this context could describe an actor in a service-oriented architecture (SOA), wherein every component of the system has a purpose at the business level and acts independently of the other components. Transcoding to provide format independence, for example, is a service to the storage system, because it adds value to the media workflow and provides a basic, business-oriented building block for media facilities.

A key aspect to SOA is the technology-independent interoperability of services. A higher-level storage service composed of multiple infrastructure services providing capabilities such as basic metadata logging, media movement and transcoding should, according to the precepts of SOA, expose all of these interfaces programmatically to external systems in addition to leveraging them internally. Based on this exploration of media-aware storage, the services that could fall under the storage "umbrella" are as follows:

- archive;
- media movement;
- cataloging;
- transcoding and format conversion;
- metadata management;
- rights and clearances;
- versioning; and
- editorial (to a limited extent — mainly the storage and processing of EDLs).

This group of functionality could be termed the "media service."

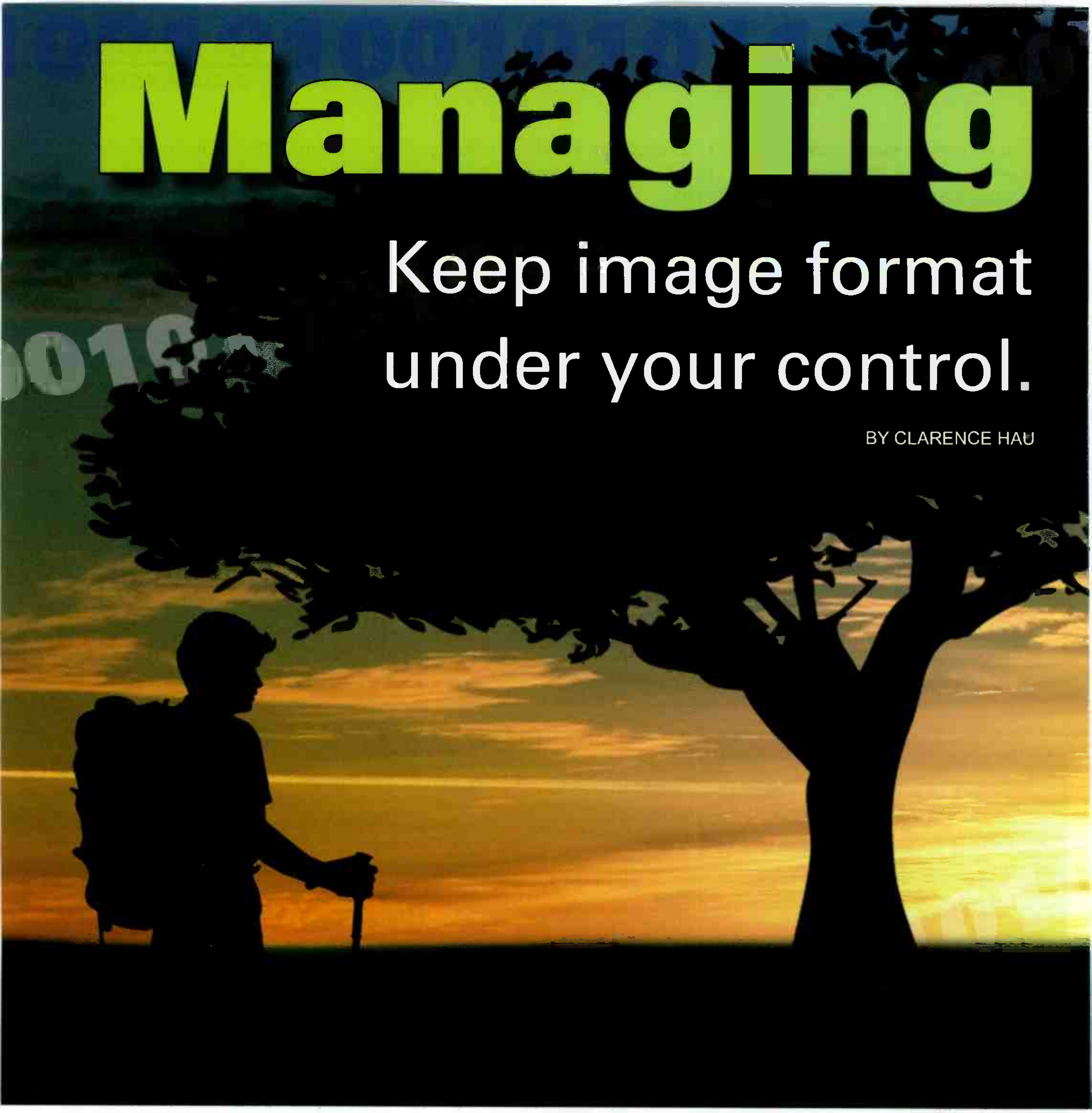
Future of media-aware storage

Moving forward, some of these models will, no doubt, have greater "sticking power" than others. In 10 or even five years, the status of media-aware storage in the industry will look very different than it does today. It is almost guaranteed that some of the technology trends surfacing this year will be out of vogue by that time, while others will be around and integrated into the industry's storage concept in a much more permanent way.

The concept of a media service is becoming increasingly necessary in a world where complex, file-based facilities are being constructed in less time for less cost. There is a strong need here, however, for standardization. Initially, every vendor will have its own definition of service-oriented storage, so the various solutions in this space will in no way be comparable.

The media equation is a complex one, so the generally-accepted IT principles about storage (including recent trends toward service orientation) do not necessarily mesh with the needs of the media world. Therefore, the best solution for the industry is a vertically-integrated one (a media service) that can, itself, interact in the horizontally-integrated world of the modern media facility. BE

Joey Faust is a consultant with National Teleconsultants and co-author of the 2008 book "The Service-Oriented Media Enterprise." Faust presented a longer version of this article at the 2008 SMPTE convention. A copy of that version is available from www.smpte.org.



Managing

Keep image format under your control.

BY CLARENCE HAU

The 2009 analog shutdown is here. As programming content will continue to originate in both SD and HD for many years, broadcasters have been forced to find ways to maintain the presentation quality for home viewers after the Feb. 17, 2009 deadline.

Active format description (AFD) has become the cornerstone of a number of broadcasters' strategies for management of aspect ratio throughout the delivery path to the home. With thousands of different touch points, end-to-end deployment of AFD can be a challenge, but significant progress has been made. This article will look at how broadcasters plan to use AFD in the post DTV transition landscape, as well as what steps have been taken to deploy AFD throughout the end-to-end delivery path to the home.

Dual aspect ratio challenges

The amount of HD programming available to home viewers has grown considerably over the past few years. In this environment, TV broadcasters are faced with challenges on how to best format and deliver their content to both HD and SD audiences.

When HD programming was introduced by broadcasters, a parallel production and distribution process was most commonplace. For scripted programming, two unique versions of a show were normally provided by the content providers, i.e., an HD version and an SD version. For live program-

ming, two separate control rooms and production groups were often used. One of the main benefits of this approach was being able to maintain full control on how programming was viewed by both HD and SD audiences. (See Figure 1 on page 54).

With a changing distribution landscape and increasing cost pressures, broadcasters have been forced to move toward a more efficient production and delivery approach. In this model, a single version of content is produced and delivered in HD. The SD version is derived from the HD version through a downconversion process.

The most common methods of downconversion, center cut and letterbox, are illustrated in Figure 2 on page 54. The use of downconversion to generate SD from HD introduces certain restrictions on how each version can be presented to viewers. As the aspect ratio of HD (16:9) and SD (4:3) formats differ, certain decisions must be made on how to reformat the original HD signal into SD.

HD content produced for center cut SD delivery must be center cut safe. Center cut safe video content has no important details on the left and right sides of the screen. This content can be center cut to generate a properly displayed full screen 4:3 image.

However, for HD content that takes full advantage of the entire 16:9 frame, a center cut downconversion can result in 4:3 content that is missing important details. Figure 3 illustrates how full frame HD content can be adversely affected when center cut.

