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JANUARY 1999

Broadcast ENGINEERING®

THE JOURNAL OF DIGITAL TELEVISION®

Remote Broadcasting

Building remote trucks
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Also:
Understanding MPEG

PRODUCING FOR HDTV Page 51

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January 1999
Volume 41
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Broadcast ENGINEERING
THE JOURNAL OF DIGITAL TELEVISION

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Features

Beyond the Headlines

Digital Handbook

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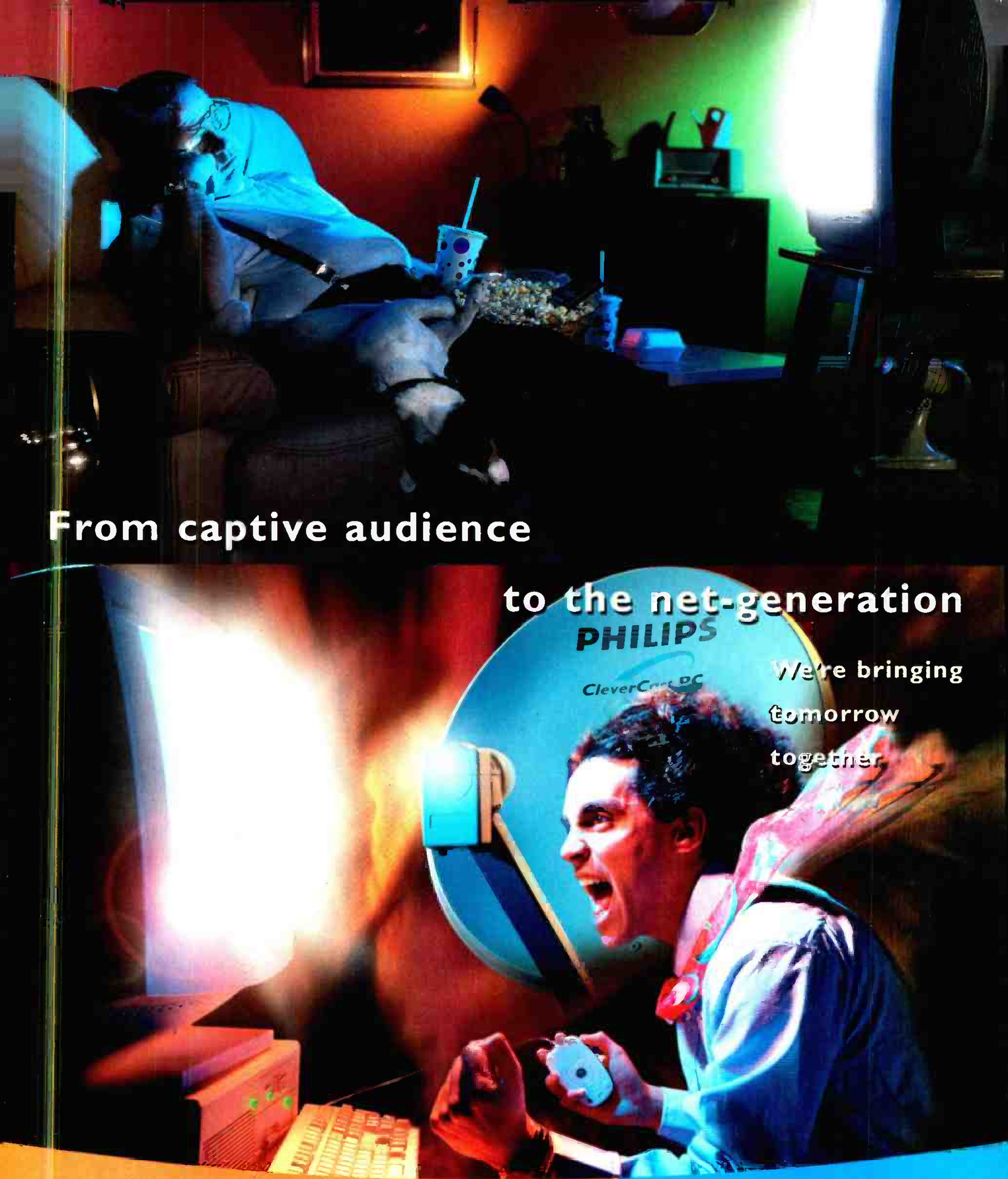
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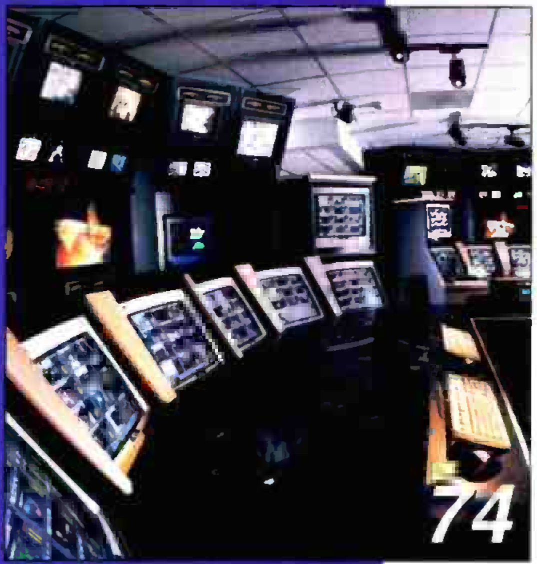

ON THE COVER:
Photography supplied by Sony. High definition truck (HD1) owned by NMT stationed outside of Madison Square Garden. HDVS equipment installation by Sony. Built by Bennett Systems.

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Questions? Contact:
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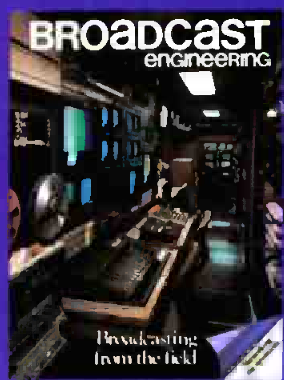
jim_saladin@intertec.com
913/967-1905 fax

FREEZE FRAME

A look at the technology that shaped this industry.

Do you remember?

Compared to today's HD trucks, this 1987 truck built for NBC looks almost antiquated. The truck was described: "used for large...sports programs that require sophisticated taping and switching functions". First five entries correctly identifying the video switcher shown win *Broadcast Engineering* T-shirts. Send entries to: brad_dick@intertec.com or fax 913-967-1905.



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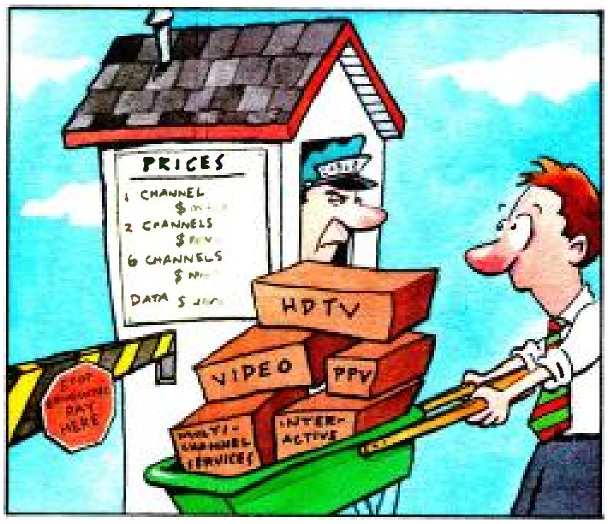
Broadcasters pay for carriage

Our fearless FCC leader recently commented that he preferred that the Commission not be tasked with having to deal with digital must carry. It's apparently not important enough to address. The issue of digital must carry represents the future of over-the-air broadcasting and yet the very Commission charged with overseeing broadcast seems unwilling to address it's future. (Except to levy a 5% TAX on TV stations for any new revenue-generating schemes they might come up with.)

Rather than help protect the industry charged with implementing our nation's digital future, these bureaucratic appointees again want to play politics. This commission is shirking its responsibility by allowing cable to deny carriage to local TV stations, or charge these TV stations for the "privilege" of being carried.



I wonder if the commission has really considered what the failure of digital must-carry will have on Reed Hundt's famous DTV time schedule? Does anyone really think that if cable isn't required to carry every and all transmitted signals from full-power TV stations that DTV will grow?

A recent study by Forrester Research predicts that fewer than 1 million homes will have an HDTV set by 2003. That represents only 1% penetration over the next four years! However, according to the schedule set forth by the FCC, some 40% of American homes are supposed to be watching DTV by then.

America is saying, "I want digital — but that means cable too!" Cable has been allowed to drag its heels, kicking and screaming into the digital age. While broadcasters, must meet an artificial schedule of build out (again for political, not technical, reasons) cable is allowed to claim that it is unprofitable to upgrade its systems to digital capacity.

However, there is a simple solution. Put cable on the same digital schedule as broadcasters:

- May 1999: All cable systems in the top 10 markets must offer digital service.
- November 1999: All cable systems in the top 30 markets must offer digital service.
- May 2002: All MSO-owned cable systems must be transmitting digital service
- April 2003: All cable systems in top 50 markets must offer digital service.
- April 2004: All cable systems in the top 100 markets must offer digital service.
- April 2005: All cable systems in top 200 markets must offer digital service.
- April 2006: All cable systems must offer digital service.
- All-channel digital must-carry begins the day a cable system begins digital service.

Seems to me that if Washington can require a TV station in Podunk, USA to spend $1 million or more to transmit *Roseanne* or *Oprah* in digital, then monopolies (called cable) should be made to do the same. American viewers deserve nothing less.

At *Broadcast Engineering's* recent DTV98 seminar in Chicago, we had the unique opportunity to see how HDTV was perceived by everyday viewers. At the conference, a large exhibition display was held just outside the seminar hall. While those of us at the conference had seen HDTV before, the hotel staff had not. It was fascinating to watch these people experience HDTV for the first time.

To a person, they loved the images. They often returned with coworkers to show them HDTV. They were excited about what they saw. Most wanted to know *when* they could get HD, not what it would cost.

If the FCC is going to require broadcasters to follow a DTV schedule, and if it can negate local zoning ordinances for outdoor antennas, then it *must* require cable to implement digital on the same schedule as broadcasters — all without charging them for every "bit" of delivery.

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Brad Dick, editor

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Reader Feedback

One more Band-Aid

I find it ironic that even as the progressive proponents seek to banish interlace from the face of the TV earth, they continue to support another "legacy" that has been around almost as long, one that causes even more headaches on a daily basis. That "legacy" is the 59.94Hz frame rate, and its necessary Band-Aid, dropframe timecode. A few years ago, Charlie Rhodes suggested that maybe it was time to return NTSC to true 60Hz operation. While this causes some problems with composite digital systems, it does attempt to fix several more. Mr. Rhodes demonstrated that concerns from the 1950s regarding over-the-air interference are no longer justified, and that the time for the 0.1% offset is past. (How many times have you heard that "the time for interlace" has passed?)

Now I hear that SMPTE is considering adding another "fix" to dropframe timecode and proposing to change the reference frequency again (although by a significantly smaller amount.) They are also proposing to "fix" the analog blackburst signal so it could allow digital audio devices to be properly synchronized.

The experts say that it is too difficult to simulcast 59.94Hz NTSC and 60Hz HDTV. Most of the up- and downconverters I have seen have frame buffers and external reference input on them already, so what's the big deal? Don't get me wrong, I know there is no quick fix for all of today's problems, but maybe 60Hz is an idea whose time has returned. What's wrong with this picture: 50, 60, 24, 48k, then 59.94... Hz? Yes, we've learned to live with it, but timecode and digital audio sync problems are a daily source of broadcast and post-production grief. If only for the timecode and digital audio reasons, I think the world would be a better place without an oddball 59.94 frame rate.

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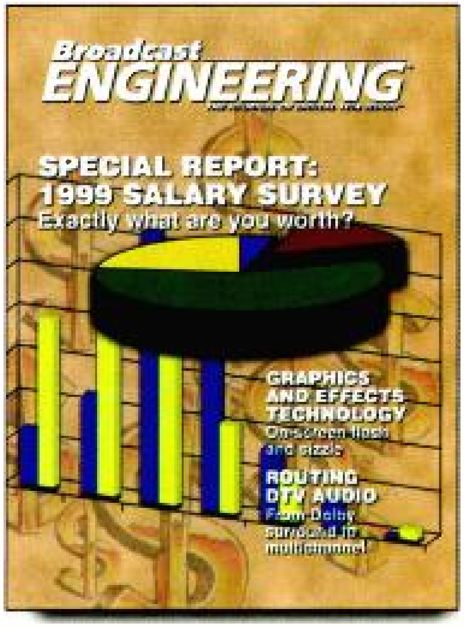

Sad, but true

Dear Editor:

The article on salaries incorrectly lists the median salary for below top 50 chief engineers at $42,000. Median should be the point at which 50% make above and 50% make less. The other data in the table shows only 44.8% of chief engineers making less than $45,000, so the median should be above that. Last year it was right at $45,000. What is the correct median income? Many of us use this information in salary negotiations, so incorrect data can be harmful.

BOB MARDOCK

Editor's response:

The data in the Broadcast Chief Engineer table on page 99 is correct. This table is simply a condensed version of the raw material, where the salaries were broken down into smaller categories. The printed table was just shortened for space reasons.

In regard to the decreases in some salary categories (certified engineers for example) these salaries are also correct. The results are statistically valid and based on the responses from surveyed readers. We have not changed the methodology from previous years and therefore the data are as valid as ever. While it may be tempting to do so, please don't blame the messenger for the facts.

BRAD DICK
EDITOR

Fertile ground

Dear Sir,

After reviewing Paul McGoldrick's article "Needed: Analog engineers," in the October issue, I felt a need to contact him, or at least the people at *Broadcast Engineering*.

I am a technical maintenance engineer at Harpo Studios in Chicago and also a graduate from Napa Valley College in Napa, CA. This small community college has an extensive Electronics, RF and Video Engineering program.

I have always considered it a "sleeper" program in that not many people in the industry are aware of it. Yet, it produces the kind of engineers Mr. McGoldrick suggests are a dying breed. A lot of these people, including myself, were hired before formally graduating by companies like Sony (San Jose), The Grass Valley Group and many local broadcast and post-production facilities.

The men behind the program are Gary Vann are Ernie Abbot if anyone is inclined to check it out. ■

BILL HOLLIS
BILLNTIFF@MSN.COM

Send your comments to:
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or fax 913-967-1905.

Also check out the BE website at
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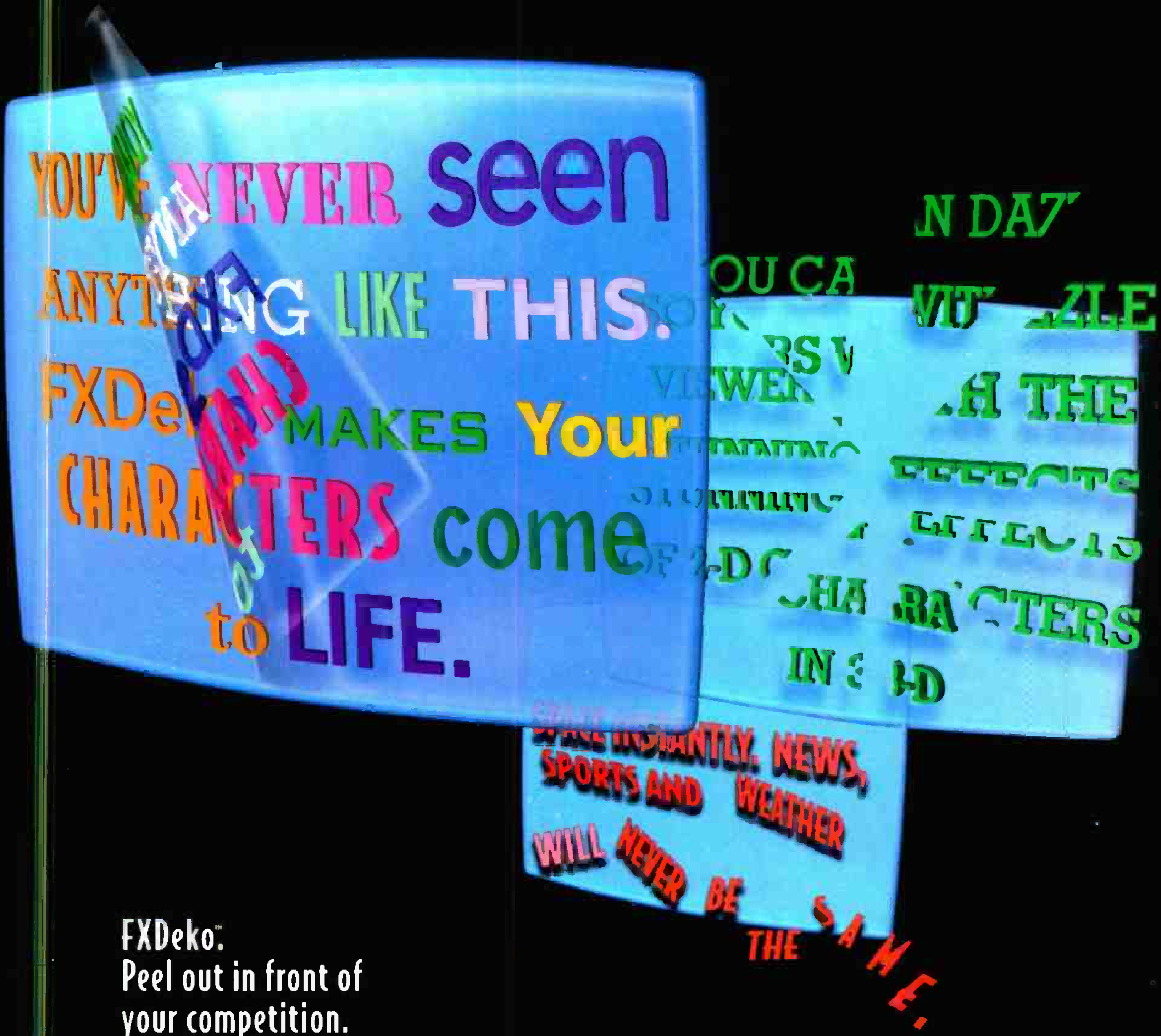

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DTV disharmony

When a DTV station moves in next door to an existing NTSC channel, a certain adjustment period is bound to be necessary. The players in this particular instance are Frank Martin, chief engineer of KPXN-TV Channel 30 (NTSC) and Frank Geraty, director of broadcast operations and engineering at KTLA-DT Channel 31.

While one camp was trying to get its new DTV transmitter system on the air, the other camp found not only that it had new RF neighbors, but some unforeseen issues had been raised in the process. To make matters worse, the historically good communications channels between the engineers in Southern California's broadcast community had broken down for the first time in a long time and things had gotten out of hand.

Frank Geraty, director of broadcast operations and engineering, KTLA-DT Channel 31

It is important to bring to your attention to what happened and to what measures can be taken to avoid this type of problem. If you want to see the entire text of the discussion, go to http://207.42.32.124/cgc postings.htm#DTV-DISHARMONY . The incident came to light in a newsletter published by Bob Gonsett which serves the Southern California broadcast community.

Keep in mind the obvious: Having NTSC and ATSC stations occupying adjacent channels is a new phenomenon. Older TV sets, cable headends, master antenna systems, etc. were not designed to accommodate different types of emissions hitting their receiving front-ends and IFs.

The receiving end won't be the sole point of address for what appear to be interference problems; the FCC has spelled out important prescriptions for both the new ATSC and the existing NTSC transmitter installations.

There are several ways to reduce the possibility of interference. One is to have the DTV pilot carrier and the NTSC visual carrier frequency locked together. This is spelled out in Section 73.622(g)(1) of the FCC rules and regulations: "DTV stations operating on a channel allotment designated with a "c" in paragraph (b) of this section must maintain the pilot carrier frequency of the DTV signal 5.082138MHz above the visual carrier frequency of the analog TV broadcast station that operates on the lower adjacent channel and is located within 88Km. This frequency difference must be maintained within a tolerance of plus or minus 3Hz." Because KTLA-DT operates on channel 31c, according to the allocations table of Section 73.622(b), this would apply. Another way to maintain frequency stability between the two stations is to install and lock to GPS frequency reference equipment at both stations.

Martin pointed out that the KPXN-TV/KTLA-DT situation may not be the only Southern California-based dilemma. There is the issue of KVEA-TV Channel 52 and KABC-DT Channel 53. To date, there have been no reports of problems between these two stations.

Geraty reported that KTLA voluntarily shut down its DTV operation until they could ensure that their DTV pilot carrier was locked to within +/- 3Hz of KPXN, Channel 30's licensed visual carrier using their GPS reference signal.

Gonsett noted the importance of checking the FCC's allocation table (Rule Section 73.622(b) as revised) to see if your DTV station will be on a "C" designated channel. Your construction permit won't necessarily say. When a "C" designated channel is used, the DTV pilot and NTSC visual carrier frequencies must be precisely locked per FCC Rule Section 73.622(g)(1).

Gonsett also suggested that the episode underscores a need for the FCC to rethink its rapid DTV deployment. "There needs to be a built-in experimental period — perhaps two months — where the effected NTSC station could ask the DTV station to reduce power or sign off completely while the NTSC attempts to repair affected fringe-area receivers, especially those at CATV headends," he said. As more DTV stations sign on, it is likely that CATV headends and many individual NTSC viewers will suffer interference effects even if the frequencies are locked. Certainly, DTV needs to be introduced in a harmonious way to avoid outright disruption of established NTSC viewers.

If you have questions for any of these gentlemen, you can e-mail them directly, as follows: Frank Martin, chief engineer, KPXN-TV Channel 30, ednixon@ix.netcom.com Frank Geraty, director of broadcast operations and engineering, KTLA 5/KTLA-DT 31, FGERATY@TRIBUNE.COM or Bob Gonsett, consulting radio engineer, Communications General Corporation (CGC), rgonsett@connectnet.com ■

24fps: a possible production standard?

We've lived with NTSC (standard-definition television — nominally 30 frames [60 fields] per second), in virtually all aspects of production and distribution for so many years, it's hard to shift gears and think differently. At the October SMPTE meeting in Los Angeles, it appeared that parts of our industry were looking to use different scan and frame rates for different applications, but still remain under the same ATSC banner — a sort of unity through diversity.

Sony's Larry Thorp and Panasonic's Dave Wisewell announced that their respective companies will be showing 24-frame, 1080p production equipment at NAB. This approach makes a great deal of sense. It will eliminate one major problem right off the bat: 3:2 pulldown. Abandoning interlace in these first generation machines may be a different story.

The 24fps, 1080p part of the ATSC standard may be on its way to becoming a *de facto* standard when working with film-based material. Thorpe and Wisewell stated that having the VTR work at 24fps would be a popular solution to many of the post-production companies.

See February's edition of *Broadcast Engineering* for a complete discussion on 24fps as a new production standard. ■

Dave Wiswell, group manger, advanced TV products, Panasonic

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Cable joins EAS efforts

Readers may recall that all broadcasters had to be online with EAS as of January 1, 1997 or show a purchase order indicating that equipment was on its way to the station to replace the old EBS gear. Cable was, of course, given a break. In September 1997, the FCC adopted a Report and Order (R&O) in which it spelled out the Emergency Alert System (EAS) requirements as they apply to wired and wireless cable systems. In that R&O, a phase-in period was specified which outlined how and when cable operators must comply with EAS requirements.

The main purpose of replacing EBS with EAS, as stated by the FCC, is to replace the weekly "this is only a test" message for TV and radio stations with less obtrusive weekly tests and shorter, monthly on-air tests, but that isn't all. Not everyone watches TV or listens to the radio, and provisions for alerting the sight- and hearing-impaired were a goal. The FCC wanted other media, besides broadcast, to be able to notify the public of impending emergencies. The first step in broadening emergency alerting beyond broadcasters is with cable.

Cable participation in EAS is not optional. The FCC says that all cable systems, wired and wireless alike, will participate.

Cable EAS will be done in accordance with the following schedule:

- Systems that serve 10,000 or more subscribers are to have installed EAS equipment and be providing EAS audio and video messages on all channels by December 31, 1998.
- Systems with more than 5000 but fewer than 10,000 subscribers must install EAS equipment and provide EAS audio and video messages on all channels by October 1, 2002. There are about 900 systems with between 5000 and 10,000 subscribers, with the remaining bulk of the systems having fewer than 5000 viewers.
- Systems with fewer than 5000 subscribers are to provide either national level EAS messages on all programmed channels (including the required EAS test messages), or install EAS equipment and provide a video interrupt and audio alert message on all programmed channels, as well as EAS audio and video messages on at least one programmed channel by October 1, 2002.

The only distinction made by the FCC between wired and wireless cable operators is where they added the number of subscribers served by a fixed-station transmission site to the wireless criteria.

The FCC will allow any existing local-warning systems to remain operational, providing they don't preempt or conflict with EAS. Satellite Master Antenna Television (SMATV), Open Video Systems (OVS) cellular and wired-telephone

DTV closed captioning tested

The Electronics Industry Association (EIA) has issued a new standard for closed captioning in a DTV environment. The new standard EIA-708 specification provides for expanded closed-caption capabilities at the receiver. In addition, the ATSC standard, A/53, specifies how to carry closed caption, either EIA-608 (the SD standard), EIA-708 or both, in the digital ATSC datastream.

Until recently, the typical NTSC-to-DTV conversion dropped closed captioning. On November 4, WCVB, Boston, had the first live, on-air broadcast with the new DTV closed-caption information. A Lucent/Harris Digital Video Flexi-Coder tied to an ULTECH DTV-708 Closed Caption Data Server made the broadcast possible. More information: www.lucent.com/ldv; www.atsc.org; www.fcc.gov/dtf/caption.html ■

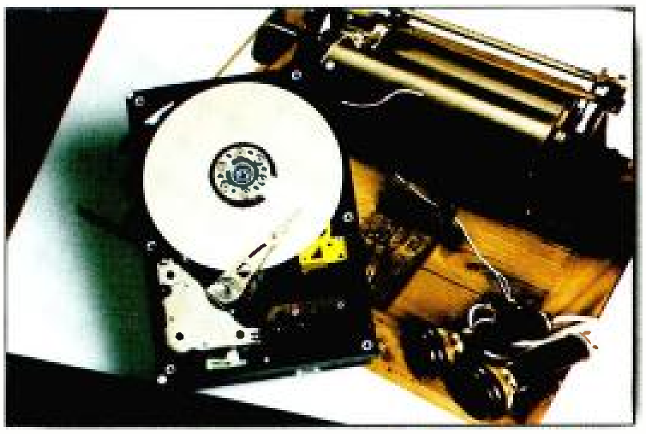
Recording milestone

To mark the 100th anniversary of magnetic recording, IBM has announced the world's highest-capacity hard drive, the Deskstar 25GP. The unit is a 25GB drive that has 5000 times the capacity of the 5Mb hard drive it introduced in 1956. According to IBM, the new drive will hold either the double-spaced typed text on a stack of paper more than 4000 feet high, 20,000 digital images, or more than six full-length feature films.

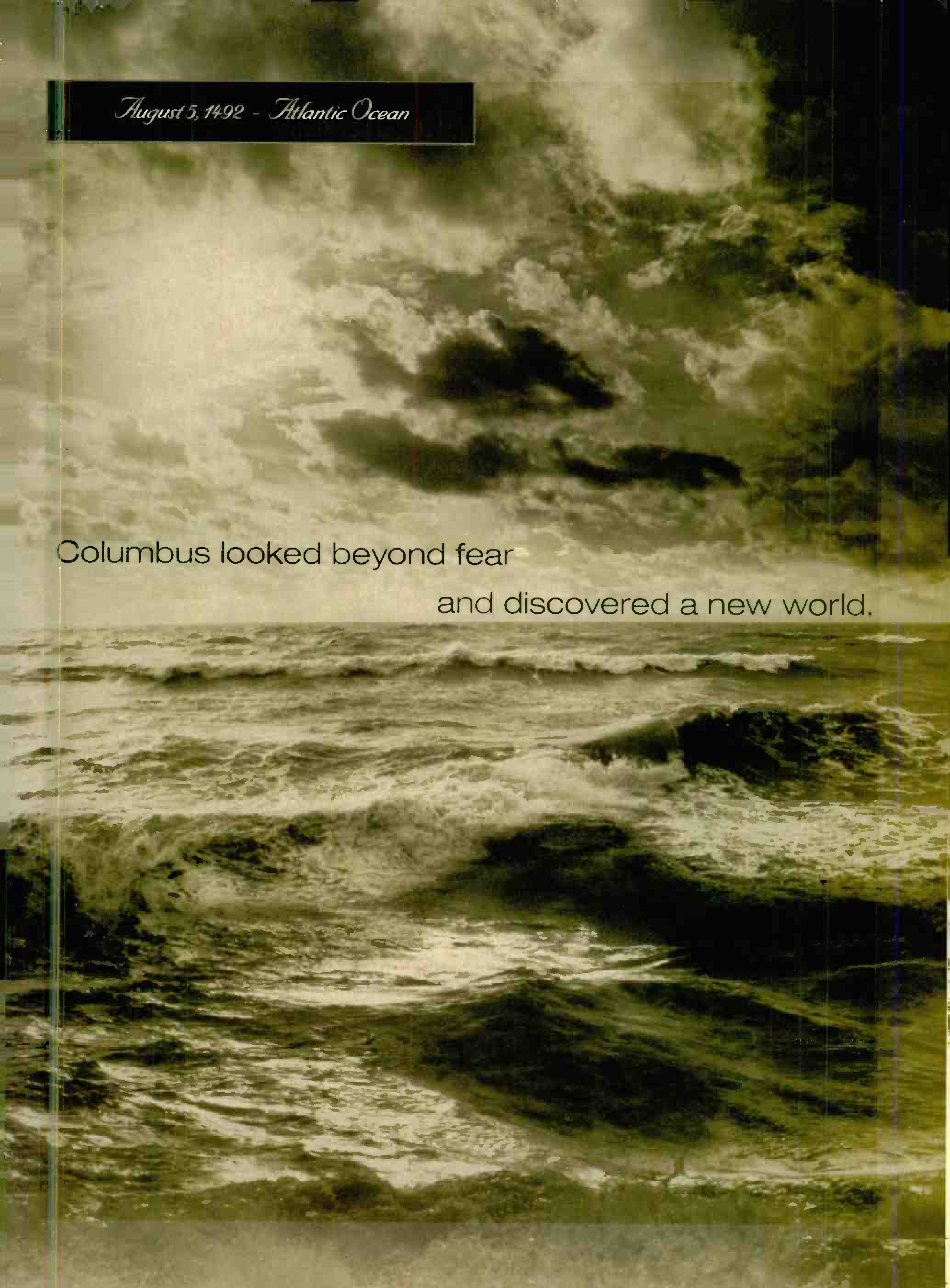
With the higher bit capacities required for HDTV, this device, though aimed at the PC market, has great potential in broadcasting. IBM says they have another product targeted for video editors, engineers, scientists and other extreme-performance PC and workstations users, the 22GB Deskstar 22GXP, a high-capacity, desktop-PC, 7200RPM drive. Although the 5400RPM, 25GB drive would probably work, it is designed more for consumer users who want high capacity and good performance.

IBM says that both drives are ideal for storage-intensive applications such as multimedia, video streaming, 3D graphics, digital photo albums and storage of large images downloaded from the Internet or intranets.

The capacity and rotational speed are not the only factors enhancing the performance of these drives. These are among the first drives to feature Ultra ATA/66, an interface that doubles the transfer rate. For a fact sheet on the 100th anniversary of magnetic recording go to www.ibm.com/harddrive. ■



In honor of the 100th year of magnetic recording, IBM has released the Deskstar 25GP. The unit has 5000 times the capacity of the hard drive it introduced in 1956.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as you move into the world of DTV, you don't have to either. That's because with Sony, you get the broadest range of digital solutions for broadcasting today. Start with our MAV-70.

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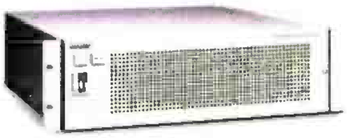
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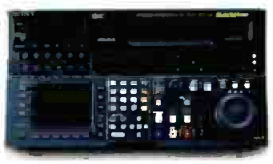
HDCAM HDW-500 VTR

MAV-70 Server
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HDCAM HDW-700 Camcorder
- 40 minute 1/2" HD cassette
- Memory setup card
- Lightweight one-piece camcorder

services are exempted from participating in any EAS programs.

I would be remiss if I didn't raise a question about a very large viewing audience that probably eluded the FCC when it first drew up its EAS plans. The direct-to-home (DTH) satellite industry crossed the historic 10-million customer mark at the end of October, adding more than 232,000 subscribers during the month. By the end of October, DTH satellite service totals for the U.S. stood at 10,044,463.

DTH is cable's biggest threat. DirecTV added 107,000 subscribers in last October with the satellite provider signing up over 864,000 new customers during the first 10 months of the year. DirecTV's audience stands at over 4.165 million. EchoStar's DISH Network added 100,000 customers in October for a 10-month total of 669,000 in 1998 and now has 1.709 million customers. PrimeStar reported the addition of 40,707 in October, bringing its total to 2.207 million. C-Band lost more than 15,000 subscribers during the month, according to General Instrument's Access Control Center, though its total still stands at 1.963 million.

It is unfortunate that while no other facet of the broadcast diadem has a faster growth rate or is better equipped for the delivery EAS, DTH is not a part of EAS. All DTH providers use digital formats to deliver signal to their subscribers, which means the Subscription Management Systems (SMS) and Conditional Access (CA) are in place as a permanent part of the bitstream. Most DTH systems are capable of multilingual subtitling with several languages available at the same time. Integrated Receiver Decoders (IRD)s can be addressed individually, or to almost any predefined area. If they can turn your receiver off so you can't watch a sporting event or send tailored advertisements to entice you to watch a special event, they can certainly deliver an emergency message designed to save your life.

This was confirmed with Dinesh Mehta, the president of Sun Up Systems, a software company providing traffic and control systems. I asked if EAS had to be limited to only television. He said, "This data could be an associated audio, a set of webpages, multilingual subtitles, e-mails, or any other such means of communication. The person would not even have to be watching TV to be able to receive an EAS message. This message could be automatically downloaded to a PC, for example, and made available to the recipient the moment he or she logs on."

The obvious question is: Why hasn't the FCC mandated this service to carry EAS as well? When asked, the Commission replied that, "EAS is designed primarily for local use." Talk about speaking out of both sides of your mouth. Get the emergency message to the uplink terminal and they can deliver it — IRD by IRD, zip code by zip code, or whatever other criteria that might be imposed.

For additional information about EAS, consult the SBE EAS handbook or visit the SBE website at www.sbe.org. ■

Accom acquires Scitex

Accom, Inc. announced the acquisition of all assets of Scitex Digital Video, Inc. The purchase price was approximately $10 million. In addition, Accom will issue to Scitex warrants to purchase up to a 10% ownership interest in Accom.

Junaid Sheikh, chairman and CEO of Accom commented, "The acquisition of Scitex represents an important transaction in Accom's history. Accom and Scitex combined will offer a broad product line comprised of outstanding products in the areas of digital video effects generators, digital disk recorders, linear and nonlinear editors and virtual sets aimed at the professional video market."

As part of the transaction, Accom will be taking a number of immediate consolidation steps, including the shutdown of six Scitex facilities and a significant reduction in headcount for the combined companies. Despite a strong showing from its nonlinear product lines, Scitex has not been a profitable company for "quite some time." The consolidations, in conjunction with streamlining moves and complimentary product lines, will be major factors in the future of the company. "We've cut expenses so that now we'll be profitable," said Sheikh. "Growth will come from good new products."

The company will continue to be headquartered in Menlo Park, CA. ■

FCC levies new fees against broadcasters

The FCC voted unanimously to assess a five-percent fee on gross revenues for ancillary or supplementary services for which commercial broadcasters receive a subscription fee or for which they are "paid by means other than advertising to transmit." The FCC claims that this fee satisfies the requirements of the 1996 Telecommunications Act, which allows the public to recover a portion of the spectrum that was loaned to broadcasters. Politicians didn't want to be seen as unjustly enriching broadcasters and the fees represent the amount that the government would have received if the spectrum would have been sold at auction.

Reasons for setting the fee on gross revenues include simplicity in calculation by both the broadcaster and the FCC. The Commission stated that it didn't believe the 5% fee would dissuade broadcasters from developing DTV ancillary and supplementary services. The NAB had suggested a two-percent fee and was apparently disappointed by the Commission's decision for the higher amount.