The preferred downconversion method by many HD content providers is letterbox. Letterbox downconversion is the best way to ensure that all image details from the original HD program are preserved for the 4:3 SD audience.

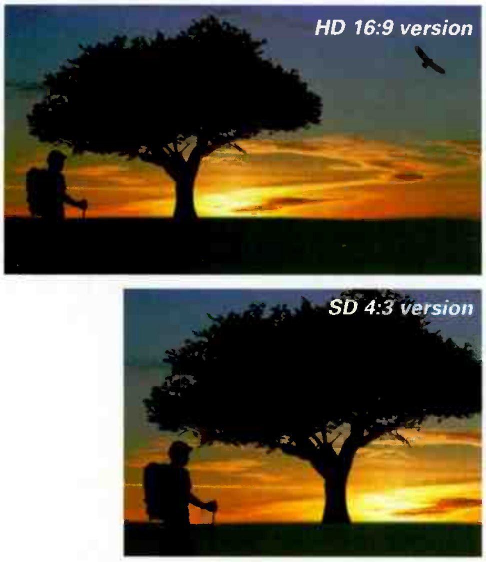


Figure 1. Example of 16:9 and 4:3 shot selection

Figure 2. Letterbox and center cut downconversion illustrations

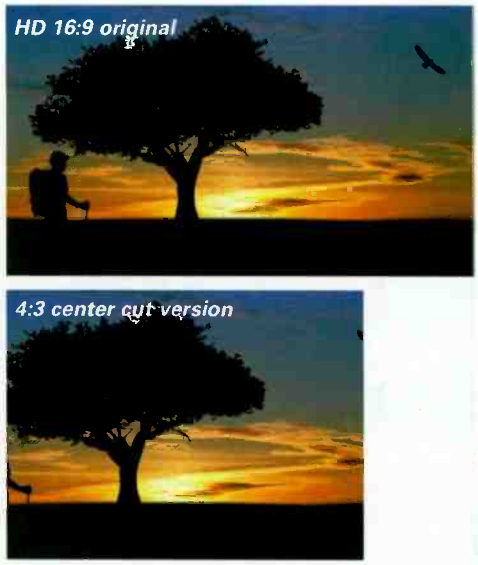


Figure 3. Example of adversely affected center cut downconversion

Figure 4. Example of adversely affected letterbox downconversion

However, much of the content in HD distribution paths is upconverted from SD sources. When upconverting 4:3 SD signal to HD, the result is a pillarbox representation (with black bars on the right and left sides of the 16:9 frame. Letterbox downconversion of this material will result in a postage stamp representation. (See Figure 4.)

Most HD broadcasters will continue to have a mixture of both HD and SD originated content for many years. Locking into a specific downconversion format (center cut or letterbox) will force broadcasters to make compromises on the presentation quality for HD and SD viewers.

Dynamic aspect ratio control with AFD

AFD is a method of describing aspect ratio and picture characteristics of video signals. It has been used to control how television sets optimally display pictures transmitted with varying aspect ratios.

In 2007, SMPTE released SMPTE 2016-1 and 2016-3. With these new standards AFD codes were updated, and a method of carrying AFD within baseband SDI video signals was defined.

One of the first implementations of the new standard was dynamic control of aspect ratio on baseband video format converters. These AFD-supported downconverters opened the door for new production and distribution methods optimized for dual format delivery. Table 1 on page 56 shows the most commonly used AFD codes along with their usage for HD to SD downconversion.

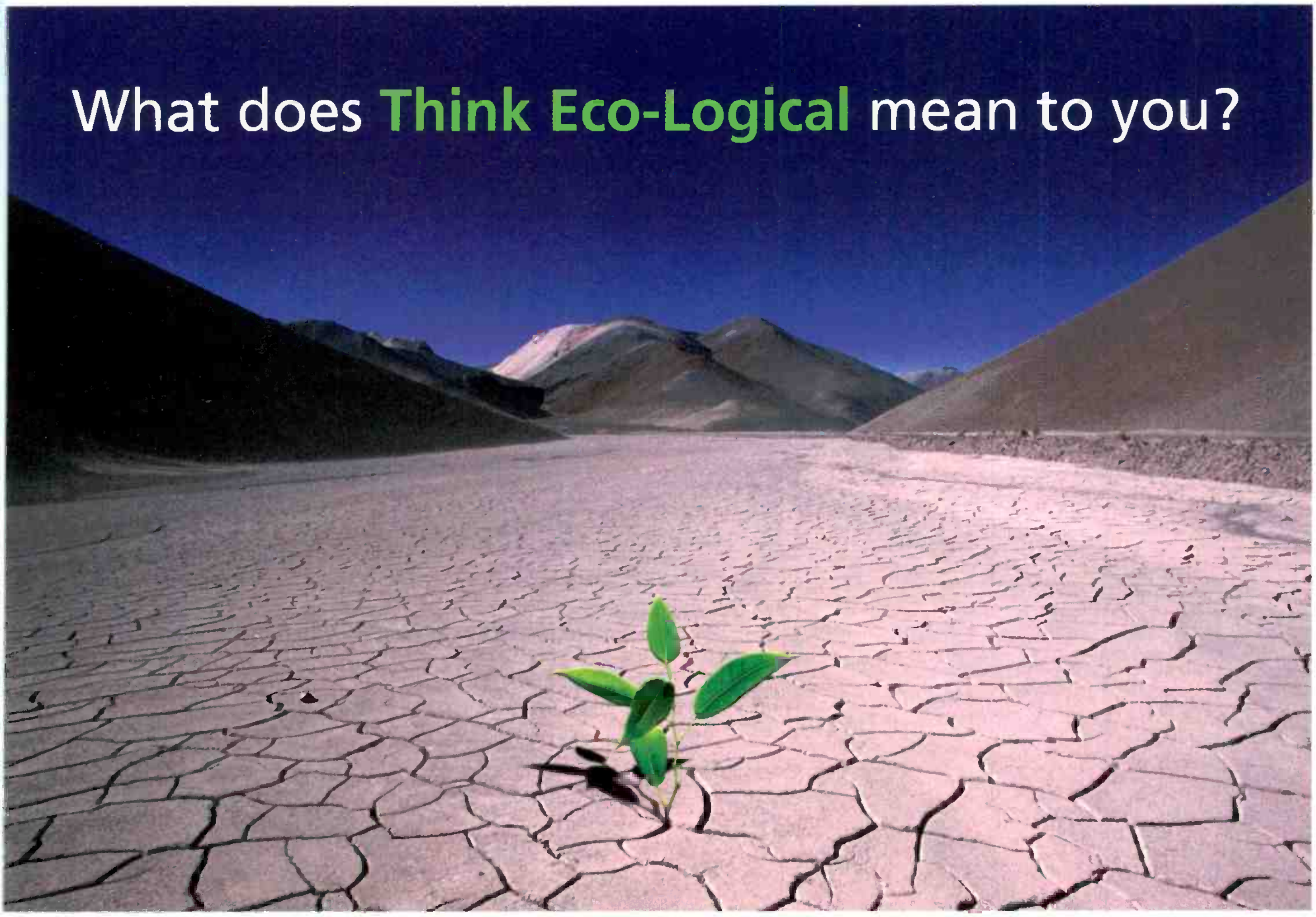
Production scenarios

One of the main benefits of AFD is the ability for program providers to maintain creative control of their content. With proper use of AFD, broadcasters can maintain this creative control by allowing the audience to view content as the content creator originally intended.

The most proven use of AFD is applied at the final stage of production — not on individual production elements. Within this model, the proper AFD code is recorded onto the final version of content as it will be aired, whether it be a live show, recorded program or commercial spot.

From an operational standpoint, a predefined downconversion format should be assigned to HD programs or commercial spots through application of the proper AFD code.