It should be noted that the Communications Act of 1996 does not distinguish between public and commercial broadcasters in this area. Since the law and the FCC rules limit noncommercial stations from airing broadcast advertisements, a Notice of Proposed Rulemaking (NPRM) seeking comments on what rules should apply to public broadcasters' ancillary or supplementary services is pending. In the original ancillary and supplementary fees NPRM, public broadcasters asked that they be exempted from any fees, even if they charge for new broadcast or supplementary services. ■

Pinnacle Systems acquires Truevision

Pinnacle Systems, Inc. entered into a $14.5 million deal to acquire Truevision, Inc., a supplier of digital video products. The deal, which is subject to regulatory and stockholder approval, is expected to close during the first calendar quarter of 1999.

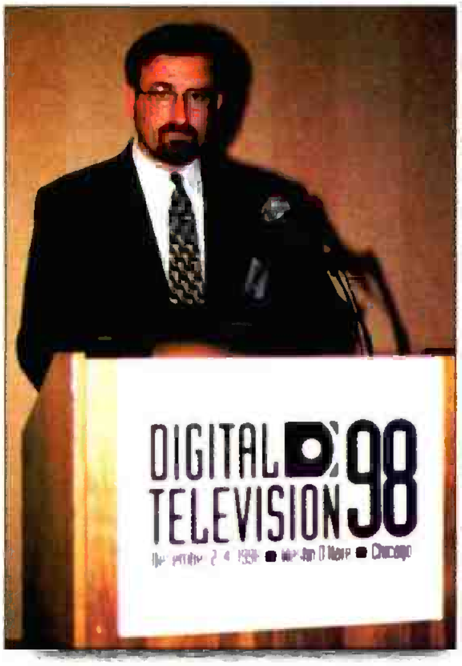
"We are very excited about merging these two companies," said Mark Sanders, president and chief executive officer of Pinnacle Systems. "Truevision's product lines complement Pinnacle's well, and together we will serve a far wider array of customers and applications in the digital video editing market."

"Truevision has invested heavily in its next generation architecture for video editing, particularly in new custom chip technology that is scaleable for HDTV applications. We believe that combining this technology with parallel chip developments underway at Pinnacle will afford Pinnacle competitive advantages in next-generation capture card and video-editing platforms," Sanders continued.

The company expects to maintain Truevision's engineering and customer support operation in Indianapolis and to merge Truevision's Santa Clara, CA, engineering, sales and logistics operations into Pinnacle's Mountain View, CA, headquarters. ■

DTV98 a success

Broadcast Engineering's DTV98 conference was a huge success in Chicago last month. With more than 350 present, attendees learned the secrets of installing and maintaining DTV systems for their stations and production facilities.



Steve Mahrer, manager, DTV, engineering liaison, Panasonic, gives a review of the pieces needed to complete the DTV puzzle.

The sessions were oriented toward those responsible for the design and installation of DTV facilities around the country. Dr. Robert Hopkins, vice president and general manager of Sony Pictures High Definition Center, Culver City, CA, opened the conference by reminding attendees of the importance of HDTV-quality images in capture and transmission for the attraction of new audiences.

Attendees assembled to view equipment at the recent *Broadcast Engineering* DTV98 seminar. Included were live displays of HDTV equipment and a wide variety of systems integrators and RF technology.

Other presenters covered production technology and RF-system design. One session looked at the increasingly important area of digital interference. A session presented *BE* columnist Don Markely reviewed how NTSC stations are only now discovering how DTV signals can interfere with their reception, especially on Grade B-area cable systems. (To better understand this developing problem, see Transmission and Distribution, page 68.*)*

This year's conference also hosted an exhibition area, where companies demonstrated the latest in digital technology. Exhibitions included systems integrators, HDTV monitors, cameras, recorders and RF systems.

Next year's conference will also be held in Chicago and scheduled for early December. ■

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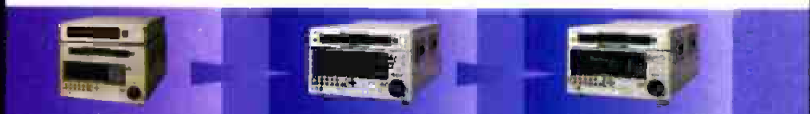

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New rules adopted for unbuilt stations

BY HARRY MARTIN

As part of its streamlining initiatives, the FCC has substantially revised its rules governing broadcast construction permits as follows:

•Permits will be issued for three years in lieu of the current two years for full-power TV stations and 18 months for other broadcast facilities;

•Restrictions on for-profit sales of unbuilt construction permits have been mostly eliminated;

•Permits will terminate automatically at the end of their three-year terms, with no opportunity for extension.

The new rules, which will become effective in February, apply equally to construction permits for new stations and construction permits for changes in the facilities of existing stations.

Having concluded that a three-year construction period provides an adequate and realistic time to construct, the FCC will not afford opportunities for extending construction permits at the end of their three-year terms. Instead, unbuilt construction permits will automatically terminate on their expiration date without further notification from the FCC. The current practice of providing additional time for construction after a permit has been transferred or modified has been eliminated.

The only form of relief will be the "tolling" (suspension) of the three-year construction period during times when construction is impossible due to hurricanes, earthquakes, etc., and during the pendency of a petition for reconsideration or application for review of the grant of the permit, an appeal to a court of such an FCC decision, or an appeal to a court relating to a federal, state or local requirement for construction or operation of the station. As a result, the three-year deadline can be suspended during the pendency of a court appeal of a final zoning determination, but not during the pendency of a zoning application before a local body. The permittee must notify the FCC of circumstances warranting suspension within 30 days in order for the three-year deadline to be suspended.

The new rules also apply to existing construction permits. Existing permits will be extended to three years from the date of the initial grant if requested no later than 60 days prior to the expiration of the permit. In addition, the permittee may notify the FCC of circumstances warranting suspension of the three-year construction period. No additional time will be allowed for construction when there has been three years to construct.

Ownership reporting changed

The FCC has decreased the frequency of ownership reports to every two years. In addition, the agency has conformed the ownership report filing dates for commercial and noncommercial stations. The FCC also is requiring that ownership reports for commercial stations identify the gender and race/ethnicity of each individual having an interest in the licensee or permittee. The FCC plans to use this information to assess the need to promote opportunities for businesses owned by women and minorities for participation in the broadcast industry.

Effective in February, both commercial and noncommercial stations will file ownership reports along with license renewal applications and every two years thereafter, within 30 days of consummation of an approved assignment of license or transfer of control, 30 days of the grant of the initial construction permit for a new station, and at the time the initial license application for a new station is filed. Noncommercial stations will no longer be required to file supplemental ownership reports within 30 days of any change in previously reported information. All stations may continue to file certifications of continuing accuracy of previously filed reports in lieu of new ownership reports whenever those come due. Stations licensed to individuals (sole proprietorships) or partnerships composed entirely of natural persons remain exempt from filing ownership reports.

Commercial stations will be required to identify the race or ethnicity and gender of each individual having an attributable interest in the licensee or permittee. Sole proprietorships and partnerships composed of natural persons, who are exempt from filing ownership reports, are encouraged to file gender and race/ethnicity information voluntarily. Race and ethnicity identifications include Black, Hispanic, Native American, Alaska Native, Asian and Pacific Islander. ■

Harry C. Martin is an attorney with Fletcher, Heald & Hildreth, PLC., Rosslyn, VA.

Dateline

TV stations in the following states must file their ownership reports by February 1, 1999: Arkansas, Louisiana, Mississippi, Kansas, Nebraska, Oklahoma, New Jersey and New York.

Stations affiliated with ABC, CBS, Fox and NBC in the 10 largest markets must complete construction of their DTV facilities by May 1, 1999. The deadline is November 1, 1999 for network-affiliated stations in markets 11-30.

All commercial stations not affiliated with one of the top-four networks, and affiliated stations outside the top-30 markets, must file their DTV construction permit applications by November 1, 1999. Noncommercial TV stations may wait until May 1, 2000.

ATSC encoding

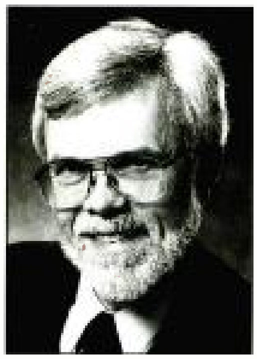
BY JERRY WHITAKER

The function of any compression system is to provide for efficient storage and/or transmission of information from one location or device to another. The encoding process, naturally, is the beginning point of this chain. Like any chain, video encoding represents not just a single link, but many interconnected and interdependent links. The final product, as you might assume, will be no better than the weakest — or worst — link.

Every station wanting to participate in DTV program origination will need an ATSC encoder. Selection of one particular model over another is not — at this writing anyway — as straightforward as it might at first seem. In this month's column, our experts give their views on the art of encoding. ■

Jerry Whitaker is Broadcast Engineering's seminar program consultant

Andy Butler, PBS



EXPERT

Many users question the cost of first- and second-generation DTV and HDTV encoders. The reason for the relatively high cost is simple. The team that created the MPEG-2 standard was aware of the proposed use for the technology. From the beginning, it was intended for mass distribution of programming to the final user. Under this model, the material would be encoded once and decoded many times. To create an economically feasible system, the designers decided to require the encoders to do the most difficult and complex portions of signal manipulation. The decoders could be relatively simple and inexpensive. This makes good sense in the overall scheme of broadcasting, but does require a hefty investment for those who wish to create programming.

Hands-on evaluation

The PBS Engineering Labs evaluated a number of encoders during the summer of 1998. The results were, at best, inconsistent. Some of the second-generation encoders performed respectably on most material, while some first generation units were barely capable of creating a viewable picture. The manufacturers realize that this situation is unacceptable and we are seeing considerable improvements. This fluid situation requires careful consideration before purchase.

Based on what we learned this summer, here are some hints. First, there are very few "measurements" of encoder performance. Several manufacturers are developing innovative tools for qualitative analysis, but right now these tools are as primitive as the devices they are designed to measure. Be prepared to spend some time watching real programming on a real-time basis to pick the best encoder for your installation.

MPEG encoding is a very different process. To properly judge encoders, you need to think carefully about the process so you understand what you see. An example is preconditioning for noise. Noise is annoying in an analog system, but usually does not destroy a final product. An MPEG encoder often sees video noise as rapid, complicated motion. Devoting large amounts of its bit budget to capturing this motion can cause the encoder to lose detail, fail to follow true motion, or freeze. Good second-generation encoders incorporate aggressive noise reduction to help control this problem. You need to know what your proposed encoder includes and how much control you have over this action.

Another example has a less elegant solution. One of the most challenging situations for MPEG encoders is a high-contrast, black-and-white image. This may sound counterintuitive, but the encoding process uses complicated algorithms based on our perceptions of color and spatial relations to decide what information to discard during the compression process. Black and white robs the encoder of an entire menu of tools for bit reduction. Once again, seemingly simple material can cause the encoder to overrun its bit budget and fail.

In addition to audio and video, an ATSC encoder has to deal with other critical information such as PSIP tables and ancillary data. Determining how well these capabilities are implemented in a given encoder can be difficult. Most encoders have one or more data inputs, but we found several instances where the control software has no provision for activating these inputs.

Architecture considerations

A final note on architecture. Be careful about how you view your encoder. It is actually a multifunction system that prepares (or multiplexes) all of your services — video, audio, and data — into the complex bitstream that is your final product. Consider how accessible each function of the unit will be for service and future upgrading. We have had trouble with all-in-one encoders because of the complex, multilayer circuit boards that form the backplane of these devices. To prevent such problems, we chose an encoding system with separate chassis for each encoder, plus a stand-alone multiplexer. This system is more complex and might be more expensive, but it offers great flexibility and is less vulnerable to total failure.

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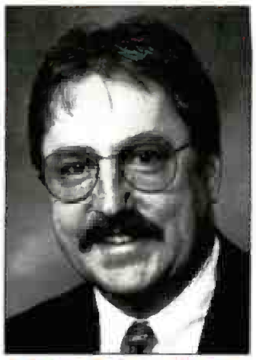
Picking the right encoder is almost like mating for life. The investment is large and the results will dramatically impact your ability to deliver competitive product for a long time to come. ■

Andy Butler is director of engineering for the Public Broadcasting Service, Alexandria, VA.

John Delay, Harris Corporation



VENDOR

If you are planning to offer any degree of locally encoded programming when you initiate digital broadcasting, an encoder is an investment that cannot wait. However, it is likely that the services you offer with DTV — whether a single channel of high-definition programming, multiple channels of standard-definition, data services or any combination that suits the 19.39Mb/s payload of the 6MHz 8VSB signal — will change or refine over time. How can you be sure that the encoder you select today will be able to meet future challenges?

The selection process

One way is to pay close attention to the architecture of the encoding system in the selection process. By adding a few questions to your selection criteria and by understanding the fundamentals of an *ideal* encoding system's design, you will be able to take significant strides to future-proof your DTV facility and, in the process, maximize your equipment investment.

As a starting point, here are some questions you may want to ask any encoder supplier:

- Will the encoder provide *cost-effective* source coding (compression) and packetization of audio, video and data?
- Will you be able to upgrade the system to provide additional services later — without disrupting existing services?
- What degree of redundancy, including controllers, multiplexers, power supplies, and physical line interfaces, is possible with the system?
- How will upgrades be made? Does the system use a hardware platform that will allow you to enhance performance or implement different standards by adding software, or is more required?
- Can the system support all of the standards as well as PSIP, data insertion and closed captioning?
- Is the encoder a self-contained system, or is it dependent on external PC platforms?
- How easy is it to operate and control the encoder in general, and to perform such tasks as switching from standard definition or data services to HD broadcasting?

These basic questions will give you a top-level idea about an encoding system's long-term functionality. ■

John Delay is director of product management, Harris Corportion

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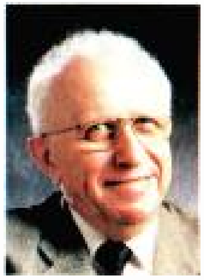
Transition to Digital

Digital video basics

BY MICHAEL ROBIN



Digital video systems represent the infinite video signal level variations, inside a given limit as a limited number of binary numbers. Early attempts to digitize video signals were for accomplishing video signal processing, such as timebase correction, frame synchronization and standards conversion. These processes were difficult or impossible to carry out in the analog domain.

Contemporary digital video techniques are found in digital tape recording and digital video distribution systems, among others. Transmission of digital video in bandwidth-restricted channels and videotape-recording applications have resulted in efficient and high-performance digital bit-rate compression technologies.

This article discusses the basic concepts of sampling and quantization, which are at the root of all contemporary and future applications.

The digital video black box

Figure 1 shows a simplified block diagram of a typical black-box digital device. This black box can represent any digital device or system. The input is a conventional analog video signal. The signal is bandlimited by a low-pass (anti-aliasing) filter and fed to an A/D converter where the analog signal is converted into digital form. A/D conversion involves two major steps; sampling of the analog signal and quantizing the sampled values.

The digitized signal is then fed to some type of processor. In timebase correctors, the processor performs timebase correction in the digital domain. In video recorders the processor records and plays back the video signal in digital format.

The processed signal is fed to a D/A converter that converts the binary values representing the video signal into a voltage representing the amplitude of the original signal. The recovered analog signal is low-pass filtered using a *reconstruction filter*. The reconstruction filter removes higher frequency spectral components, passing only the analog video signal.

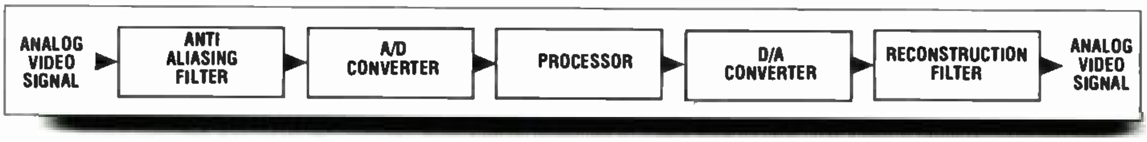


Figure 1. Block diagram of a basic digital black box.

Sampling the video signal

Sampling is the digital equivalent of amplitude modulation. Essentially, the digital carrier (repetitive sampling pulses) is amplitude modulated by the video signal, resulting in a wide modulation spectrum with carriers at fs (the sampling frequency) and its multiples (2fs,3fs,..nfs). The process is similar to amplitude modulation except for the wide modulation spectrum that is a result of the rectangular sampling pulse shape. As in any amplitude modulation process, the carrier frequency must be higher than twice the maximum baseband frequency fb. Figure 2a shows the ideal spectrum of the sample baseband. In this case, the baseband video spectrum does not exceed half the sampling frequency. Figure 2b is an example of the baseband video spectrum extending beyond half the sampling frequency. In this case the lower sideband of the modulated carrier interferes with the baseband video spectrum resulting in *aliasing*, which simply means the generation of spurious video frequencies. Figure 2c shows a practical application where the sampling frequency is higher than twice the video bandwidth which, in turn, is limited by a suitable low-pass anti-aliasing filter. For proper sampling, the video sampling fre-

FRAME GRAB

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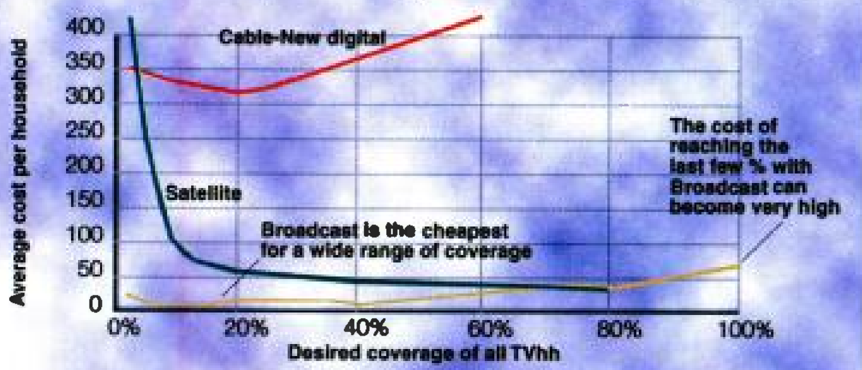

Relative infrastructure costs to provide video service to a population. Shows average cumulative costs per household excluding reception equipment. Cable costs will be much lower if existing networks can be upgraded.

Source: CDG Consultants www.cdg.net terry.brunner@cdg.net

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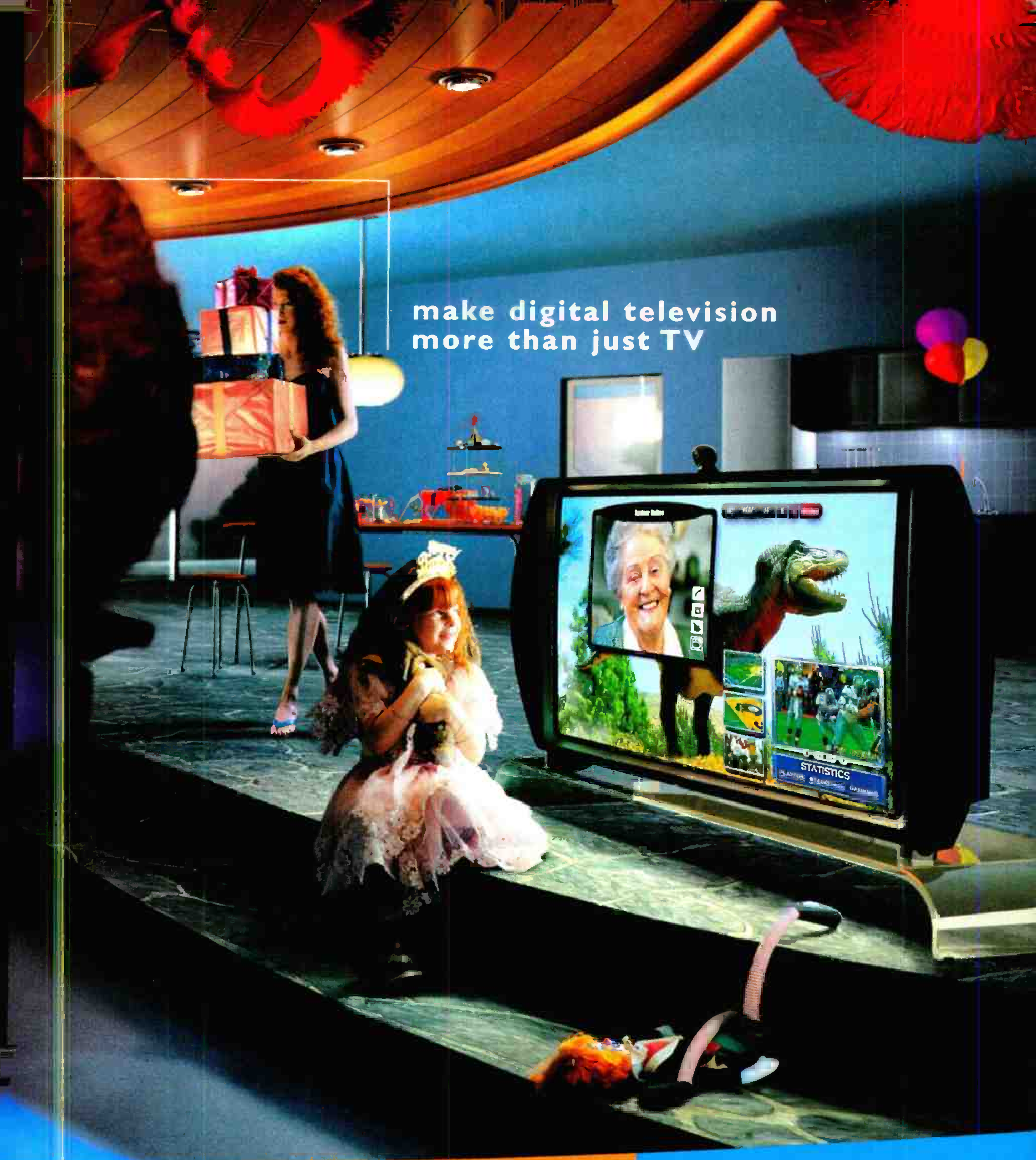
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STATISTICS

quency has to meet several conditions:

- It must be higher than twice the maximum frequency of interest (the Nyquist rule).
- It must be high enough to allow for the design of realizable and cost-effective low-pass (anti-aliasing) filters with minimum ripple and group delay.
- It must be a multiple of a basic video frequency like f_H (horizontal scanning frequency) or fsc (color subcarrier frequency). The sampling rate of video signals has evolved through the years. Analog composite video signals are sampled at a multiple of the subcarrier frequency fsc. Analog component video signals are sampled at a multiple of the horizontal scanning frequency f_H.

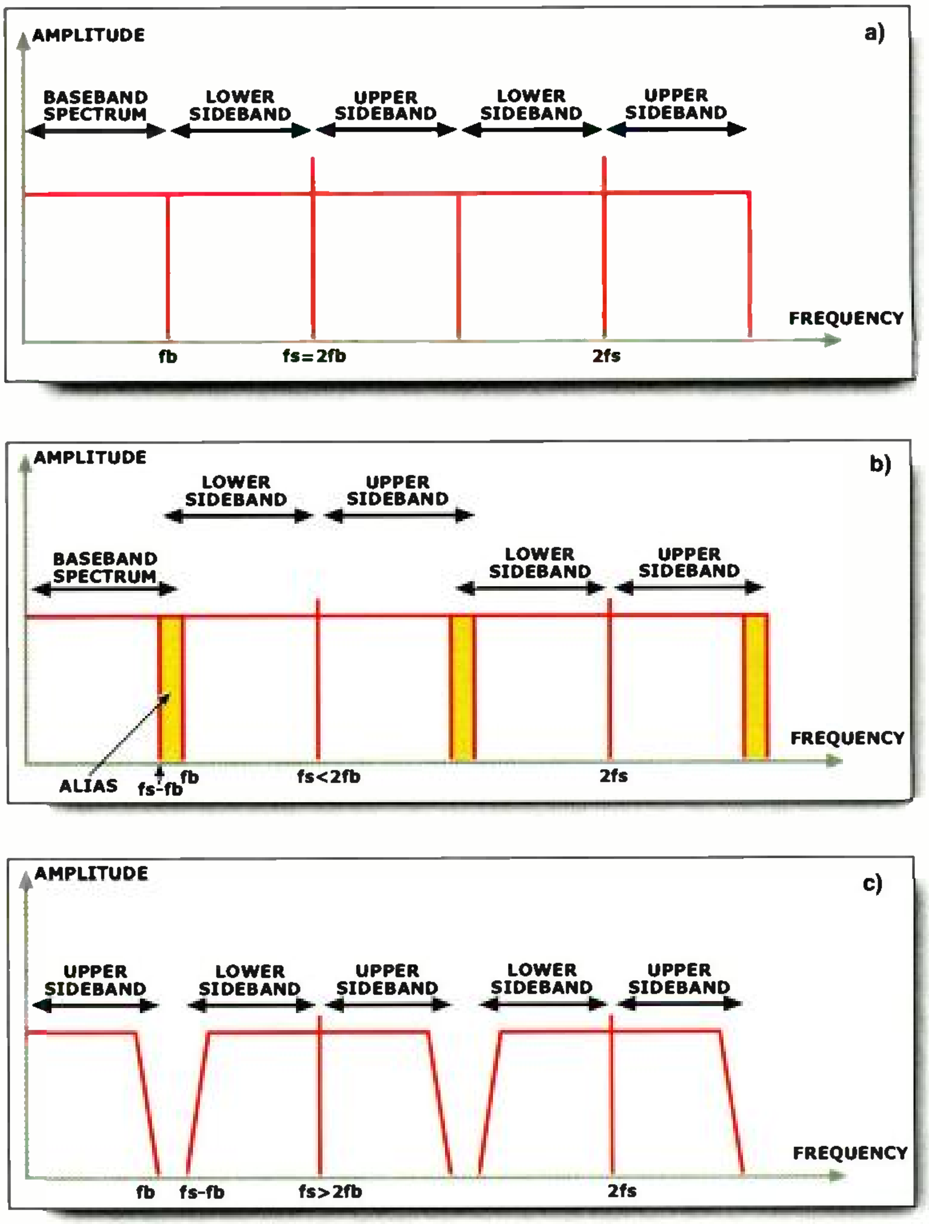

Figure 2. Sampled signal spectrums, a) the ideal spectrum of a sampled baseband signal, b) aliasing caused by low sampling frequency, c) spectrum of a sampled and filtered baseband signal.

Quantizing the sampled values

Sampling the analog video signal results in a progression of samples repeated at regular intervals. The amplitudes of these samples reflect the instantaneous baseband signal amplitude at the sampling instant. Ideally, the sampling pulse has a very short duration. In reality, its duration is $T=1/f_s$ resulting in a sample-and-hold process which ensures that each sample amplitude is held in memory until the next sample arrives. The resulting high-frequency loss is compensated for in the reconstruction filter.

The quantizing process assigns binary values to the sampled pulse amplitude values. The sampled value word length depends on the number of bits per sample provided by the system. As a consequence, the amplitude levels of the continuously varying analog signal are converted to a finite number (n) of discrete levels (Q) according to the expression: $n=2^b$, where b is bits per sample. The resulting digital signal is an approximation of the original analog signal.

Early video equipment used eight bits/sample while contemporary high-quality studio equipment uses 10 bits/sample. This limits the accuracy of the digital representation of the original analog video signal, because only a limited number of discrete values ($2^8=256$ or $2^{10}=1024$) are recognized by the system. In addition to limiting the number of signal amplitude values the system recognizes, the various digital standards limit the excursion of the video signal, or the *quantizing range*, to less than the total number of possible values. This practice maintains an acceptable headroom for varying analog signal levels as well as allowing for special timing reference signals (TRS). The TRSs are unambiguously defined and are distinct from samples carrying video information. The limited number of binary digital values representing the video information results in quantizing errors, i.e. the erroneous representation of video levels. With eight or more bits per sample the quantizing errors are visible as wideband noise. With less than eight bits per sample the system exhibits contouring effects. Figure 3 shows the effect of an insufficient number of quantizing levels available to represent the original sampled waveform. As a result, all sample amplitudes occurring within specific bounds are assigned a single value that is one of the possible levels i.e. n, n+1, n+2 etc. Quantized values may contain errors not exceeding ±½Q. The approximate signal-to-noise ratio (SNR) of a digital system is given by the formula:

$$SNR(dB) = 6b + 6$$

where n is the number of bits. Consequently, a 10-bit system will have an SNR of approximately 66dB.

Digital video standards

Two different digital video concepts coexist in the world today: Composite digital video and component digital video.

- Composite digital video: Composite constitutes a stepping stone from the analog composite (NTSC or PAL) world to the all-digital production environment. The current sampling rate is 4fsc, nominally 14.3MHz for NTSC and for PAL. Manufacturers developed products such as D-2 and D-3 VTRs and a wide range

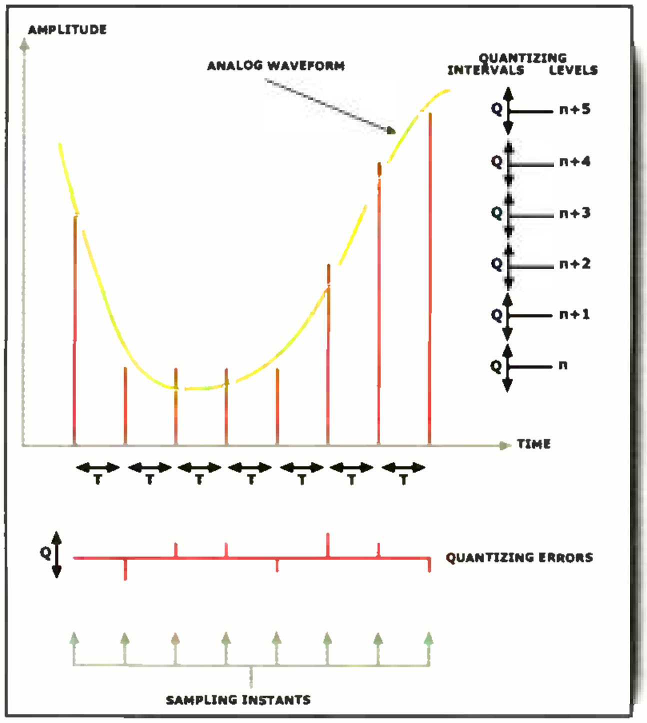

Figure 3. The quantizing process can result in quantizing errors as high as ±½Q.

of 4fsc compatible digital production equipment.

• Component digital video: Component is based on the use of one luminance and two color difference signals or the green, blue and red signals. The document describing the concept is known as ITU R601 (formerly CCIR 601). It defines the manner in which the three component analog signals, Y, B-Y and R-Y, are sampled, quantized and time division multiplexed into a single package for distribution, processing or recording. The sampling frequencies are common to SDTV (525/60 and 625/50) and are a multiple of f_H and 3.375MHz resulting in the well-known 4:4:4, 4:2:2 and 4:1:1 sampling strategies. A typical component digital video black box consists of three channels similar to the signal channel shown in Figure 1. When the 4:2:2 sampled and digitized component signals are time division multiplexed, the result is a bit-parallel data rate of 27Mwords/s. The bit-serial data rate of the 4:2:2 digital signal is 270Mb/s. Advantages of using the component approach include: wider bandwidth chrominance, elimination of NTSC/PAL artifacts and improved SNR.

Digital video advantages and disadvantages

The advantages of digital video can be summed-up as follows:

•Single-pass analog-type impairments are noncumulative if the signal stays digital. However a concatenation of digital black boxes using analog interfaces leads to cumulative signal degradations and should be avoided.

•Reduced sensitivity to noise and interference.

•The digital data can be time-domain multiplexed.

•Many tasks that are difficult or impossible to perform using analog technology can be performed efficiently and economically in the digital domain.

•Techniques such as compression can be easily applied.

The disadvantages of digital video include:

•Analog-type distortions, as well as unique digital distortions related to sampling and quantizing result in variety of visible impairments.

• Wide bandwidth requirements for recording, distribution and transmission often necessitate sophisticated bit-rate reduction and compression schemes to achieve manageable bandwidths.

• Unlike analog signals, digital signals do not degrade gracefully and are subject to a cliff effect.

Digital video technology is sweeping the broadcasting industry with competitively-priced picture processing, transmission and recording capabilities. However, there are inherent inaccuracies in the process mostly related to the sampling and quantization processes. It is increasingly common to digitize analog component signals at the camera and recover the analog composite (NTSC or PAL) signal only prior to feeding the analog transmitter. With the advent of DTV the video signals will be kept in the digital form until the viewer's home screen thus removing cumulative analog-type distortions. ■

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

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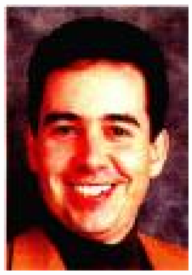


The EBU/SMPTE Task Force Report: A window to the future

BY BRAD GILMER

This is the first of a series on the EBU/SMPTE Task Force. This group was called together to anticipate future challenges, identify candidate technologies, and establish the standards needed for interoperability. *Final Report: Analyses and Results* of the *EBU/SMPTE Task Force for Harmonized Standards for the Exchange of Programme Material as Bitstreams* was published in August 1998 and, along with numerous papers, was presented at IBC '98. Having accomplished its mission, the Task Force has since disbanded. However, the work it laid out has just begun. Over fifty standards, recommended practices, and engineering guidelines were identified by the Task Force and need to be developed and implemented.

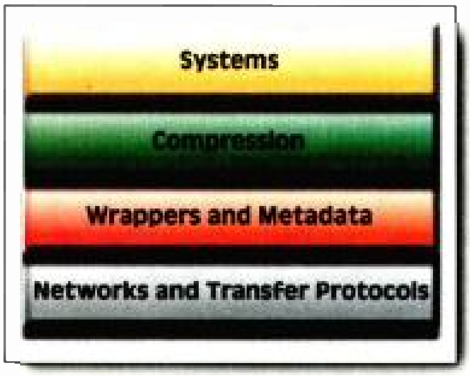


Figure 1. The Task Force committees were organized in layers such that changes within a layer do not require changes in items above and below.

The Society of Motion Picture and Television Engineers (SMPTE) is taking up where the Task Force left off. To handle this work more quickly and efficiently, that body's committee structure was recently revamped to reflect the structure of the Task Force.

Both the Task Force and its report are organized in layers. While not quite the OSI model, the idea is the same – entities within a layer can be changed without having to change items above or below that layer (see Figure 1). The recent reorganization within SMPTE resulted in committees that closely resemble this structure. It and other organizations have realized that a layered approach allows quick responses to marketplace demands. Layered standards allow an area such as protocols to be improved without rewriting the entire TV standard.

This month, an overview of the entire document will be presented. Future entries in this column will review, section by section, the work of the Task Force. The series will finish with a summary, including the potential impacts on our industry at large.

Networks and transfer protocols

The Task Force anticipates that video will be increasingly distributed within and between broadcast facilities as bitstreams. Simple economics will drive this change, based on the high-volume computer market. Currently, video can be manipulated on high-end desktop systems. The expectation is that video will become an increasingly common component of consumer-level computer systems. This will directly benefit our industry by allowing this hardware and software to be leveraged into our businesses. However, interchange of video bitstreams will only be possible with commonly agreed-upon network configurations and transfer protocols.

Building upon a reference architecture developed by Hewlett Packard's Al Kovalick, the Task Force report discusses the difference between file transfer and streaming (for more information, see Computers and Networks, August 1998). Also described are different file transfer methods, quality-of-service considerations (especially important if you are planning to transfer content over a public network), and specific methods that can be employed to either stream content or transfer it as a file.

The Task Force recommended Fibre Channel for fast/large file transfers, and ATM for wide-area network file and stream transfers. It recognizes that Ethernet is ubiquitous and may be used for low-performance transfers. The Networks and Transfer Protocols group came up with a number of recommended standards to allow the mapping of a particular container, such as DV, into a particular transport technology such as ATM. This area will be explored further in a later column.