For live programming produced from a control room, a device can



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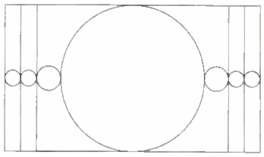
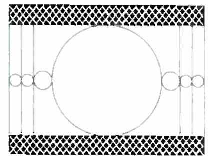
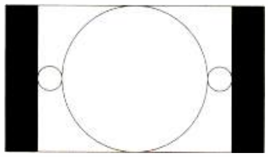
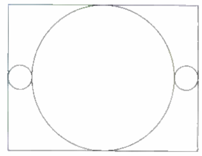
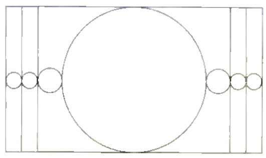
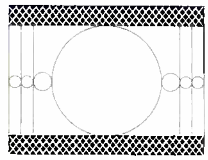
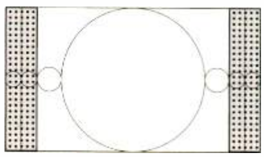
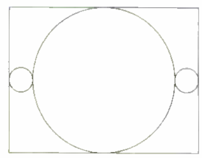
AFD	Aspect ratio	Description of HD signal	Original HD image	Description of downconverted SD signal	Downconverted SD image
16:9_8	16:9	Full frame 16:9 image; not center cut protected		16:9 letterbox in 4:3 frame	
16:9_9	16:9	Pillarbox 4:3 image from 4:3 originated material		Full frame 4:3 image	
16:9_10	16:9	Full frame 16:9 image; not center cut protected		16:9 letterbox in 4:3 frame	
16:9_15	16:9	Full frame 16:9 image; center cut protected		Full frame 4:3 image	

Table 1. AFD usage for HD to SD downconversion

be used to insert the proper SMPTE 2016-3 AFD code into the main program output. This will help to ensure that the proper AFD code is attached to the final version for air and available to all downstream distribution systems. (See Figure 5.)

For preproduced programming, a number of options are available for AFD authoring. If the output of the production session is HD-SDI, the same SMPTE 2016-3 AFD insertion described above can be effectively used.

For finished content that is delivered via tape (e.g. commercial spots) or baseband video (e.g. from edit rooms), the appropriate AFD data can be authored during the ingest process as shown in Figure 6 on page 58. Using this model, a process should be established to allow the content providers to select how their HD content should be downconverted.

With file-based transfers from NLEs to playout servers becoming more common, AFD insertion in this domain has also been successfully implemented. This production workflow allows for finished NLE projects to be automatically transcoded and transferred to playout servers without going back to baseband video. As illustrated in Figure 7 on page 58, a completed project can be transcoded and transferred directly to a playout server with the desired AFD code attached.

Many HD servers preserve vertical ancillary data space (VANC) on ingest and playout. However, each manufacturer has a proprietary method of storing VANC information in its internal file formats. For this reason, simple file transfers in and out of playout servers may result in the loss of AFD data. Limiting these types of file transfers between the same manufacturer models will help to protect against AFD data loss. File compatibility and VANC preservation must be tested and established.

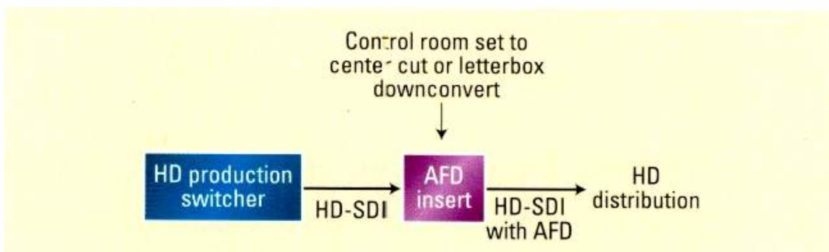


Figure 5. AFD insertion in live control room

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IT Fundamentals, Part I*

Presented by Al Kovalick

Jan. 13, 2009 – 2:00 pm EST

This is the first of a three-part series on building IT-based broadcast and production facilities. Part I focuses on networking theory, storage platforms and understanding facility workflow in a file-based environment.

In this webcast, attendees will learn about:

- Key IT network design fundamentals
- Designing new workflows to take advantage of file-centric solutions
- Selecting and sizing storage systems
- Predicting and maintaining QoS variables, including bandwidth and error rates

COMING IN FEB.

Engineering project management

Presented by John Luff

Feb. 10, 2009 – 2:00 pm EST

Today's TV stations are no longer sufficiently staffed to plan and execute major upgrades to facilities, or build entire new state of the art systems suitable for the next generation. Complex projects often require the use of outside contract personnel or companies with demonstrable expertise in designing, managing and building large projects. But working with outside experts requires unique management skills. Attendees will learn about the setting of goals, design, planning and execution of projects through the skills of outside vendors.

* Complete all three IT Fundamentals courses and receive a certificate of participation, upon application.

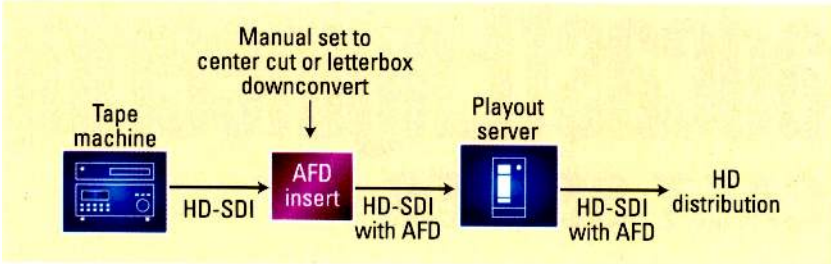


Figure 6. AFD insertion during ingest operation

Distribution and AFD preservation

As discussed in the previous section, ensuring that AFD data is encoded on final versions of content is the first important step in establishing a successful AFD-driven process. Ensuring that the AFD data is preserved through the downstream signal path within the broadcast facility is just as critical.

AFD data in accordance with SMPTE 2016 is carried in the VANC of SDI video signals. Specific attention should be paid toward ensuring all downstream video processing systems (e.g. video routers, switchers, DAs and frame syncs) will reliably pass VANC data uncorrupted. The following recommendations should also be considered:

1. *Focus on HD signals.* System designs should be focused on carriage of AFD data in the HD-SDI signals for the purposes of downconversion to SD. Most legacy SD devices have been found to strip out any VANC data present in the video signal, so system designs should not rely on AFD data within SD signals.
2. *Select video line location.* Select a specific video line location to carry AFD data to be followed plant-wide. This will be essential for quality control and troubleshooting throughout the signal path.
3. *Avoid multiple AFD codes.* For any AFD inserting system that is implemented, specific care should be taken to avoid the introduction of multiple AFD codes in a single video stream. This can cause adverse affects in many AFD supported systems.
4. *Insert AFD on upconversion.* SD originated content must go through an upconversion process before being inserted into a facility's HD distribution path. Where possible, the proper AFD code should be inserted at the point of upconversion. Many upconversion devices allow for this and will help to ensure that the AFD code will be available throughout the facility.

Despite best efforts to encode program-specific AFD codes, mechanisms should be put into place to ensure that a default AFD code is automatically inserted into video streams when authored AFD data is not present. This is best handled close the final distribution point out of the facility as shown in Figure 8.

Distribution to the home

After the DTV transition, most cable and satellite providers will continue to provide broadcast network signals on their analog tier (or digital SD channels), but will no longer have off-air NTSC signals available to do so. Cable and satellite providers will downconvert HD signals from local stations to provide these SD services to their subscribers. The ATSC has published RP A/79, which provides guidance on capabilities needed on these professional IRD devices including AFD usage.

Leading up to the February 2009 transition, cable and satellite providers will be installing new IRD devices within their headend/local collection facilities. These new devices will downconvert the DTV signals from local stations for delivery to their SD subscribers.