Wrappers and metadata

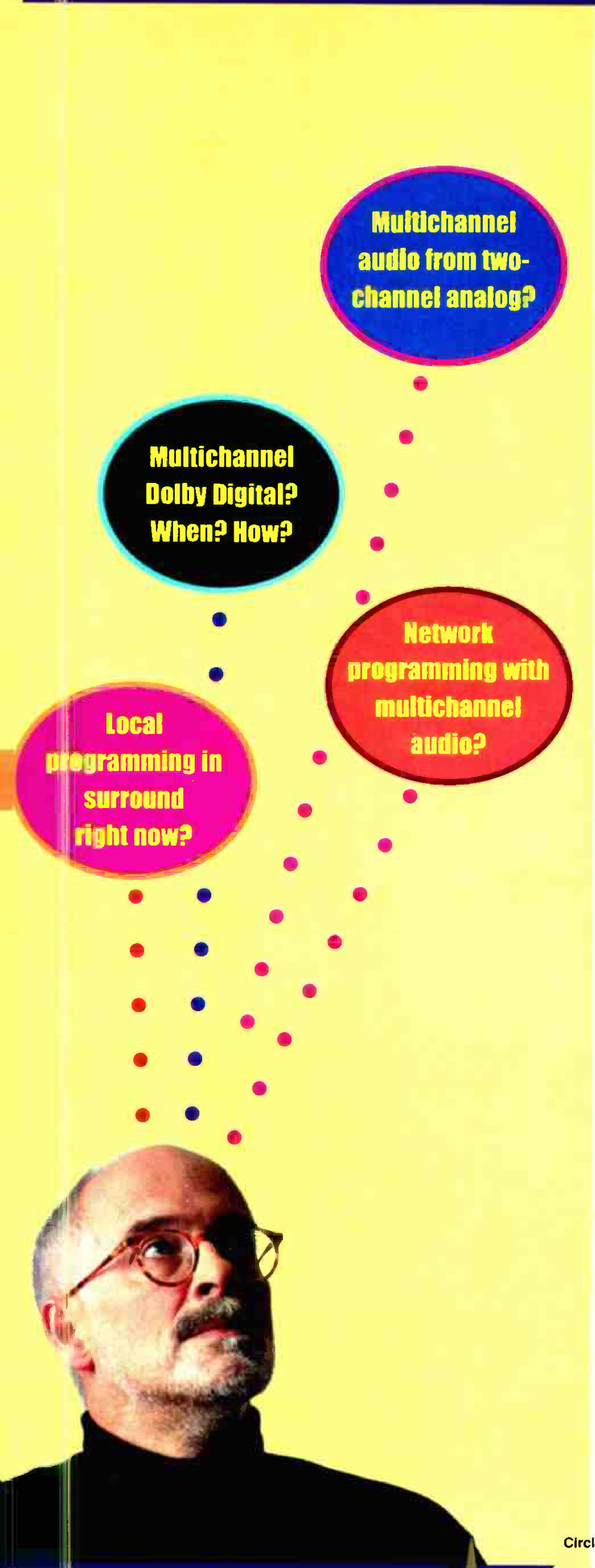
"Wrappers and Metadata" explores how pictures, sound and text (collectively referred to as *essence*) are packaged together in coherent groups. Metadata is data about the data – timecode, GPS-coordinate data for a remote shoot, news scripts, etc.

This section of the report describes, in detail, how essence is grouped into content packages, and how various contents can be grouped together within a common wrapper. This architecture will be important to the editing and transferring of material within and between facilities for years to come.

This section also tackles the difficult subject of metadata. Some rough rules for the classification of metadata were

Obtaining a copy of the Task Force report

The Final Report is published jointly by the EBU and SMPTE. Contact the EBU or SMPTE and ask to be sent a paper copy (the EBU can supply a Special Supplement, SMPTE can supply a Journal) or download the .pdf document from the EBU website (www.ebu.ch/pmc_es_tf.html) or from the SMPTE website (www.smpte.org/engr/ebumeet1.html)


Multichannel audio from two-channel analog?
Multichannel Dolby Digital? When? How?
Network programming with multichannel audio?
Local programming in surround right now?

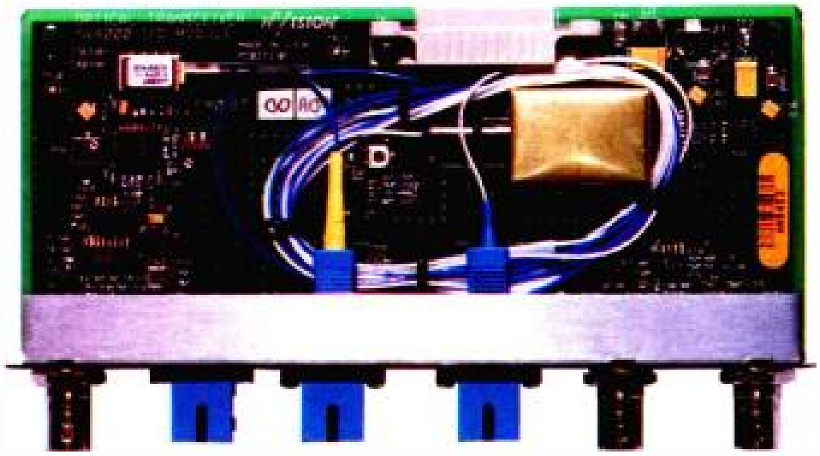
Transporting Digital Video via Fiber Optic Links

Fiber Optic technology has been successfully employed by Telcos for many years. However, its use as a transport layer for digital video has been limited and viewed as an expensive technology for all but long haul applications. Most of the electrical-to-optical (E/O) and optical-to-electrical (O/E) converters offered for digital video applications are modified versions of telco designs. Although these products provide adequate performance, they often carry a high cost and do not always handle all possible signal patterns found in the video format.

With the advent of digital television and the requirement to convert many analog broadcast facilities, fiber optic transports will probably become a standard requirement to ensure that SDI (270/360 Mbit) signals can be easily distributed at distances in excess of 250 meters. An additional motivation to employ fiber will come from any installation that will generate, distribute or redistribute programming in HD-SDI (1.5Gbit); in this case, receivable signal distance via coax will be limited to 150 meters at best and nominally 100 meters.

NVISION... has a reputation for delivering high quality products at reasonable prices, and carrying this image over to the fiber designs was paramount.

NVISION, a manufacturer of routing and distribution equipment for digital video and audio signals, based in Grass Valley, CA, has taken a new approach to the design of products for fiber optic conversion. Inspired by their design of new routing products for HD-SDI and SDI signals, NVISION now offers a comprehensive range of O/Es, E/Os and transceivers for SDI and HD-SDI signals. These modules have been designed from the ground up.



NVISION's 4000 Series HD4270 module

Before the NVISION design engineers set pen to paper (or mouse to pad), the company conducted extensive research to understand user requirements and their difficulties with available equipment. This research uncovered several problems that required attention:

1. The purchase costs for the E/Os and O/Es were too high.
2. Available fiber E/Os were often very sensitive and required that SDI signals performed well within the SMPTE specifications for signal level and jitter.
3. Most fiber products would not handle pathological signal content (long strings of 0s or 1s)
4. Adoption of fiber often presented technical problems for system engineers unfamiliar with the nuances of fiber termination and management.

NVISION started by designing fiber converters for HD-SDI, as this was technically the most difficult task. They utilized their 4000 Series equipment frames as the host for the new modules. This allows purchasers to include fiber optics with standard DAs, A to Ds, embedders etc. The company has a reputation for delivering high quality products at reasonable prices and carrying this image over to the fiber designs was paramount.

As a result of their efforts, they now offer six fiber optic products: An SDI transceiver (SD4170), an SDI O/E (SD4171), an SDI E/O (SD4172), an HD-SDI transceiver (HD4270), an HD-SDI O/E (HD4271) and an HD-SDI E/O (HD4272). All of these products meet the following criteria:

1. The new products are inexpensive.
2. They will perform well with any input signal that meets SMPTE specifications.
3. They will receive all signals without bit error, including pathological content.
4. NVISION offers a technical support line to help system engineers with fiber installation (530) 265 1059.

Other additions to the 4000 product line include 4 to 16 channel audio embedder/disembedders. When used in combination with fiber optics, these products allow a video channel and up to 16 phase aligned AES channels to be transmitted over tremendous distances for an affordable price.

Also, these products provide the only current method to transport accurately phased groups of six audio channels at base band. This provides a reasonable way to manage surround sound mixes (5.1 channels) prior to compression for delivery to the home.

NVISION can be contacted at 1 800 719 1900 or by fax at 530 265 1021. You can visit their website at www.NVISION1.com.

Calculating transmission distances

When determining the transmission distance for a given signal and fiber optic transmitter/receiver combination, the following rule of thumb is applied. Please note that the numbers given are pessimistic and are offered as a guide only.

1. **Calculate the maximum loss budget (allowable loss between transmitter and receiver), *i.e.* Tx power = -7.5dBm – minimum receiver level = -20dBm**
   Maximum loss = 12.5dBm
2. **Calculate the losses of the path, including length and connectors.**
   Use 0.3dBm loss per km for SDI or HD-SDI.
   Add .5dBm loss for each connector in the path (including bulkheads).
   Total loss = length in km x 0.3 + # connectors x 0.5dBm
   ***i.e.* 10 km x 0.3 = 3dBm + 4 connectors x 0.5dBm = 2dBm.**
   Total loss = 5dBm
3. **Subtract path losses from the loss budget. (It's that easy!)**


Digital Television...
The Ultimate Frontier
These are the exploits of the daring NV Force,
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to seek out new technology, and create new solutions;
to boldly lead where no company has led before.
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FIBER OPTICS
NVISION PRESENTS
DIGITAL AUDIO DISTRIBUTION AMPLIFIERS, A TO D CONVERTERS, D TO A CONVERTERS, DIGITAL DELAY MODULES
REFERENCE GENERATORS DIGITAL AUDIO MASTER-CLOCK GENERATOR
STANDARD DEFINITION VIDEO SDI DISTRIBUTION AMPLIFIERS, AUDIO EMBEDDERS/DISEMBEDDERS FOR UP TO 16 AUDIO CHANNELS, SDI FIBER OPTIC CONVERTERS
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MATRIX SIZES RANGING FROM 8x8 TO 2048 x 2048
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assembled, and the concept of a registry for a metadata dictionary was introduced. The report also identified the requirement for a unique identifier to label each item as it passes through the system. Potential wrapper formats were also identified, as was the importance of the interoperability of these formats.

Finally, this section of the report identifies a large amount of work to be taken up by SMPTE, including the definitions of wrapper profiles and metadata sets and the mapping of various wrappers onto transport mechanisms.

Compression issues

One of the Task Force's goals was to reach consensus on a single compression scheme. About halfway through its work, the group realized this was impossible. Different compression schemes serve different areas of the market, and competing compression schemes have their ardent supporters. As a compromise, two incompatible compression schemes – DV and MPEG – were recognized.

The report contains an exhaustive discussion of compression issues and should be required reading for anyone using or contemplating the use of compression in their facility. Topics range from MPEG group-of-pictures structures to compression preprocessing, sample structures, and HDTV considerations. Also discussed in detail are the issues and difficulties surrounding audio compression schemes.

The concept of an agile decoder, a unit capable of decoding compressed essence, either between multiple compression families or within a single compression family, was considered. Currently, there is no commercially available decoder that can decode both MPEG and DV. Finally, several recommendations regarding compression and its applications were made.

Systems

The Systems section brings together the Task Force recommendations for the development of complete solutions. The need for a Systems group was recognized somewhat later than the other groups; however, substantial progress was made in developing an overall system model. The group recommended that an object-oriented approach to system software be required in future TV facilities. The Systems section of the report recognizes that facilities will be built largely within the confines of two models – peer-to-peer and hierarchical. The Task Force recommends the peer-to-peer

Planning for the revolution

BY S. MERRILL WEISS

The technology used for TV production undergoes a worldwide revolution about every 20 years. Monochrome in the 40s was followed by color in the 60s. The 80s saw the shift to digital operation, and 2000 will bring the widespread use of video and audio compression, treatment of content as data, data networking, and similar techniques.

In the past, when these revolutions came, they simply happened. Often, they weren't even recognized for what they were until after they had transpired. This worked because the replacement of one technology with another did not cause any significant change in the way the business was done. Change was incremental, and, consequently, the workflow adjusted to follow.

The coming revolution will be different. It is already bringing about huge shifts in the business of television, and those shifts will accelerate. It has been recognized in advance. Because of this, there is an opportunity to guide the changes to minimize dislocations and maximize the benefits of the resulting systems.

The purpose of the EBU/SMPTE Task Force on Harmonized Standards was to examine the changes that are beginning to occur, devise a rational structure for their management, and initiate the development of standards that will facilitate the transition to the new way of working. The result is a road map that shows us where we are going and how we are likely to get there. It will serve as a guide for development and impetus for implementation of the new TV production technology over the next decade or more.

S. Merrill Weiss is co-chair of the EBU/SMPTE Task Force

model because of limitations in the hierarchical approach.

Monitoring and diagnostics will be a part of any future broadcast facility. As facilities migrate from tape/hardware-based systems to computer/software-based systems, it will become more difficult to physically observe faults or other signs of impending equipment failure. For this reason, vendors need to provide improved monitoring and diagnostic utilities for their products. There is also a need to monitor facilities from a central point.

The issue of multiplexing content and essence into containers appropriate for emission was also considered. Many possibilities exist. If systems are to be built, some agreement on how multiplexing is to be performed is needed.

Migration from current systems, as well as plans that fit the economic model for broadcasting were also explored. It is fine to talk about future systems, but they will not be built if there is no economical way to migrate to them.

Finally, the Systems section describes the standards required to implement systems based upon the work of the Task Force.

The work of the Task Force is important to almost everyone in the industry. As you can see from this summary, almost every aspect of the business is touched upon in some way. There are specific recommendations for technologies and standards that will set the path for years to come. Over 200 people and almost as many companies put over $1 million and two years of effort into this report — quite a bargain when you can get it free over the Internet. ■

Brad Gilmer is president of Gilmer & Associates, Inc., a technology and management consulting firm — (770) 414-9952

Ask Dr. Digital

Too much camera?

BY STEVE EPSTEIN, TECHNICAL EDITOR

I have a three-part question regarding the advantages of 3-CCD cameras recording onto 4:1:1 DV tape.

It is my understanding that single-CCD cameras have individually colored lenses over each sensor, and the ratio of colors is 0.30R + 0.59G + 0.11B. If a single-CCD camera has a 570,000 pixel array, then 570,000 pixels/480 lines = 1187 pixels/line. Does that mean that there are roughly 1187 x 0.299 = 354 red pixels per line on this one CCD camera?

How about a 3-CCD camera with 380,000 pixels on each CCD. Does that mean there are essentially 380,000/480 = 791 pixels of each color per line?

If the DV format reduces the color information to 4:1:1, are there only 500 pixels/line x .25 = 125 pixels for each chroma signal on a line? Is the higher color resolution of the 3-CCD camera being wasted with 4:1:1, or is this an example of images captured with higher quality looking better even when viewed in a lower-quality format?

Thanks,
Kenji Hughes

Rx

That's an interesting bunch of questions. Before delving into them, let's clear up some issues.

In 3-CCD cameras, a prism is used to split 100% of the incoming light into three colors — red, green and blue. The signals derived from the CCDs are then matrixed to provide output signals such as composite video and/or Y, R-Y, B-Y. The equations used vary depending on the video standard involved, but the equation you mentioned is the one used for NTSC. In cameras, the actual mixing equations are based on the characteristics of the optical path and the pickup devices. Be aware that the mixing occurs in the camera electronics rather than through the use of pixel counts in the CCDs. Also, note that the CCD output is an analog signal. CCDs are effectively arrays of light-sensitive, analog sample-and-hold circuits.

In a single-CCD system, colored stripes cover the CCD. Typically, the stripes are secondary colors such as cyan, magenta and yellow or the standard colors of red, green and blue. Depending on the CCD, these stripes may also include clear stripes for a luminance channel, but this immediately reduces the amount of chroma information available. Like the 3-CCD system, the channel outputs are matrixed to provide the desired output signals. A fundamental difference in single-CCD systems is their performance in low light. In a 3-CCD system, 100% of the incoming light reaches the imaging array. In a striped array, the stripes block nearly two-thirds of the incoming light (the red stripe blocks green and blue, while the blue stripe blocks green and red). Additionally, with less signal available to put into the matrix equations, the potential errors can easily skew the output colors, especially in low-light situations.

In addition to increased light sensitivity, a distinct advantage of 3-CCD systems is the use of *spatial offset*. Using a one-half pixel offset for the green CCD effectively doubles the number of pixels available for the luminance channel, smoothing the image information and reducing aliasing. The disadvantages of using 3-CCDs are, of course, the heavy requirements for optics and extra circuitry, which result in increased costs and weight.

Now, let's look at the numbers. Rather than comparing apples and oranges, let's try to keep things as equal as possible. The following examples will refer to the use of 380,000 pixel CCDs. These CCD chips are actually 811 pixels wide and 508 pixels high (411,988 pixels total). Of those, only 768 x 494 (379,392 pixels total) are active. Using sophisticated techniques such as optical low-pass filtering and spatial offset, the horizontal resolution (luminance) of a 3-CCD imaging system can be ap-


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proximately equal to the number of horizontal pixels. Because techniques such as spatial offset are not available in single-CCD cameras, the horizontal resolution (luminance) is reduced to about 60% of the number of pixels or, in this case, to about 470 lines. In systems using a 4:3 aspect ratio, horizontal resolution can be converted to bandwidth using approximately 80 TV lines/MHz. Therefore, the luminance channel of a 3-CCD camera with 768 pixels/line requires a bandwidth of 9.5MHz.

Before going any further, remember Nyquist theory. Sampling a 9.5MHz signal with a 13.5MHz sampling frequency results in aliasing. To avoid aliasing, this signal must be bandwidth limited to 6.75MHz (540 lines). All that extra resolution ends up in the bit bucket. Bear in mind that the quality of the filtering circuits will significantly impact the ultimate quality of the remaining image. Now, if we assume the resolution of the red, blue and green channels of a 3-CCD system are approximately equal to the luminance resolution of a single-CCD system (60% of the number of pixels, or 470 lines), then the chroma output channels have to be bandwidth limited to 270 lines for a 4:2:2 system or to 135 lines in a 4:1:1 system. Can you say *bit bucket overflow*? Again, this is dependent on a number of factors, including the quality of the filters used.

Moving to the single-CCD system, the luminance channel offers 470 lines of resolution. That 70 line (540 to 470) shortfall in the number of lines of luminance resolution is critical. Human eyes are more sensitive to luminance than chrominance. Because of the reduced horizontal-luminance resolution, pictures from this system will not look as good as those from a 3-CCD camera using the same CCDs. If we take this one step further, to obtain 540 lines of horizontal resolution and provide a full-bandwidth luminance channel, a single-CCD system requires a CCD with 900 active pixels per line. Moving to the chrominance side of the discussion, if the array is striped as RGBRGB etc. the number of pixels in each color channel becomes 1/3 the total, or 256. With a pixel count of 256, the horizontal resolution will be 60% of that, or 153 lines. This is slightly more than the available chroma bandwidth in a 4:1:1 system (135 lines) but less than the available resolution of a 4:2:2 system (270 lines).