Most of these new IRD devices include support for AFD controlled downconversion. If AFD data is properly encoded into the local stations' DTV signals, cable and satellite providers will be able to automatically

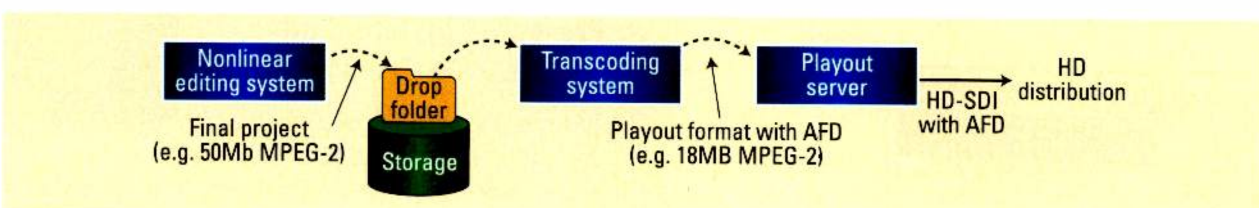


Figure 7. File-based AFD insertion

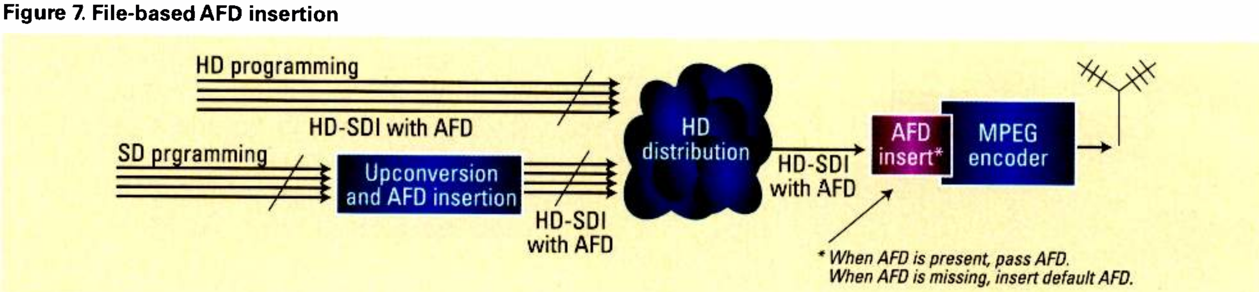


Figure 8. Downstream AFD paths

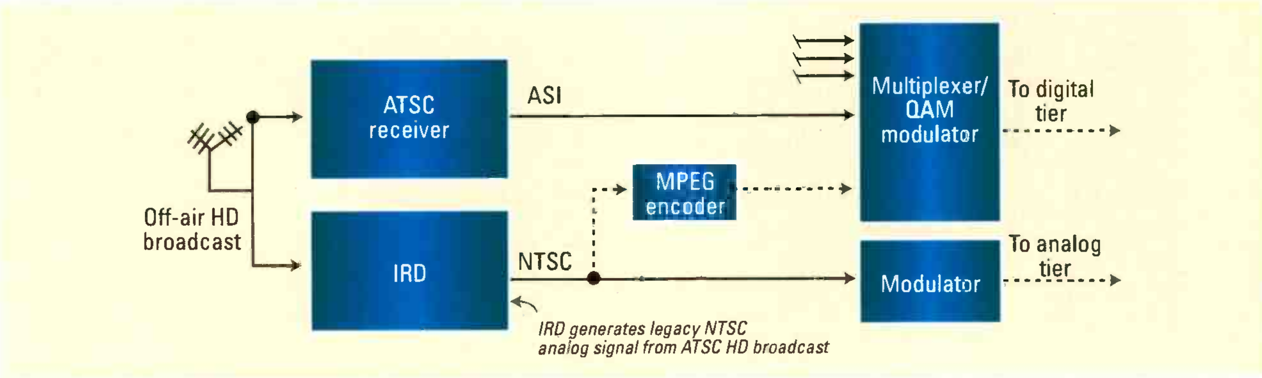


Figure 9. Headend signal path with AFD

create properly formatted SD signals, as shown in Figure 9.

Conclusion

Proper aspect ratio management will be critical for preserving creative control of programming after the DTV transition. Using AFD technology can improve the capability for program providers to deliver content to their audience exactly as they intend.

AFD will not solve all of the aspect ratio challenges, but existing technical solutions have been proven to be successful at providing the flexibility needed by broadcasters. As AFD usage expands and technology solutions mature, more advanced uses are sure to emerge. BE

Clarence Hau is director of systems engineering at NBC-Universal. This article is based on a paper he presented at the SMPTE 2008 Technical Conference.

Editor's note: For a discussion on local station implementations, see the extended version of this article in our online archives at http://broadcastengineering.com/issue_20090101.

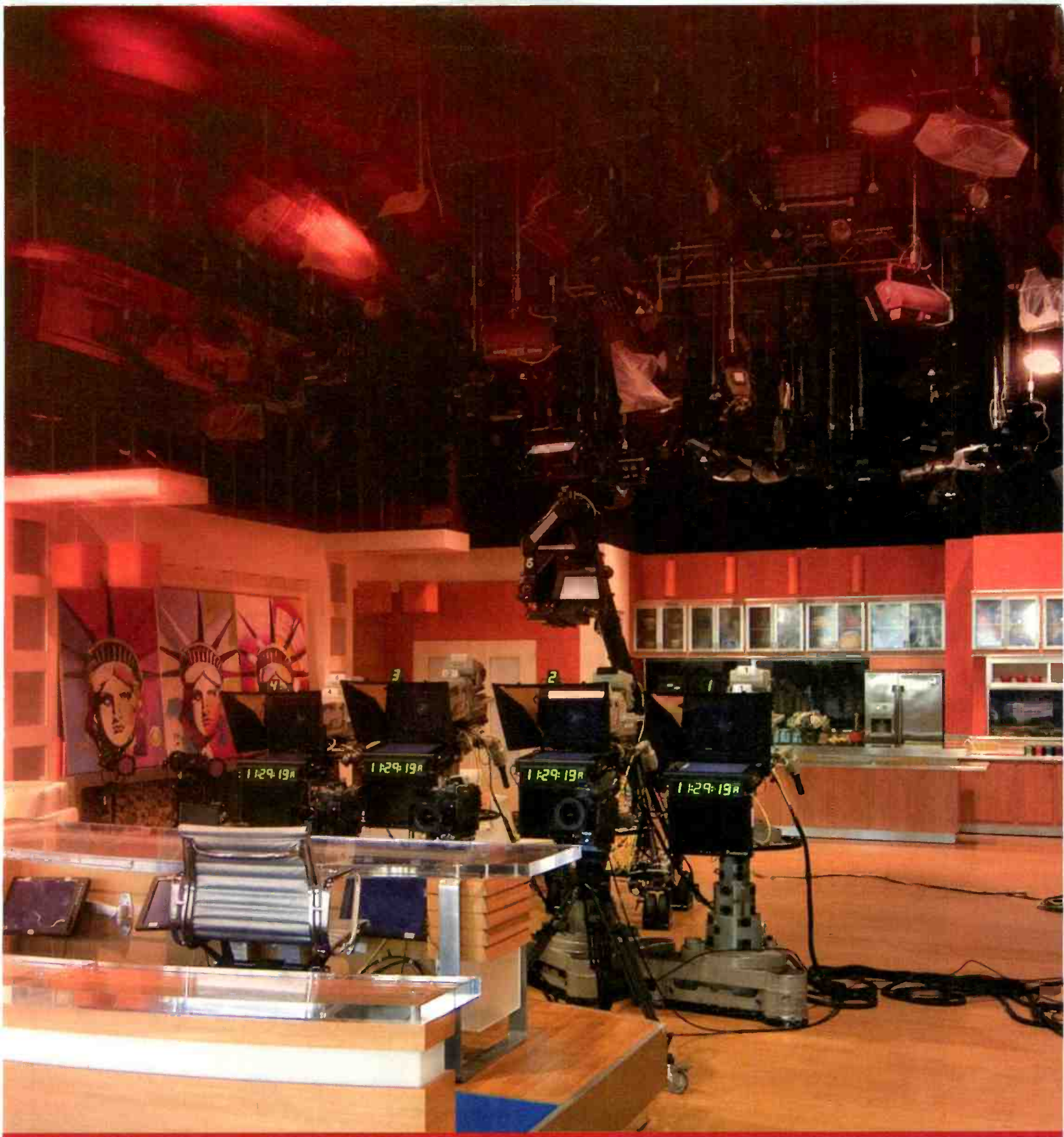
TV production spaces: ventilation systems

BY ANTONIO ARGIBAY, AIA

When designing TV production facilities, one of the major factors to consider is the type of ventilation system required for the comfortable, quiet and efficient operation of the facility.