So, what does this mean? Are you buying unnecessary resolution? Possibly. Can you make better pictures by staying analog? Yes. Is it important? Maybe. By definition, SMPTE 259 is limited to 540 lines of horizontal luminance resolution. Any additional resolution is lost in the conversion process. However, the additional resolution *can* be utilized within the camera itself to improve picture quality—both digital and analog. Properly designed, a 900pixel/line, single-CCD camera offers all the luminance resolution recordable on any system based on a 13.5MHz (4) sampling rate. This same camera falls short in chroma resolution for a 6.75MHz (2) sampling rate, but will provide more than enough for a 3.375MHz (1) sampling rate. Relative to your question concerning a 3-CCD camera and 4:1:1 recording, yes, it is more than you need. However, there may be features or durability factors that make the 3-CCD system a better choice. In any event, if the analog outputs of CCD cameras are used, all of the available resolution is maintained.

Need help? Drop me a not at *drdigital@compuserve.com.* ■

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On the Cover

The launch of STS-95, the Space Shuttle carrying American hero John Glenn, marked the beginning of nationwide broadcasting of HDTV signals using the ATSC DTV standard. (*Photo courtesy of NASA.*)

HDTV: The New Imaging Revolution

his is an exciting time for video professionals and for consumers. Our new digital television system, the product of a decade of work by scientists and engineers around the world, is on the air. It works. It makes beautiful pictures. It provides capabilities never before possible. Indeed, the ATSC DTV system offers features thought to be little more than fantasy just 10 years ago.

In the course of preparing this special report on HDTV, I discussed the status of DTV implementation with a number of TV station engineers working to put their digital signals on the air. The word from the trenches was that implementation problems abound. Some stations are running into tower licensing road blocks. Others have horror stories to tell about the difficulties they have found in interfacing new digital gear and getting it to work. Still others are baffled by the abundance of scanning formats, and plan to stay out of the fray until "things are sorted out."

These are, of course, all important issues. But, in the greater scheme of things, I have to say they're *just details*. Important details to be sure. But just details.

The launch of every new technology has been fraught with growing pains. Consider what TV engineers of the 1950s faced when their management decided that it was good business to convert to color. In 1954, getting a black-and-white signal on the air was an accomplishment, let alone holding the frequency and waveform tolerances sufficiently tight that the NTSC color system would look halfway decent. And then there were the receivers: big, expensive, and unstable. Round picture tubes with long necks. The sets commandeered living rooms across America. And service these things? There were two dozen convergence adjustments alone in the RCA CTC-15 chassis, the first design that really worked – and it was released nearly a decade after the first color broadcasts began.

These problems were, in the final analysis, only details. Obstacles to be overcome. Challenges to be met. Such is the case with DTV.

The ATSC digital TV standard is, of course, just technology – a technical scheme that permits certain tasks to be accomplished. As such, it is neutral insofar as intrinsic benefits. DTV will, instead, become whatever we choose to make it.

At this point in the transition to DTV, many obstacles exist. Many more will be uncovered as the early-adopters learn by doing. The bottom line, however, is that DTV is the future of the professional video industry. Without it, we cannot hope to compete in the *information age* that is now unfolding.

The DTV train has left the station, and there's no turning back. It promises to be a splendid ride.

– **Jerry C. Whitaker**

Welcome to Digital

This special supplement to *Broadcast Engineering*, *Video Systems*, and *Millimeter* magazines is intended to help readers make the transition from NTSC to high-definition video. It is our goal to bring to you instructional tutorial articles, application stories, news items, and new products supporting the technologies encompassed by high-definition imaging.

This supplement is edited by Jerry C. Whitaker, an industry consultant and author. His latest work, *DTV: The Revolution in Electronic Imaging* (McGraw-Hill, 1998), is the definitive handbook on digital television. Additional editorial support has been provided by Peter Hammar, a long-time video industry consultant and historian.

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Additional reader support is available at the Technical Press website, *www.technicalpress.com*.

At the Smithsonian Air and Space Museum in Washington, DC, visitors crowded around new HDTV receivers to watch the Shuttle launch in high-definition. (Photo courtesy of Harris.)

HDTV: In the Field and On the Air

By Jerry C. Whitaker and Peter Hammar

TV – and more important, HDTV – are on the air. Stations across the country are broadcasting pilot programming and beginning to fashion new business strategies made possible by this technology. Although broadcasters are the most visible early adopters of DTV, many other industries are gearing up and already making commercials. TV programs and motion pictures using HDTV equipment spawned by the new ATSC DTV standard.

Put side-by-side, the breadth of the HDTV applications now finding commercial success is staggering – from NASA to post-production to medical imaging. It is impossible in a limited number of pages to chronicle all of the industries in which HDTV has found a home. However, the following profiles will provide a sampling of the enormous build-up in progress across the United States and around the world.

Go for launch

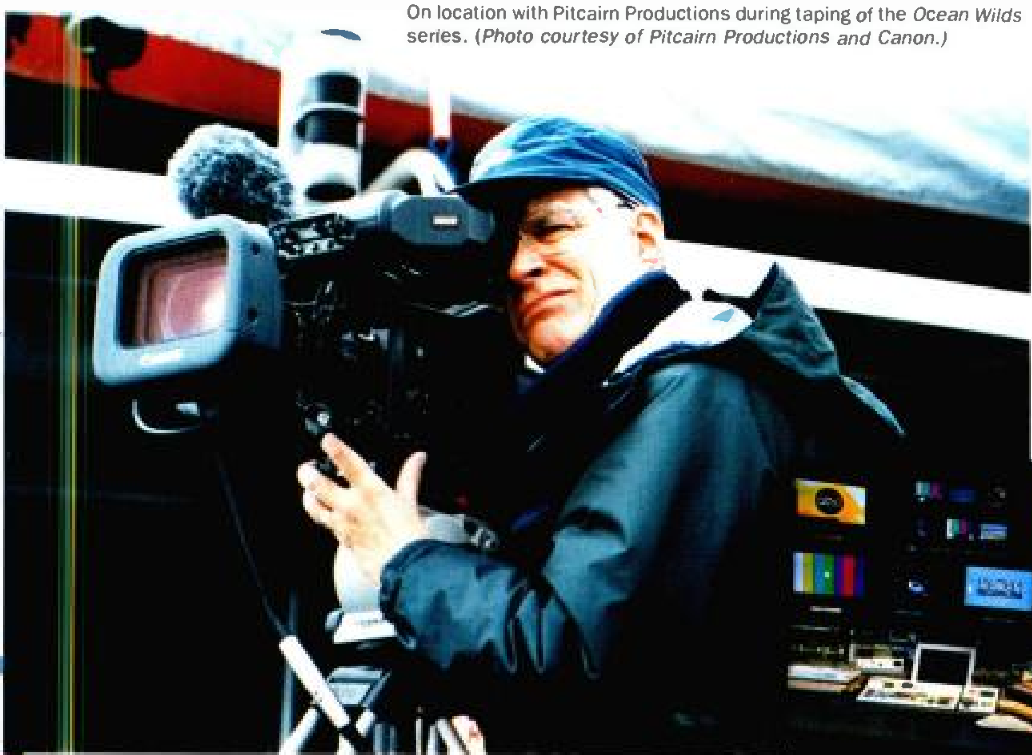
If HDTV truly is the "next big thing," then it is only fitting to launch it with a bang. The new ATSC system received just such a sendoff, playing to excited audiences from coast to coast during the launch of space shuttle mission STS-95.

The first nationwide broadcast of a high-definition TV program using the ATSC DTV system, complete with promos and commercials, aired Oct. 29, 1998. The live HDTV broadcast of Senator John Glenn's historic return to space was transmitted by ABC, CBS, Fox, NBC, and PBS affiliates. Organized by the Harris Corporation, the broadcast featured a number of "firsts."

There were six trucks involved in the remote from the Kennedy Space Center – one for video production, one for audio and graphics, one for transmission, and three satellite uplink trucks. The video production truck was provided by NHK Japan. Ten cameras were used in the production – some with operators and some remotely controlled or fixed – including a camera that was placed 1,000 feet from the launch platform. This automated camera was mounted on a custom-built, remote-controlled, pan-and-tilt assembly. The camera was placed in a protective enclosure to shield it during liftoff. The video and control telemetry were connected to the production truck via five miles of fiber-optic cable. Three other cameras were also linked by fiber, and those HD cameras fed 1035-active-line video to the production truck.

Cameras used in the broadcast included Ikegami HDL-79 and Sony HDC-700/HDC-750 models. The audio and graphics truck included Panasonic D5 VTRs, Sony HDW-500 VTRs, a Sony 2000 editor, and a Tektronix/Grass Valley 110-HD switcher.

There were three 1.5Gbits/s serial digital (SMPTE 292M) feeds from the video production truck. Two 59.9Hz (1080x1920) feeds were provided, one with commercials and one without, that were uplinked for domestic use. Viewers of the commercial feed saw Procter & Gamble spots. In Washington, D.C., a local one-minute promotional insert for WRC-TV's HD service was included. This was done using a "crash" switch from the satellite feed's demodulated 19.4Mbits/s stream to a local compressed transport stream from a Tiernan



On location with Pitcairn Productions during taping of the *Ocean Wilds* series. (*Photo courtesy of Pitcairn Productions and Canon.*)

encoder fed by tape. A third feed was used for distribution to Japan.

The U.S. feeds were sent to separate Harris/Lucent EVA200 encoders to create separate 19.4Mbits/s ATSC transport streams. The 1035-line video was centered in the ATSC 1080-line structure. The audio was Dolby AC-3 encoded in mode 2/0. The output of the encoders went to a patch panel and then to Newtec modulators, whose 70MHz outputs were carried 500 feet via Heliax to the uplink trucks. Program quality was monitored using Ku downlinks and Newtec NTC/2060 demodulators feeding Ikegami HTM-2003 HD monitors.

The commercial station feed was set up for 1:2 Reed Solomon encoding and used QPSK via Telstar-4, transponder 16L (time was donated by Unity Motion). About 26.5MHz of the available 27MHz was used with this robust coding scheme. The non-commercial uplink went to a different truck aimed at GE-3 with its equipment set for 3:4 Read Solomon encoding and also using QPSK occupying 18MHz of the GE-3 transponder. The feed to Japan for NHK broadcasting was 60Hz at 45Mbits/s and was uplinked on Galaxy-9.

The feed was available free for any broadcaster who could receive the signal. The affiliates and other providers transmitted the broadcast to viewing sites in Washington, New York, Atlanta, Chicago, Los Angeles, and 15 other cities. Audiences in those cities watched the launch on new digital receivers and projectors during special events at museums, retail stores, broadcast stations, and other locations. Many of the stations moved their on-air dates ahead of schedule in order to show the Glenn launch broadcast. The largest scheduled viewing site was the Smithsonian's National Air and Space Museum in Washington, where viewers watched the launch on an IMAX theatre screen and four new digital receivers.

The impressive ABC-TV HDTV Release Center at the network's New York headquarters. (*Courtesy of ABC.*)

WRAL-HD, which in 1996 became the first station to broadcast a commercial digital signal, provided editing equipment and several high-definition vignettes that were shot in Houston and Washington. NHK provided high-definition production equipment and engineering expertise through NHK Enterprises America.

Kodak filmed and transferred footage for several of the vignettes that were used in the show, using the same process that networks will use to prepare much of their current television, movies, sitcoms, dramas, and commercials for prime time digital broadcasts. The Kodak/Philips Spirit telecine was used for film transfer.

Other organizations involved included All-Stars Communications, EF Data, Turner Engineering, Unity Motion, Rave Productions, and Jaleo, North America. TV set manufacturers included Philips, Samsung, Sharp, Zenith and Panasonic.

Beyond the technical details was an even more important story insofar as HDTV production is concerned. All of the cameras used in the coverage provided an HD signal except for one NASA pool feed of the launch control center at the Kennedy Space Center, which was upconverted NTSC. On occasion, the director would switch to the launch center feed, providing a dramatic "A/B" comparison of HDTV and NTSC. The difference was startling. It easily convinced the industry observers present at the Air and Space Museum showing of the compelling power of the HDTV image.

The second production issue to come into focus during the broadcast was the editorial value of the wide aspect ratio of HDTV. At one point in the coverage, program anchor Mary Alice Williams described to the TV audience how the shuttle was fueled the night before. In describing the process, the camera pulled back from the launch pad shot to reveal a fuel storage tank off to one side of the pad. As Williams continued to explain the procedure, the camera continued to pull back to reveal a second fuel storage tank on the other side of the launch pad. Thanks in no small part to the increased resolution of HDTV and – of course – the 16:9 aspect ratio, the TV audience was able to see the entire launch area in a single shot. Such a shot would have been wholly impossible with standard definition imaging.

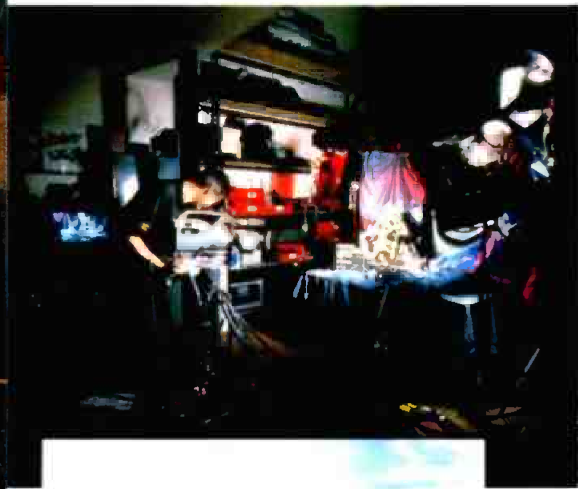
The STS-95 mission marked a milestone in space, and a milestone in television. A future shuttle mission will further advance video imaging by including an HDTV camcorder (Sony HDCAM) to capture a variety of images in support of the scientific projects planned. The high-definition images captured will provide the most detail ever seen of space travel using an electronic medium.

ABC launches HDTV effort

In an effort very much down-to-earth, but nonetheless groundbreaking in its own right, the ABC Television Network has brought online a new HDTV "Release Center." The network's first regularly scheduled broadcast of high-definition TV programming aired on Sunday, Nov. 1, 1998 – the 1996 version of Disney's *101 Dalmatians*. The broadcast originated from the ABC HDTV Release Center designed, built, and equipped by Panasonic System Solutions Company (PSSC).

The HD production suite of American Production Services, Seattle, a pioneer in high definition programming. (*Photo courtesy of APS and Sony.*)

Below: New HDTV cameras with improved colorimetery offer color control and matching far superior to NTSC devices. (*Photo courtesy of APS and Sony.*)



The latest generation of HDTV camcorders has made it practical and affordable for APS to shoot HDTV in the field. (*Photo courtesy of APS and Sony.*)

Located at the network's headquarters in New York, the multimillion-dollar HDTV Release Center serves as the hub for the release and distribution of progressive scan programming to ABC's digital-ready affiliated and owned stations.

The Release Center consists of two fully redundant edit/control rooms. Each room serves as a stand-alone facility, providing the collective capability to originate two separate program streams or one stream with full backup. A variety of monitoring options were provided, including HD and SDTV 16:9 and 4:3 devices. The Panasonic AJ-HD2700 D-5 HD recording system is a key component of the equipment complement at the Center.

Pitcairn Productions takes to the high seas

Panoramic outdoor and nature shots have long been recognized as one of the selling points of HDTV. It is no surprise, then, that Feodor Pitcairn Productions chose HDTV as the medium for its *Ocean Wilds* series. Pitcairn's goal was to capture the first full HD images of whales and dolphins in the Azores. Using HD cameras (Sony HDW-700) and hydrophones, Pitcairn fashioned a rare close-up portrait of these creatures and other dramatic oceanographic stories not previously captured in HD. The goal was a definitive, enduring undersea HD series that clearly surpassed previous natural history programming in quality and scope.

While the Azores is a beautiful location, the high winds and pitching seas made shooting quite difficult. Many of the shots were taken on boats where tripods simply do not work. Yet, camera stability was critical to the production. Pitcairn enlisted the help of Canon's HJ15x8B HD lens and IS-20B II image stabilizer to capture steady shots in the roughest of seas. The IS-20B II gave Pitcairn the ability to shoot not only from boats, but also helicopters – even in the high winds typical to the remote Azore islands.