TV production facilities can be uncomfortably warm, even hot. Studio lighting is by far the primary determinant of heat load in a production space. Even though other components, such as solar load and size of audience, may come into play with a street-front studio, nothing compares to the sheer immensity of watts-per-area devoted to production lighting.

The industry standard load for production spaces is 45W per square foot. A small studio may have a substantially larger load, because the net production area ratio is so much higher than in a larger studio. In large studios, you can theoretically lower this load to the range of 35W to 40W per square foot. However, this is impractical in reality, because air has to be delivered locally — at the area of production — in quantities that



average 45W per square foot, and that could be anywhere in the studio.

Cooling is for people

Another factor that drives the design of a cooling system is physics — how heat is perceived by studio occupants, which is substantially different from what we are used to in a normal occupancy, such as an office or a home.

In a TV studio, heat is experienced as radiation from a set of lighting sources. This is radically different from convection, which is experienced as warm air.

By definition, radiation is the direct transport of energy through space via electromagnetic waves, light included. Convection is the transfer of heat by the actual movement of thermal energy in fluids (in this case, air).

Understanding these two methods of heat transfer is critical to designing a cooling system that is workable for the talent who use the studio space. It is from this knowledge that you decide on an ideal temperature for the studio, one that must be maintained while production is underway.

How cold should it be?

Some readers may be familiar with a phenomenon experienced by skiers. The temperature is cold (below freezing), yet they are exposed to full sun in the mountains, with the snow reflecting additional sunlight on them. It often feels warm, even though the skier may be wearing only a T-shirt. When the sun goes behind a cloud, it feels incredibly cold. The skier was experiencing heating by radiation, with little convection heating. Air is cold and holds little moisture at low temperatures; hence, there is very little matter to be heated by radiation.

This is the same effect your talent will experience, to a lesser degree, when working under the lights. So, how cold should it be? It should be cold enough that the talent doesn't sweat. An ideal temperature is at least 68° F for extended periods, but it is not unusual to find studio temperatures as much as 4° F lower. If there is an audience, those audience members can feel uncomfortably cold.

Calculating the cooling loads

The desired temperature of the studio when it is in operation is called the design temperature. The other important temperature is the discharge temperature at which air is discharged from the air diffuser. With these two temperatures in hand, and with the estimated load based on 45W per square foot, you can solve an equation for the required air volume by using the sensible heat formula. Typically, the entire load in a studio is sensible heat, which is heat in the form of thermal energy. Latent heat, the amount of energy in the form of heat released or absorbed by a substance during a phase transition, plays a negligible role in a typical studio design. The sensible heat formula is $hs = 1.08\ q\ \Delta t$ where:

- hs = sensible heat in BTU/hr;
- q = air volume flow in CFM;
- t = temperature difference in degrees Fahrenheit (delta in temperature between design and discharge temperatures); and
- 1.08 = a formula constant.

Or, as it is more commonly written, $BTU/hr = 1.08 \times CFM \times \Delta t$.

With an understanding of the variants (design and discharge temperature), once given a load, you can calculate scenarios to help better understand the implications of design temperature criteria decisions and system selection.

So how cold should it be? It should be cold enough that the talent doesn't sweat. An ideal temperature is at least 68° F.

System selection issues

Every facility has a set of givens, each of which is critical in selecting a cooling solution for your studio. Here are some things to consider:

- When adding a studio to an existing facility, what type of infrastructure is already present for this project to tap into?
- Do I need a stand-alone system, or is there a chilled water system available?
- Is this studio part of a planned, new facility, where an overall cooling and redundancy strategy is to be considered?
- What is the initial cost of various system options when balanced with an

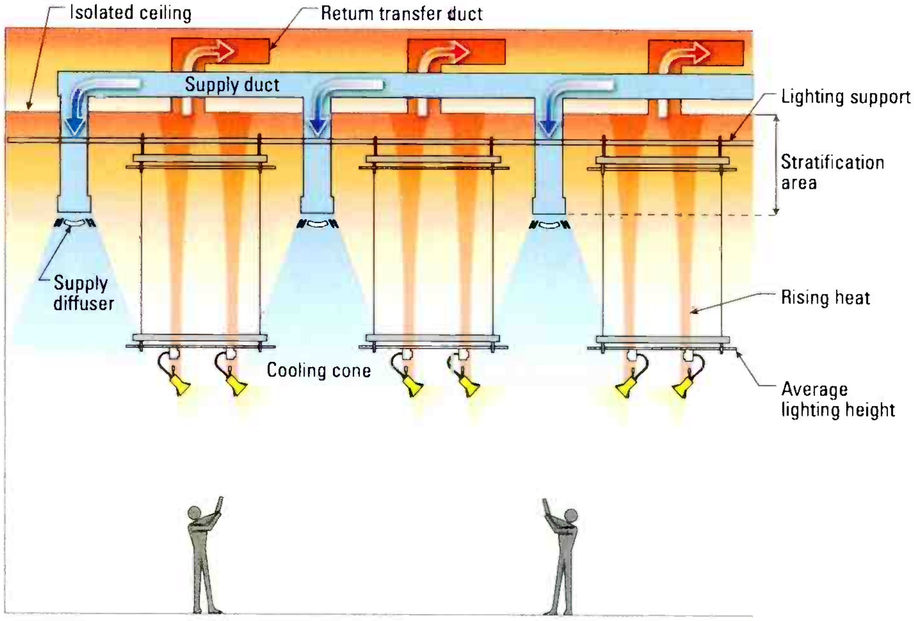


Figure 1. An example of how air-conditioning flows in a studio

operational cost analysis?

- What are the maintenance and reliability issues?

Let's start by looking at some air-conditioning system basics. (See Figure 1.) All air-conditioning is based on a fan blowing air through a coil. Either a refrigerant or water is used in a closed system to absorb the heat from the air moving through the cooling coil. This cools the air at the discharge side of the coil. The heat absorbed by the refrigerant or water is carried through piping to a condenser section, where it releases the captured heat and can begin the cycle again. Some systems use water mixtures as the medium for the heat transfer, but only rarely would they be considered as a solution. Refrigerant is the most commonly used method.

There are two basic types of systems that use refrigerant: direct expansion (DX) systems and chiller systems. DX systems use an evaporator that is in direct contact with the air stream, making the cooling coil of the air supply and the evaporator of the refrigeration loop one and the same. (See Figure 2.) In a chiller system, chilled water is produced and used as a medium to transfer the heat from air side (fans in the building) to chillers — and then to the outdoors for heat rejection.

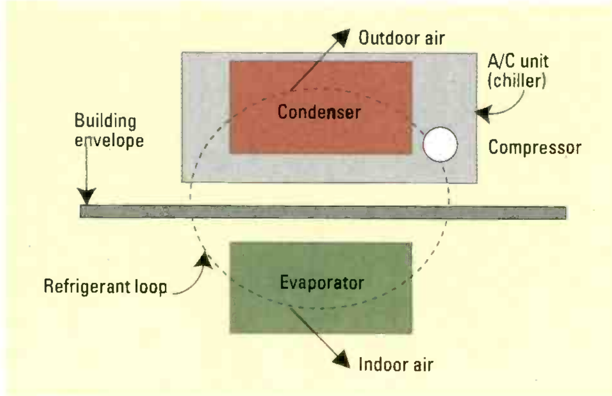


Figure 2. DX split system

Types of DX systems

DX systems are typically divided into unitary or split systems. Unitary systems comprise all the components of a refrigeration loop, including controls, in one unit. A split system separates a portion for installation inside the building (fan, cooling coil and filter), with the condenser and compressor located outdoors, connected by refrigerant piping. Unitary DX systems can be indoors or roof-mounted, often with a bottom discharge right into the building.

Unitary indoor DX systems are typically too small to make them viable candidates for a TV studio application, unless it is an extremely small project where a mechanical room with a large amount of louver space is available. A commercial split system allows all of the air-handling equipment to be installed indoors, resulting in many benefits:

• Air-handling units (AHUs) will be in an air-conditioned space, protected from the elements and tempera-

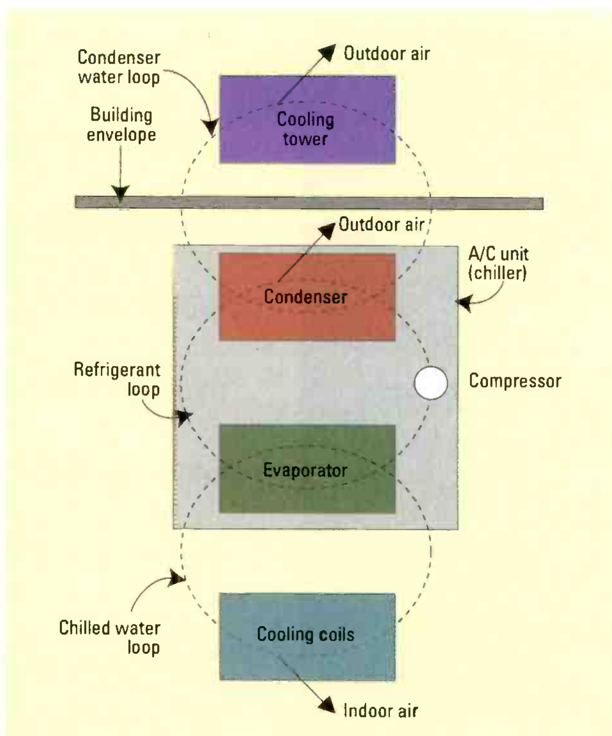


Figure 3. Water-cooled chiller

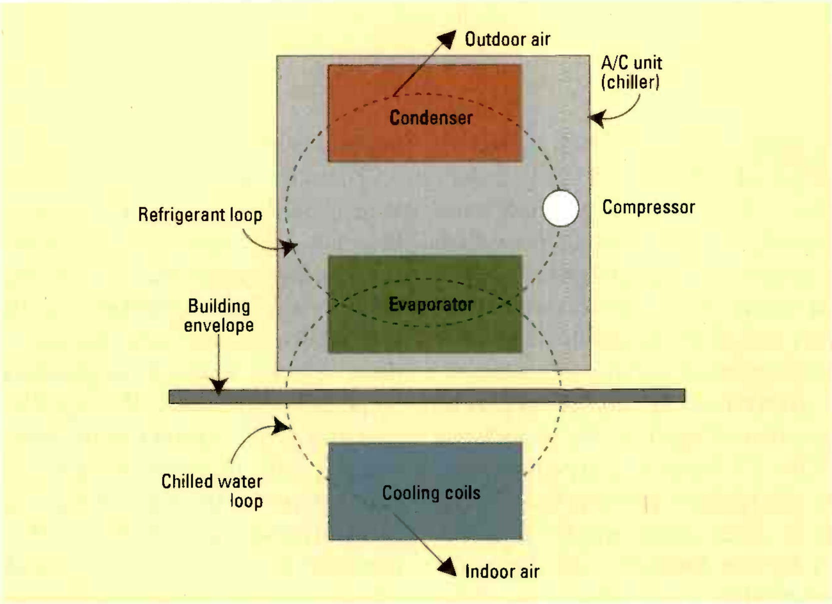


Figure 4. Air-cooled chiller

ture fluctuations.

- Maintenance for filters and belts is easier and therefore more likely to occur.
- Most studios require at least two AHUs. This means AHUs must be joined by ductwork so that units can share one distribution system. This is more difficult to do outdoors.
- No ductwork should ever be exposed to the elements and the deterioration that those elements cause. All exterior ductwork must be waterproofed, insulated and maintained.

DX and chiller systems

Chillers are more efficient than DX systems and can be either water-cooled or air-cooled. (See Figures 3 and 4.) Water-cooled chillers are often used for large systems (500 tons where 1 ton = 12,000 BTU/hr) and require a cooling tower. Air-cooled chillers are flexible, modular systems that can be used where installation of a cooling tower is not feasible. In a chiller-based system, whether air-cooled or water-cooled, the air handler is indoors and, therefore, shares the benefits mentioned above.

Keep in mind that the air discharge temperature of a chiller-cooled system is typically 55 degrees, and for a DX system it's 60 degrees. However, the discharge temperature of a DX system can drop as low as 48 degrees when the compressors first turn on. These fluctuations, coupled with the normally higher discharge temperature, make a

DX system less efficient and less comfortable for studio occupants.

Even so, DX systems are especially popular for one-time projects, because of their lower initial cost and relatively simple maintenance. Large facilities or those built from scratch and consuming more than 100 cooling tons mean higher energy consumption. In such cases, larger ductwork will be required. Always insist on a professional analysis.

Redundancy

Production facilities can be mission-critical, meaning the air-conditioning system must work in some capacity during an equipment failure, or they can be noncritical, where content is created on a flexible schedule. Each broadcaster has to identify the facilities' performance criteria with the aid of a consulting team in order to set the HVAC design criteria.

There are several levels of redundancy to consider. Complete redundancy requires at least two AHUs and related power, along with other system components. Depending on the selected system, other needed components may include pumps, chillers and other single-point-of-failure candidates.

Other levels of redundancy may be considered based on the importance of the TV studio as a key component in the content creation food chain. It is often economically desirable to include built-in redundancy for maintenance and unit replacement because even if it's not a mission-critical space, you can't be without a studio for long periods.

When air-conditioning a studio, the cost for air distribution largely remains a constant where redundancy issues are considered. Usually it takes multiple units to cool a studio, lessening the chance that the studio will be without cooling at any given time.

Typically, plan for three units with capacities so that, in case one unit fails, the other two can fulfill the cooling requirements. For example, a cooling requirement of 100 tons can be satisfied with the use of three 50-ton units. This provides 50 percent redundancy. If one HVAC unit fails while another is in maintenance, only 50 percent of the load can be served. The additional cost is primarily in the units themselves. The incremental cost is based on the risk tolerance, which defines the number and capacity of units.

Acoustical issues

If all of the other studio noise issues have been eliminated by adequate acoustical isolation via walls, doors and ceilings, then the air-conditioning system becomes the primary source of noise in a studio. It may be noise from air moving in the ductwork, or it may be airborne noise generated by turbulence at different points in the ductwork.

Cooling system noise can be diminished by placing mechanical systems an adequate distance from the first discharge outlet in the studio. This is typically 75ft. By using a lined discharge plenum of 2in (typically) and continuously lined ductwork to the discharge point most of the system noise will be absorbed prior to entering the space.

Noise generated by air turbulence can be diminished with turning vanes mounted in the ductwork, by placing balancing dampers as far as possible from the discharge and by decreasing the velocity of the air. Of these three options, the last two are the most difficult to satisfy, as they require careful design, fabrication and a thorough examination of potential problem areas. An acoustical consultant should be able to establish general design criteria.

Return air openings must exceed the supply surface area by about 10 percent and do not require direct ducting. Generally, return air is removed from the space through a transfer duct that is fully lined with 1in of duct liner and has two 90-degree turns to trap sound. To remove the air from the ceiling cavity, install a duct directly tied to the unit that penetrates the sound-isolated wall construction.