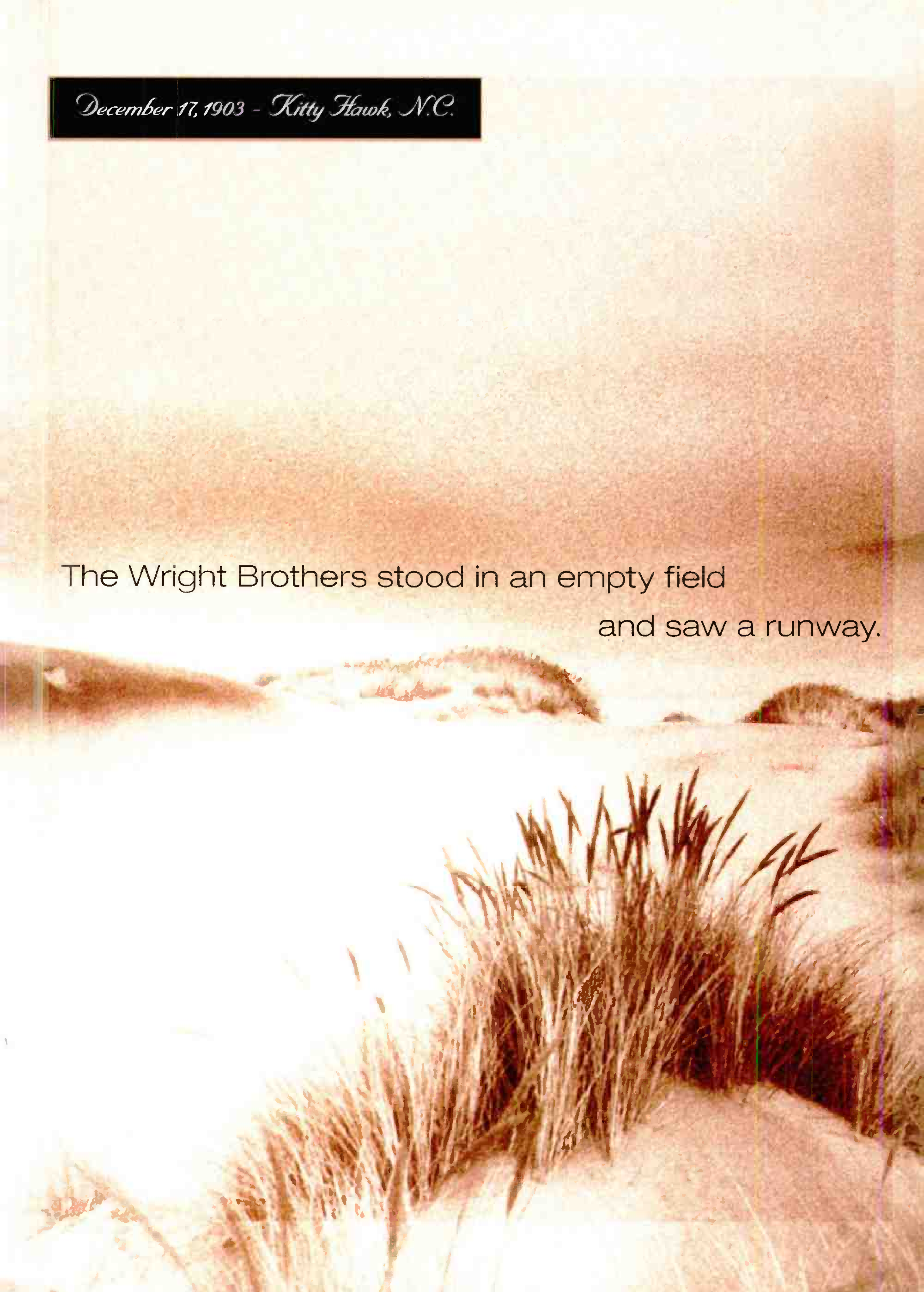
High-impact promos

From the production standpoint, one of the most difficult tasks facing a program producer is how to promote his or her product. Almost inevitably, promos designed for network television are assembled on a tight timetable and confined to short time slots. The challenge of hooking viewers on a program when given only 15 seconds to explain it and build interest for it is really monumental. One sure way to make an impression is to give the viewer something different. Enter HDTV.

The Public Broadcasting Service, while not saddled with the same restraints of a commercial network, must nonetheless promote its programs and – indeed – itself to be successful. It is for this reason that "HD November" was an important step for PBS. The network – along with The Interface Group, which provides film and video production services to professional communicators in the Washington area – created four 20 second promos and two opens – a 110-second piece and a 60-second piece – for the network's first foray into high-definition television.

"PBS Digital Week" began on Monday, Nov. 9, 1998, with the broadcast of the nation's first two programs shot and edited in high definition – *Chihuly Over Venice*, which spotlights the work of renowned glassblower Dale Chihuly, and *Digital TV – A Cringely Crash Course*, the first national program designed to inform general audiences about digital technology. These programs were followed by Ken Burns' documentary *Frank Lloyd Wright*, which aired Nov. 10 and 11, 1998.

The documentary included the first on-air test of enhanced digital television, an entirely new form of television that uses Intel Corporation technology to deliver graphically rich interactive content – Wright's architectural plans,


December 17, 1903 - Kitty Hawk, N.C.
The Wright Brothers stood in an empty field
and saw a runway.


HDCAM HDW-700 Camcorder

The world told Orville and Wilbur that man couldn't fly, but they left doubt behind and turned possibility into reality. Today, that kind of determination to leap into the future makes

With our HDTV suite, where you go is entirely up to you.

Sony the only manufacturer who provides a complete solution for HDTV production. From the ground up, no one offers digital innovation like we do. Take our HDCAM™ HDW-700 for example, the first HD camcorder ever created. Its ingenious design, based on Digital Betacam® technology, makes it a cost-effective alternative to traditional film that lets you shoot images of unprecedented quality on location, turbulence-free. We also offer HD portable and


HDCAM HDW-500 VTR


HDS-7000 Series Switcher

dtv™ READY

HDCAM HDW-700 Camcorder
- 40 minute 1/2" HD cassette
- Memory setup card
- Lightweight one-piece camcorder

HDCAM HDW-500 VTR
- Simultaneous HD/SD output
- Preread
- 4 channels 20-bit digital jog audio
- 2 hour 1/2" HD cassette

HDS-7000 Series Switcher
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HDME-7000 Multi-Effects System

studio cameras, nonlinear editing systems, servers and everything else you need to take wing—from HD editing VTRs, switchers and a 3-D effects system, to Trinitron® monitors. And flexibility? Try full compatibility for HD and downconverted SD formats, and open standards designs so our products seamlessly work together and with other manufacturers' equipment. Sony has the complete digital solution, which is why NMT has chosen us to outfit their HD production trucks. It's also why pro-


HDM Series Monitor

duction professionals like American Production Services, CBS, HD VISION and Madison Square Garden Network productions are already taking off with our HD systems. And Sony's service and support programs


NMT HD Production Truck

offer just what you need today and tomorrow. Get a first class trip into the future by calling 1-800-635-SONY, ext. PROD or visit www.sony.com/production. HDCAM™

We're ready. Are you?™

HDME-7000 Multi-Effects System
- HD SDI for video inputs/outputs
- Easy-to-use GUI
- DME LINK™ Interface to switcher

HDM Series Monitors
- HR Trinitron CRT picture tube
- 1080 or 1035 active lines
- 16:9 widescreen with 4:3 Area Marker

SONY

On the set of the Talisman Crest Ltd. production of *The Secret Adventures of Jules Verne*, shot in high-defintion. (*Photo courtesy of Talisman Crest Limited and Sony.*)

sketches or detailed biographical notes, for example – to select viewers as the program was broadcast.

The four 20-second promos – or "digital bits," if you will – are "factoids," each explaining a different aspect of digital television and how PBS will use DTV in the classroom. The opens will continue to precede all high-definition programming this year. Seven PBS member stations nationwide began digital broadcasts on Nov. 9, 1998, and at least 13 additional PBS member stations are expected to make the digital conversion later this year.

And now, a word from our sponsor

If there is one constant in the world of commercial broadcasting, it is advertising. Without a doubt, the spots pay the wages. That being the case, the reception of advertisers to DTV in general, and HDTV in particular is of critical importance to the ultimate success of this new medium. If Procter & Gamble, the world's largest advertiser, is any indication, the future is rosy indeed.

Jim Gosney, associate director of commercial production for Procter & Gamble (P&G), told a gathering of industry leaders in Washington D.C., on the occasion of the inauguration of regular DTV service, that his company – for one – is not only interested in HDTV, but enthusiastic about it.

It is difficult to overstate the leadership of P&G when it comes to media advertising. For more than a hundred years, P&G has been an early pioneer in adopting new advertising media. Its first print ad for Ivory Soap ran in 1882, when national magazines were just starting. Again, in October 1896, Ivory had its first color ad bound into a magazine. In 1923, Crisco became one of the first radio sponsors, of Graham McNamee's show on WEAF, New York, which featured a woman giving cooking recipes. Ivory Soap made history again by participating in the first live commercial TV broadcast on Aug. 26, 1939. A large crowd in the Television Building of the World's Fair watched as Red Barber announced live the details of a baseball contest with a $1,000 first prize.

Given this history, it should not be surprising that ads, produced in high-definition, for P&G brands Tide, Pampers, Bounty, Head & Shoulders, and Scope were included in the live John Glenn shuttle broadcast. It should, furthermore, come as no surprise that the P&G brand Bounty ran an HD commercial in the premiere network high-definition broadcast of Disney's *101 Dalmatians* on ABC.

There is more to P&G's HDTV efforts than just a pioneering spirit; at the heart of it all is that HDTV can sell products better than SDTV. Last year, the company formed a Digital TV Task Force, composed of representatives from several of P&G's larger ad agencies and various department heads within the company, to learn about DTV, what it will mean, and how to be ready for its implementation. The conclusion, in a nutshell, was that DTV will afford the opportunity to improve and enhance communication with consumers.

According to Gosney, the combination of higher resolution and wider aspect ratio are a one-two punch for advertisers vying for consumer attention.

The good news for advertisers interested in making HD versions of their commercials is that there should be little or no incremental cost during production, which of course is the biggest part of the budget in making commercials, as well as programs. Many national commercials today originate on 35mm film, which is itself a high-definition medium. There is, naturally, an incremental cost for post-production and distribution in HD.

The effect of the widescreen aspect ratio on consumers is worthy of elaboration. The effect of the 16:9 format is both immediate and stunning. For the first time, commercial directors have a tool that approximates more closely our natural sense of perception. The format gives the viewer the feeling of "being there" in the picture.

It is not the same presence experienced with conventional video. The additional width to the image, with the additional peripheral information it allows, is both compelling and engaging. It allows for much greater freedom of composition and staging, allowing the use of foreground and background elements in ways never before possible on television.

APS focuses on HD production

With the current preoccupation with getting DTV stations on the air, it is easy

An interior view of the huge NMT high-definition production truck, HD-1. The truck is shown here at Madison Square Garden in New York. (*Photo courtesy of NMT and Sony.*)

to lose sight of the fact that post-production facilities have been using HDTV for years. One pioneer is American Production Services of Seattle.

APS was one of the first facilities in the United States to make digital HDTV production and post-production capabilities available to its customers. Current HD projects include a Florida Public Broadcasting Service HD demonstration – in conjunction with KCTS-TV (Seattle) and The Arnold Creative Group (Coral Gables, FL) – to increase awareness of the analog-to-digital transition, a demonstration piece with South Carolina Educational Television, and Whidbey Island Films' production of the *National Desk* series for PBS.

The 13 Florida Public Broadcasting Service programs, shot with Sony HDW-700 camcorders and produced in the APS high-definition suite, are designed to be shown to help fund the service's transition from analog to digital broadcasting. The programs will be made available to PBS stations throughout the United States as educational and fund-raising material.

APS used the Sony HDME-7000 multi-effects unit to create up to 28 layers of graphics and footage, some upconverted from NTSC to HD, for the nine-minute programs.

The six-episode commitment for *National Desk* represents the production of one of the first public affairs programs to be shot in HDTV. Location shooting for the award-winning series is being originated on Sony HD camcorders and will include the integration of digital HDTV graphics rendered in post-production. The series airs during the 1998–99 season.

Secret Adventures in HD

Another production company heavily involved in high-definition work is Talisman Crest Ltd. of Montreal. The company is producing *The Secret Adventures of Jules Verne*, a 22-episode dramatic series, created by Gavin Scott (*The Borrowers*, *Small Soldiers*) and inspired by the writings of fiction novelist Jules Verne, author of *20,000 Leagues Under the Sea* and *Around the World in 80 Days*.

The series, which is being created for international TV distribution, is being shot on Sony HDCAM camcorders (HDW-700). The program is the first recurring TV series shot in a digital HD format. The HD image has given producers the sharpness needed to produce an action adventure, while the 16:9 aspect ratio allows them to capture more viewable action. Talisman is also able to seamlessly piece together footage shot on 35mm and footage shot on high-definition video with virtually no loss (or change) in quality.

The advanced colorimetry afforded by HDTV is another important consideration. New HDTV cameras allow the cinematographer to create a custom-made color palette directly in the camcorder, streamlining the overall color correction process. The portable camcorders have added to the dynamic effects of the series by capturing aerial images while hanging from a gondola and helicopter, shooting footage under water and considerable use of Steadicam shooting.

Using one of the largest green screens ever built, Talisman Crest Ltd. was able to composite shots and create a variety of backgrounds without changing scenery. Using film, it would have likely spent many more hours (or days) to achieve the same effect.

In this corner – MSG

Sporting events are unquestionably one the great promises of HDTV. One of the early adopters in this arena is Cablevision's Madison Square Garden (MSG) network. The company built a high-definition production and post-production center at Madison Square Garden for the fall 1998 NHL season.

The center provides the MSG network with a powerful tool to dramatically change the way people watch sports on television.

The installation required building an HD master control facility and converting two of Madison Square Garden's analog rooms to state-of-the art edit suites that can operate in either HDTV or SDTV.

The signal created in the edit suites provides content to the HD production truck and master control for cable broadcast, as well as to display sites throughout the arena. The equipment complement includes Sony HDCAM HDW-500 VTRs, HDS-7000 series digital switcher, HDME-7000 multi-effects unit, HDM-2830/4 and HDM-14E5U high-definition monitors, DXC-H10 HDVS cameras, HDS-V3232 HD SDI routing switchers, DVS-V3232B digital video routing switcher, DVS-A3232 audio routing switcher, BE-9100 edit controller, and the PFV-HD/HKPF/BKPF series of SDTV/HDTV conversion and distribution products.

For the 1998 season, live video production of the 1080x1920 HDTV programming was executed in an all-digital HD production truck owned by NMT and leased to MSG Network. MSG Network committed to 200 broadcast events from the Garden, Yankee Stadium, and other New York venues, using the NMT truck known as HD-1. HD-1 is the first of two Sony-built HDTV trucks purchased by NMT, one of the country's leading digital outdoor broadcast companies. From top to bottom, HD-1 features the most advanced high-definition production equipment available.

And away we go ...

From these snapshots of high-definition applications across the country, it is clear that HDTV is not simply a technical curiosity. It is a business. Real people are making real programs in HDTV, and earning real money. It is undeniable that there are many growing pains associated with such a shift in technologies, but these are just details. Important details, to be sure, but details nonetheless. The bottom line is that HDTV works, that products are available from multiple manufacturers, and that consumer interest is rapidly growing.

To borrow a classic advertising line, "This is not your father's television system." And, drawing even further back into TV history, as Jackie Gleason (who could certainly benefit from the wider aspect ratio of HDTV) might say of the current technological landscape, "Away we go."

Apart from studio and field production, HDTV cameras also are available for special purpose applications, such as the Ikegami HDL-37. (*Photo courtesy of Ikegami.*)

Once bound to the studio because of their size and weight, the new breed of high-definition cameras have taken to field with physical specifications similar to conventional-resolution cameras. Shown is the Sony HDW-700 one-piece camcorder. (*Photo courtesy of Sony.*)

HDTV Cameras: The Magic Starts Here

By Jerry C. Whitaker

he term *high-definition television* applies more to a class of technology than to a single system or specification. HDTV can be logically divided into two basic applications: Closed-loop production systems and broadcast systems.

Each system has its own applications, its own markets, and its own fundamental technologies. Perhaps the most far-reaching market is the non-broadcast business and industrial sector, illustrated in Figure 1. By comparison, broadcast and post-production applications are more easily identified and described. It was into these widely diverse markets that HDTV was born.

Japanese professional video manufacturers, under the direction of NHK (the Japanese national broadcasting company), launched a major HDTV development program in the early 1970s, long before either European or American organizations gave HDTV serious consideration. Early Japanese efforts to establish common international standards for HDTV were largely responsible for stimulating development projects both in North America and in Europe. It is no surprise, then, that this early work on HDTV has had a profound effect on current-generation high-definition systems in general, and cameras in particular.

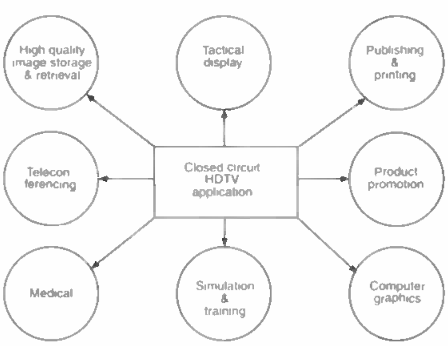

FIGURE 1. Applications for high-definition imaging in the business and industrial markets.

Production system vs. transmission system

Bandwidth is perhaps the most basic point that separates production HDTV systems from transmission-oriented systems for broadcasting. A closed-circuit system does not suffer the same restraints imposed upon a video image that must be transported by radio frequency means from an origination center to consumers. It is this distinction that has led to the development of widely varied systems for production and transmission applications. Terrestrial broadcasting of NTSC video, for example, is restricted to a video baseband that is 4.2MHz wide. The required bandwidth for full resolution HDTV, however, is on the order of 30MHz. Fortunately, video compression algorithms are available that can reduce the required bandwidth without noticeable degradation and still fit within the restraints of a standard NTSC, PAL, or SECAM channel. The development of efficient compression systems was, in fact, the breakthrough that made the all-digital HDTV system possible.

Video compression involves a number of compromises. In one case, a tradeoff is made between higher definition and precise rendition of moving objects. It is possible, for example, to defer the transmission of image detail, spreading the signal over a longer time period and, thus, reducing the required bandwidth. If motion is present in the scene over this longer interval, however, the deferred detail may not occupy its proper place. Smearing, ragged edges, and other types of distortion can occur.

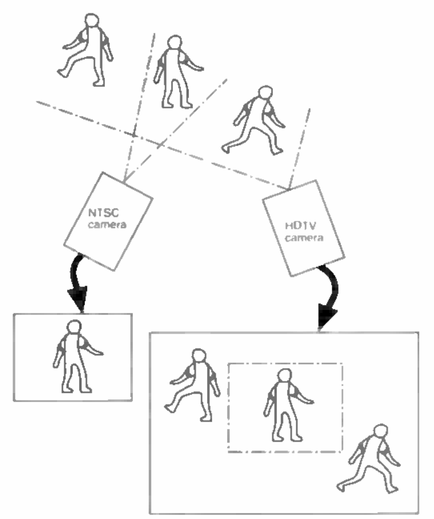

Figure 2. An illustration of the differences in the scene capture capabilities of conventional video and HDTV.

Basic parameters

The following terms are commonly used to describe and evaluate high-definition imaging systems:

Aspect ratio. The ratio of picture width to picture height.

Contrast. The range of brightness in the displayed image.

Horizontal resolution. The number of elements separately present in the picture width.

Vertical resolution. The number of picture elements separately present in the picture height.

Color depth. The range and accuracy of colors that can be reproduced by the imaging system.

The resolution of the displayed picture is the most basic attribute of any

HDTV system. The HDTV image – generally speaking – has approximately twice as much luminance definition horizontally and vertically as the 525-line NTSC system or the marginally better 625-line PAL and SECAM systems. The total number of luminance picture elements (*pixels*) in the image is, therefore, four times as great. The wider aspect ratio of the HDTV system adds even more visual information. This increased detail in the image is achieved by employing a video bandwidth approximately five times that of conventional (NTSC) systems.