Many studios are designed for a 20-25 noise criteria (NC). To achieve this kind of sound performance, ductwork air velocities must be carefully controlled. Air delivered to a studio should not exceed 750ft per minute in the primary duct, 450ft per minute in branch ductwork and 300ft per minute or less at the studio diffuser. Selecting the air diffuser is also important. Be sure to consider both acoustical performance as well as its air distribution pattern.

Air distribution for different studio heights

Content creation spaces vary widely, both in area and in height. This requires that the strategies for ventilating them adjust according to the physical characteristics of the space. Spaces are divided into three primary categories, according to their height.

First are small studios approximately 13ft to 18ft in height, where the lighting grid is installed as high as possible. In these studios, the supply diffusers and the returns are on the same plane as the ceiling and located a short distance from the luminaries. This will provide even supply air coverage throughout the studio and remove it in clusters through returns located near the perimeter, where the heat load is less.

Sizing ductwork

Regardless of the type of cooling system, it has to be delivered to the studio via ductwork. The size of the ductwork is mandated by the air volume necessary to cool the TV studio space and by the air velocities required to meet acoustical or noise criteria (NC).

Let's consider this by looking at an example:

- Find the CFM required to cool a 10,000sq-ft studio.
- Find the load expressed in BTU/hr (1W = 3.41 BTU/hr), where 10,000sq-ft x 45W = 1,534,500 BTU/hr.
- Provide the ΔT (delta in temperature between design and discharge temperature), assuming a chiller-based air temperature of 55° F and a design temperature of 68° F. The answer is 13° F.
- Apply the sensible heat formula (BTU/hr = 1.08 x CFM x Δt).

If CFM = 1,534,500 BTU/hr/1.08/13° F, the CFM is 109,294.

- If it is a DX system, the Δt would decrease by 5° F, making it 8° F (the difference between 60° F and 68°F because of the higher discharge temperature). So if CFM = 1,534,500 BTU/hr /1.08/ 8° F, the CFM is 177,604.

Notice the increase of almost 40 percent between the two systems in the amount of CFM required to cool the space, given that the design temperature remains the same. The cooling ton stays the same in both, as 1 ton of cooling = 12,000 BTU/hr, or, in this case, 128 cooling tons.

Even though it is common for air-conditioning to distribute air in a wide pattern along the ceiling in studios, it's necessary to get through the layer of hot luminaries to cool the occupants. A heavy mass of cold air, falling uniformly in the center of the space, will push warmer air to the perimeter, where it can be exhausted by convection through the return ducts.

The second category of studio are those in the 18ft to 25ft height range. These are medium-sized spaces in which the lighting plane is about 3ft below the ceiling. At this height, and with this gap between the lighting and the hard ceiling, there is a significant stratification layer. This is a layer of hot air created by the heat rising from the lighting instruments, which acts as a barrier to air flowing from the diffusers. A conventional method of distributing air (with a strong horizontal pattern) will simply result in the cooling being provided at the same height as the lighting, with little reaching the floor.

Therefore, use a diffuser that can focus the airflow downward and at an angle, creating a cone of cool air above the head level of the occupants. Use a checkerboard diffuser layout pattern, with some returns mixed into the pattern. The distance between the supply diffusers, the angle of the diffuser blades and the height above the heads of occupants must be planned so that there is overlap in coverage.

The third type of studios are those 25ft or greater in height, where the gap between the lighting plane and the ceiling is 6ft or greater. With so much available cavity in the ceiling above the lighting plane, the stratification layer can be exploited even more.

In this case, follow the same diffuser layout as in the plan above for the medium-sized studio. This entails providing a checkerboard pattern, creating overlapping cones of cold air and mixing in returns. Additionally, the diffusers should be installed about 6ft below the ceiling, where the returns are installed, to take full advantage of stratification. This also helps avoid having to supply air through the stratification layer. Carefully plan your cross-section so the heights of all the elements in the studio and the horizontal spacing coincide to provide the required coverage.

Types of diffusers

It is important that diffusers be selected with acoustical performance, as well as air distribution, in mind. In small studios, a diffuser and proper neck sizing should be based primarily on acoustical performance. In many cases, it is feasible to use standard products, whereas in others, you will find the ceiling so crowded with ductwork that custom diffusers may be required.

Custom plaque-type diffusers are common in TV studios and in other acoustical applications, because the discharge opening is concealed either with a circular or square plaque that allows the air to flow out the sides. Typically, the top of the plaque has a cone or pyramid to deflect the air horizontally.

They are only effective where the pattern of distribution is not critical, such as in small studios. In larger studios,

Ideally, air in a studio should be provided from the floor to maximize the advantage of convection.

they are ineffective in getting the air down to where it is needed. The result has been a genre of solutions called elephant trunks, which are flexible canvas ducts terminated with a plaque diffuser. Using a system of ropes and pulleys, the elephant trunks can be located at the height and location where air is needed.

Nozzle-type diffusers are the preferred way to push air down through the stratified, hot layer before it loses too much cooling ability. They are built effective at delivering high volumes, without turbulence and its accompanying noise.

Other issues regarding cooling studios

You will notice that this article concentrates on the supply and return of air from the ceiling. This is largely because TV studios, by definition, should be designed to be as flexible as possible. Placing diffusers on the walls is an ineffective way to deliver air in the huge volume that a studio needs. Even placing return registers on the walls is something that has to be examined carefully, as doing so may create a situation in which the registers will be covered with scenery or a cyclorama curtain. If a wall area has a space where a return can be installed without compromising the studio's future flexibility, it should be located close to floor level, where using up to 25 percent of the air volume can substantially help airflow.

Ideally, air in a studio should be provided from the floor to maximize the advantage of convection, which allows warm air to rise. This method of removing heat is called thermal displacement. The quantities of air required, the fact that studio floor construction is many times isolated and that the studio floor surface is needed for scenic elements, such as rugs, all conspire to make this approach impractical.

Final observations

Audience studios have code requirements for smoke evacuation/purging. Consider the use of fans, because, depending on how the studio purges smoke and other special effects, you can use them separately from the ventilation and cooling system.

Taking care on important decisions regarding issues like selecting the type of fan for the air-conditioning unit will save time and money. The use of duct silencers and attenuators has been omitted here, largely because a well-planned project should not need them. If the acoustical consultant finds that, due to certain conditions in the project, duct silencers and attenuators must be specified, make sure the acoustical consultant carefully coordinates the selection and placement, because duct attenuators are frequently the source of noise caused by their turbulence.

It is important to have an acoustical consultant involved in the design and specification of any studio air-conditioning system. It is equally important that the architect, as the leader of the project, understand the issues involved so that, in coordination with the mechanical engineer, a balanced and practical design solution will be developed for your project. BE

Antonio Argibay, AIA, is a principal of Meridian Design.

Master control systems

Today, broadcasters are increasingly relying on automation to cut costs.

BY JOHN LUFF

Master control has an auspicious sound to it. When you hear the words master control, you think of a technology that keeps everything running perfect — well, partially.

The function of master control has significantly changed over the years. For starters, it used to be responsible for just getting one NTSC channel on the air. My first job outside of a studio was in a public TV station running MCR, which the station called air operations. I was the duty director. I read the log, found the media, loaded film and tape when there wasn't another operator around, rolled the media, and did the air switching. The booth announcer (when was the last time you saw one of those in a local TV station?) waited for a hand signal while keeping an eye on the monitor. We had NAB carts for some voice-over content when there wasn't an announcer. There was no local editing, so promos were all live.

Contrast that early 1970s norm with the early part of this decade. Ten years ago, operations were usually live or syndicated content on tape, or server. Promos were always prerecorded. The booth announcer had retired, or at least only cut tracks for a short time per day for each station he supported. And MCR was seldom more than a two-man operation. If the station was automated, it may have been unmanned at times (overnight or weekend graveyard shifts). Manually rolling content hadn't disappeared, but increasingly automation at least stacked the events and rolled them more often than not. Reconciliation wasn't comparing the paper air log to the original from traffic, but rather an electronic process. It's been a pretty amazing transformation.

Senior project manager Bob Peck monitors operations in the Turner Network master control center, which employs NVISION's NV5100MC multichannel master control system.

Master control has changed even more in the past six to eight years. The dynamics behind the change are not at all obtuse; they are obvious.

Costs

Driven by costs that grow when revenue is flat, broadcasters have increased their dependence on automation and other labor-saving measures. Implementation of a file-based workflow, servers for recording and playout of syndicated content as well as interstitials are now almost a requirement.

Just as costs have impacted the playout side of the operation, they have also affected the syndication and duplication business. Twenty years ago, tape delivery of content was replaced by satellite delivery. This is now being replaced by delivery services that take content from syndicators, add the appropriate metadata and deliver it to servers in the broadcaster's facility without intervention by the operations staff.

Early implementations were developed initially for news delivery from network news departments to affiliates. They could not transfer files directly to online servers for air. Over time, standards for file interchange have become available, and IT file transfer is now a reality.

The rub today is that HD delivery of long-form content is still a work in progress. Bandwidth for delivery is somewhat of a barrier, but the bigger issue is that the delivery networks were designed for much smaller file sizes than HD. One solution would be to use H.264 to gain more efficiency. But, of course, video servers have yet to embrace H.264 for air operations. That would mean a transcode of all content, which is an inelegant process.

Centralized operations

Another major change in the last decade is the deployment of centralized operations in many broadcast groups. NBC Universal, McGraw-Hill, the New York Times and other groups have settled into reliable, cost-effective networks for their stations. Many groups, like Sinclair, have a few local hubs running where geography works to their advantage, lowering the interconnection cost to acceptable levels. The balance is labor savings against the operating cost of interconnection bandwidth.

Several years ago, I helped conduct a study of centralized operations in public broadcasting, with interesting results. In some cases, clusters made great financial sense. In others, particularly where labor costs were low, it was difficult to get the numbers to work.

Because of the deterioration of the economy, many groups are looking at options again, which could make this an interesting year. Without fundamental change in broadcast cost models, the landscape of broadcasting could look quite different in a few years. Centralizing master control is not the whole answer, but it is worth a careful look when cash flow is down as badly as is predicted this year.

Compressed bit streams

MPEG-2 has already impacted our industry in a material way that changes the very fabric of master control. When the standard was first demonstrated, it seemed impossible that we would find ways to manipulate compressed bit streams. Today, we can not only switch (splice) signals, but we can also do overlays, bugs, crawls, dissolves and complex graphics without decoding to process.

FOX has been using a compressed stream splicer for several years to deliver its HD content. One might argue that a splicer is not a master control system, but to be perfectly honest, it isn't far from one. This year, expect to see a new generation of products that will make an all-MPEG MCR attractive to broadcasters.

Multistream needs

Finally, the most insidious change is the proliferation of multistream needs. DTV has brought new opportunities for revenue, but also the requirement to produce more than one stream, with minimal if any additional factory labor and as small an increment in hardware as possible. This has materially changed the practical technical model for master control. More streams means more server I/O, multiple stream automation, repurposing engines for nontraditional release channels, and a more complex monitoring environment.

The master control engineer is now as much a quality control supervisor as an operator. Monitoring automation, transmitter remote controls, archive systems, satellite record controllers, edge cache servers from delivery services, and other tasks that largely happen on computer screens rather than video screens has become the primary job of the master control engineer. The immediate impact is a new set of skills and training requirements beyond anything we dreamed of 30 years ago. BE

John Luff is a broadcast technology consultant.

Send questions and comments to:
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Mobile finally in gear

ATSC-M/H takes a giant step forward, but is it enough?

BY ANTHONY R. GARGANO

Last month, the ATSC announced the elevation of its Draft Document A153, Specification for Mobile Digital Television, to the status of candidate standard. However, it didn't happen soon enough for viewers of the estimated 100 million portable, battery-operated receivers that will soon go dark, victims of the analog switchoff.

However, the status of candidate standard is still progress, and there will likely be working demonstrations at the January Consumer Electronics Show. Major manufacturers plan to show concept products of handheld and in-car device implementations. The status will open the door to testing during the first quarter of 2009, and some manufacturers hope to see the test results fast-tracked so they can vote on a standard by NAB.

Sound aggressive? Perhaps it is by our old industry business model, but welcome to the digital economy. In Bill Gates' book, "Business @ the Speed of Thought: Succeeding in the Digital Economy," his underlying postulate is that thanks to technology, the speed of business is accelerating at an ever increasing rate. Having joined the digital economy, the broadcast industry must position itself to compete in it.

Assuming there are no major bumps during the testing period, the ATSC should act quickly to adopt the new standard to assure a seat for broadcasters on the mobile/handheld train before it leaves the station. The cellular market — at close to 90 percent saturation — is running out of new customers to sign. That means that companies like Verizon Wireless, with 80-plus million subscribers, and AT&T, with 71-plus million subscribers, have to grow new revenue sources. They've already been successful at increasing revenue via data services, and their next target is mobile television. Verizon added a TV package to its V CAST service in 2007, while AT&T launched mobile TV last May. However, AT&T has an exclusive equipment franchise with Apple's iPhone, and because of the phone's popularity and a new second-generation 3G model, several companies are working on unique TV service clients. With TV subscriber penetration at less than 5 percent, wireless companies see a landscape rife in new revenue opportunity. But do the wireless carriers represent competitors or service partners?

Mobile TV business model

Therein lies the fundamental question for the broadcaster: What's the mobile TV service business model? Clearly, the cell phone is but one device for the distribution of TV entertainment content. Aforementioned in-vehicle services, laptops and other Wi-Fi or Internet-enabled devices, or even new dedicated RF signal receive devices, all potentially come into play. Only the latter, however, replicate the analog TV portable reception model.

Let me offer one business model concept. The multiplicity of distribution platforms would seem best served by a subscriber-oriented service model where local broadcast content is aggregated with both basic and premium cable network content. In addition to entertainment, some broadcasters already offer dedicated local weather and area traffic channels — content that would be of particular value to mobile viewers. The result could be a tiered subscription service with varied bundles of program and information content. Given the potential for advertising content uniquely designed and formatted for a mobile service, a basic local channel tier could be advertiser supported and offered for free.

Being more akin to a cable TV-type service, this model transcends the current business infrastructure of most local broadcasters. Within that context are perhaps the underpinnings of a partnership between broadcasters and cable companies, one side bringing local content and the other access to national cable networks and a subscriber billing infrastructure. Obviously, there would be a myriad of details to work out, not the least of which are rights management and content distribution restrictions. This is just one business model. Another approach might be that local broadcasters form a mobile service local marketing agreement.

Work remains to be done

Currently, there is no true working business model, and developing one is not an inconsequential task. Last year, the industry formed the Open Mobile Video Coalition (OMVC). The coalition's charter speaks to technology, standards, product development, and promoting and educating mobile TV's benefits. That's not enough. Without a compelling business model, broadcasters will play a bit part as a minor content provider in a market that research firm Screen Digest projects worldwide at 140 million subscribers worth $6.5 billion in revenue by 2011, with North America representing $2.6 billion of that total.

As the process to adopt a mobile/handheld technical standard is fast-tracked, equal progress needs to be made on the business side for broadcasters to truly take advantage of the standard. BE

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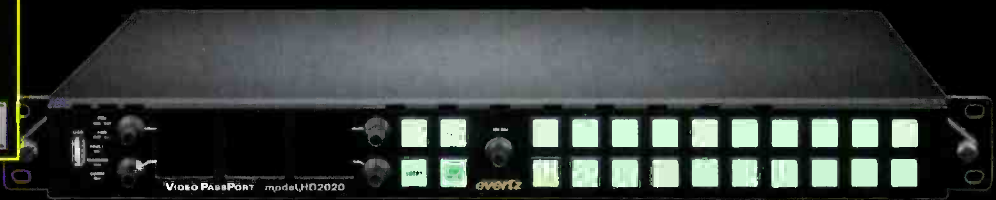

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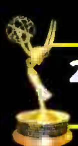

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