The HDTV image is 25% wider than the conventional video image, for a given image height. The ratio of image width to height in HDTV systems is 16:9, or 1.777. As such, the HDTV image can be viewed more closely than is

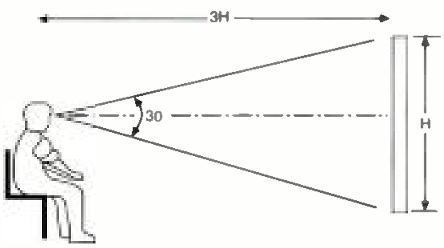

Figure 3. Viewing angle as a function of screen distance for HDTV.

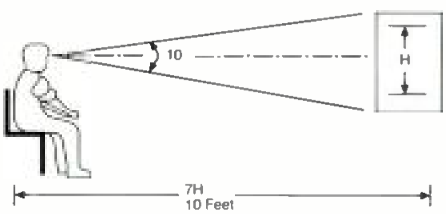

Figure 4. Viewing angle as a function of screen distance for conventional video systems.

customary in conventional television systems.

Critical implications for the program producer

In its search for a "new viewing experience," NHK conducted an extensive psychophysical research program in the early 1970s. A large number of attributes were studied. Non-technical people were exposed to a wide variety of electronic images, whose many parameters were then varied over a wide range. A definition of those imaging parameters was being sought, the aggregate of which would satisfy the average viewer that the TV image portrayal produced an emotional stimulation similar to that of large-screen film cinema experience.

Central to this effort was the pivotal fact that the image portrayed would be large – considerably larger than current

High-definition video cameras, including the Ikegami HDL 790, left, and the HDK 79, right, have reached an impressive level of development, giving program producers many new image capture options. *(Photos courtesy of Ikegami.)*

NTSC TV receivers. Some of the key definitions being sought by NHK were precisely how large, how wide, how much resolution, and the optimum viewing distance of this new video image.

A substantial body of research gathered through the years has established that the average U.S. consumer views the TV receiver from a distance of approximately seven picture heights. This translates to perhaps a 27-inch NTSC screen viewed from a distance of about 10 feet. At this viewing distance, most of the NTSC artifacts are invisible, with perhaps the exception of cross color. Certainly the scanning lines are invisible. The luminance resolution is satisfactory on camera close-ups. A facial close-up on a modern, high-performance, 525-line NTSC receiver, viewed from a distance of 10 feet, is quite a realistic and pleasing portrayal. But the system quickly fails on many counts when dealing with more complex scene content.

Wide-angle shots (such as jersey numbers on football players) represent one simple and familiar example. TV camera shooting, however, has long adapted to this inherent restriction of 525 NTSC – as witnessed by the continuous zooming-in for close-ups on most sporting events. More than a few motion-picture cinematographers have complained that television has "ruined the tastes" of the consuming public with a steady diet of close-up shots that rob scenes of panoramic impact. The techniques employed, however, are dictated strictly by the limitations of the video system. The camera operator accommodates the technical shortcomings of the conventional TV system and delivers an image that meets the capabilities of NTSC, PAL, and SECAM. There is, however, a penalty, as illustrated in Figure 2. The average home viewer is presented a very narrow angle of view – on the order of 10 degrees. The video image has been rendered "clean" of many inherent disturbances by the 10-foot viewing distance, and made adequate in resolution by the action of the camera operator. But in the process the scene has become a small "window." The now "acceptable" TV image pales in comparison with the sometimes awesome visual stimulation of the cinema.

The primary limitation of conventional video systems is, therefore, one of image size, dictated by the inherent resolution of the overall system. A direct consequence is further limitation of image content; the angle of view is constantly constricted by the need to provide adequate resolution. There is significant, necessary and unseen intervention by the TV program director in the establishment of the image content that can be passed on to the home viewer with acceptable resolution.

This point is more than just an abstract concept. Viewer expectations of the "cinema experience" are quite different from the "television experience." Before television can ever expect to achieve editorial equivalence with the motion-picture industry, it must first achieve technical equivalence. Such equivalence, of course, is the ultimate goal of HDTV.

Image size

If HDTV is to find a home for the consumer, it will find it in the living room. If consumers are to retain the average viewing distance of 10 feet, then the minimum image size required for an HDTV screen for the average definition of a totally new viewing experience is about a 75-inch diagonal. This repre-

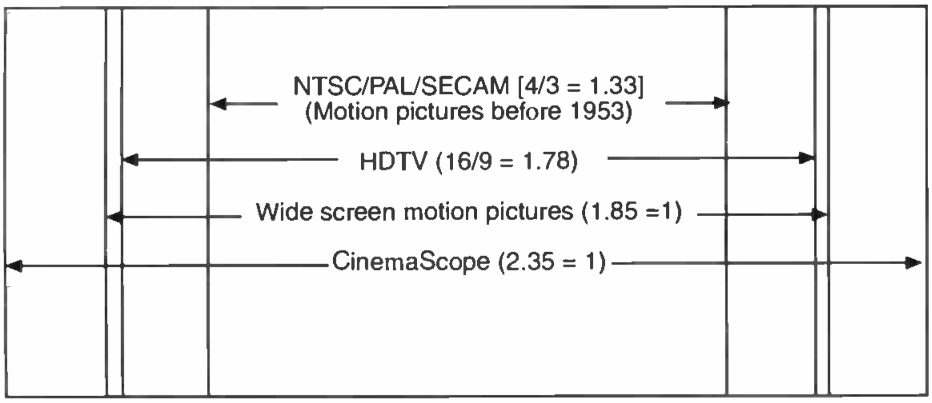

Figure 5. Comparison of common display aspect ratios.

sents an image area considerably in excess of present "large" 27-inch NTSC (and PAL/SECAM) TV receivers. In fact, as indicated in Figure 3, the viewing geometry translates into a viewing angle close to 30 degrees, and a distance of only three picture heights between the viewer and the HDTV screen. Compare this with the viewing angle for conventional systems at 10 degrees, as shown in Figure 4.

The viewing angle portrayed in the previous figures is an important, albeit somewhat subliminal, parameter. Typical human vision is not a 10 degrees experience: it is easily 30 degrees, and considerably more when peripheral visual clues are considered. Here again, the interrelated issues of image size and resolution determine whether the goal of a "new viewing experience" is achieved.

HDTV image content

There is more to enhanced viewing than merely elevating picture size. Unfortunately, this fundamental premise has been ignored in some audience surveys. The larger, artifact-free, imaging capability of HDTV allows a new image portrayal that capitalizes on the attributes of the larger screen. Remember, as long as the camera operator appropriately fills the 525 (or 625) scanning system, the resulting image (from a resolution viewpoint) is actually quite satisfactory on conventional systems. If, however, the same scene is shot using a 1080-line HDTV camera, and the angle of view of the lens is adjusted to portray the same resolution (in the picture center) as the 525-line camera when capturing a close-up of an individual ball player on its 525 screen, a vital difference between the two pictures emerges: the larger HDTV image contains considerably more information, as illustrated previously in Figure 2.

The HDTV picture shows more of the ball field – more players, more of the total action. The HDTV image is, thus, radically different than that of the NTSC portrayal. The individual players are portrayed with the same resolution on the retina – at the same relative viewing distance – but a totally different viewing experience is provided for the consumer. The essence of HDTV imaging is this greater sensation of reality.

The real dramatic effect of HDTV on the consumer will be realized only when two key ingredients are included: presentation of an image size of approximately 75 inches diagonal (minimum) and presentation of image content that capitalizes on new camera freedom in formatting larger, wider, and more true-to-life angles of view.

Format development

Established procedures in the program production community provide for the 4:3 aspect ratio of video productions and motion-picture films shot specifically for video distribution. This format convention has largely been adopted by the computer industry for desktop computer systems.

In the staging of motion-picture films intended for theatrical distribution, generally no provision is made for the limitations of conventional video displays. Instead, the full screen, in wide aspect ratios – such as *CinemaScope* – is used by directors for maximum dramatic and sensory impact. Consequently, cropping of essential information may be encountered more often than not on the video screen. This problem is particularly acute in widescreen features, where cropping of the sides of the film frame is necessary in producing a print for video transmission.

One of the reasons for moving to a 16:9 format is to take advantage of consumer acceptance of the 16:9 aspect ratio commonly found in motion-picture films. Actually, however, motion pictures are produced in several formats, including 4:3 (1.33); 2.35, used for 35mm anamorphic CinemaScope film; and 2.2 in a 70mm format

Still, however, the 16:9 aspect ratio is commonly supported by the motion-picture industry. Figure 5 illustrates some of the more common aspect ratios.

HDTV is always presented in a widescreen 16:9 aspect ratio, compared to the standard 4:3 of NTSC. SDTV, on the other hand, while expected to also be largely 16:9 widescreen, can also be standard 4:3.

As shown in Figure 6, the very essence of the future simulcast broadcast operation will dictate a great deal of program material flow between the ongoing analog 4:3 NTSC service and the new DTV service. Archive 4:3 material will be regularly accessed for the developing digital DTV channel; new material specifically originated for the

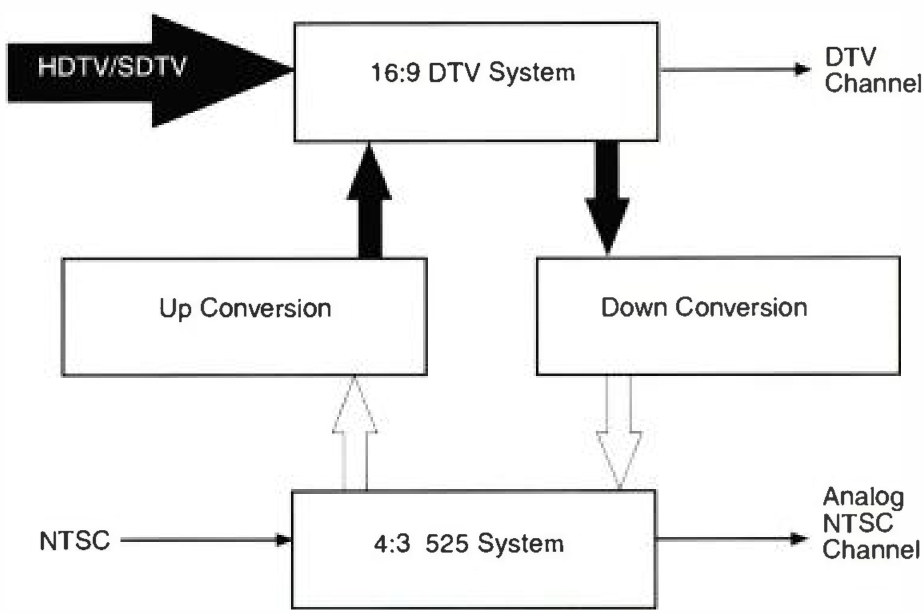

Figure 6. Program material transfer issues in the NTSC-to-DTV transition period.

widescreen DTV channel may well also be used at times on the analog NTSC channel; widescreen film-originated programming may sometimes service both channels; and so on. There are many variations that will constitute a normal daily programming dynamic in the multiple DTV scenarios that will surely evolve in the marketplace.

The management of aspect ratio is a significant new production issue, dealing in a world that will encompass two quite different image formats. There is no good way of moving program material in a bidirectional manner between two such formats. Simply put, you can derive an often excellent (or at least satisfactory) 4:3 image from a 16:9 original, but there is no way of deriving a satisfactory 16:9 picture from a 4:3 original.

DTV camera systems

Having addressed some of the basic philosophical image capture issues, it is appropriate to examine the specifics of camera and lens technologies. There are a number of the key requisites for acquisition systems supporting HDTV program origination, including:

Aspect ratio management. The need to service the standard 4:3 aspect ratio and the new 16:9 widescreen image format introduces the most difficult challenge of all to the program originator.

Highest picture quality. With the arrival of HDTV, an entirely new yardstick of picture quality will soon be appearing in the living rooms of viewers. This will be propelled by a plethora of digital delivery media that bring MPEG-2 digital component video directly into the home.

Highest signal/noise performance. Noise is the enemy of compression. Video program masters will be subjected to increasingly frequent digital compression in order to service distribution via DTV broadcasting, digital satellite and cable, and digital packaged media ranging from CD-ROM to DVD. A formerly benign noise interference (in the analog NTSC context) can, in an era of heavy digital compression, be easily translated into new and disturbing picture artifacts.

The implications of each of these issues are complex, and need to be carefully evaluated against the contemporary technologies available to camera equipment manufacturers.

With the foregoing issues in mind, the overall performance of a TV camera can be divided into two distinct categories: Those separate imaging attributes that collectively contribute to overall picture quality (that is, the aesthetics and beauty of the picture), and those separate artifacts of the camera system that collectively detract from the overall picture quality.

The name of the game in high-end video camera design is to optimize *all* of the picture quality factors while minimizing *all* of the picture artifacts. In describing the overall aesthetics of the HDTV picture, it is necessary to re-examine the multidimensional aspect of image quality and to reassign some priorities to the contribution of each of those picture dimensions.

For the purposes of overall camera performance analysis, there are four core attributes of picture quality. (See Figure 7.) They can be separately considered (and separately specified) as the key contributing dimensions of picture quality.

Picture sharpness – the overall resolution of the image.

Tonal reproduction – the accuracy of reproduction of the grayscale.

Color reproduction – the total color gamut that can be captured, and the accuracy of reproduction of the luminance, hue, and saturation of each color.

Exposure latitude – the total camera dynamic range, or the ability of the camera to simultaneously capture picture detail in deep shadows and in areas of the scene that are overexposed.

The overall performance of a camera is largely determined by the front-end imaging system, namely the combination of optics and imager. These elements predetermine the core attributes of a video picture. The image quality must be fully retained and – where possible – enhanced within the complex RGB video processing system that follows the imaging system.

The optical system

The optical system of the camera is used to form a precise image of the original scene on the surface of the imaging devices. The optical system consists of a lens to capture the image; optical filters to condition the image; and the color separation system to split the incoming light into the three primary color components.

Clearly, the quality of the optical system is critical to the performance of the overall camera. In the world of optics, there is usually a close correlation between cost and performance. It is not surprising, therefore, to find a somewhat lower level of performance in the optical system of lower-cost cameras and lenses.

With the exception of the highest levels of program production, where fixed focal length (also called *prime lenses*) are sometimes used, the zoom lens is the universal lens used with virtually all video cameras. Zoom lenses are available at a wide range of prices and performance levels, up to and including performance levels required for use with high-definition TV systems.

At first look, the requirements for a lens intended for use with a video camera appear to be quite similar to lenses intended for use with a film camera. Unfortunately, lenses appropriate for a high-quality video work differ in one critical parameter from lenses designed for film cameras: the *back focal distance* (i.e., the distance from the end of the lens to the plane where the image is formed) is increased significantly compared to film lenses to allow the insertion of the prism-type color separation system between the lens and the CCD imagers.

Several types of optical filters are used to achieve the high level of performance found in modern cameras, including color correction and neutral density filters; infrared filters; quarter-wavelength filters; and anti-aliasing filters. Each device serves a specific purpose or solves a specific shooting problem.

Camera specifications

A video camera performs the complex task of creating an electronic image of a real scene, ranging from scenes with extreme highlights – scenes with large dynamic range that must be compressed to fit within the capability of the video system – to scenes with marginal illumination. Defining the performance of a camera in a complete but concise set of specifications is a difficult exercise. It is not unusual to find a low-cost camera with virtually the same published specifications as a camera costing significantly more. Actual day-to-day performance, on the other hand, will probably show the more-expensive camera to be far superior in handling difficult lighting situations. For this reason the published camera specifications are no more than a basic guide for which cameras to consider for actual evaluation.

It is usually unnecessary to limit the choice of camera to the one with the best picture quality because virtually all professional HDTV cameras make high-quality images. Ease of use, cost, and operational features are frequently the deciding factors in choosing one camera over another for a specific application.

In an actual camera evaluation, it is typically unnecessary to spend a great deal of effort to confirm the specifications provided by the manufacturer. Instead, it is recommended to expose the camera or cameras considered for purchase to the most difficult shooting situations that they are likely to experience in the intended application(s), and then make the final choice based on the overall advantages of one camera over the others.

Cut … print it

Camera manufacturers have made tremendous strides in the design of new HDTV devices for studio and field work. Progress will surely continue, and the price/performance metric will continue to improve as well. The advancements seen to date bring electronic imaging onto an even footing with 35mm film. And although electronic imaging will not likely displace film imaging for many years – or even decades – to come, program producers now enjoy a freedom of choice never before possible. That choice is – in fact – a "new viewing experience."

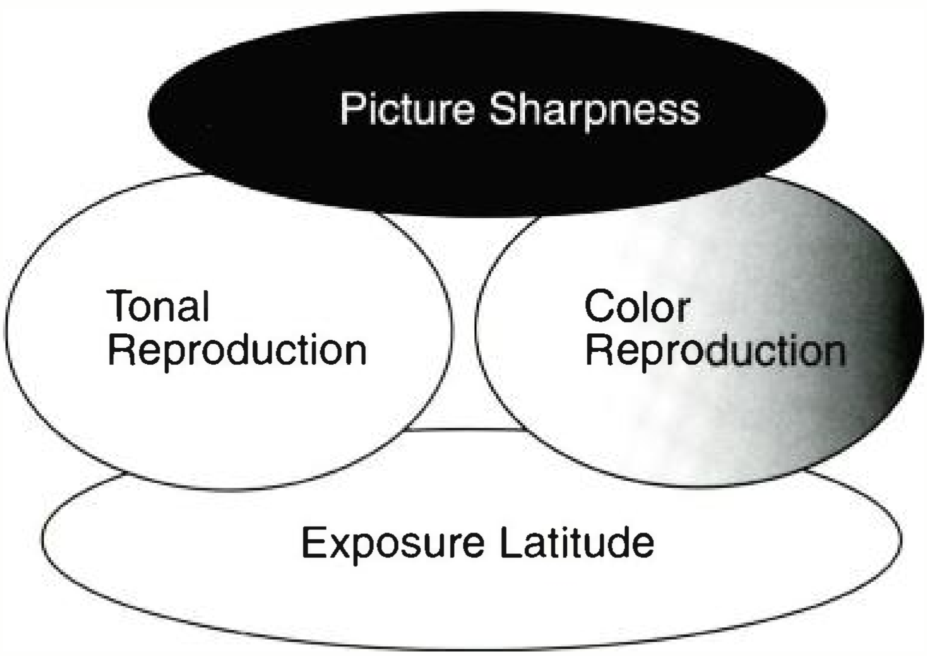

Figure 7. The primary attributes contributing to overall image quality in a video camera.

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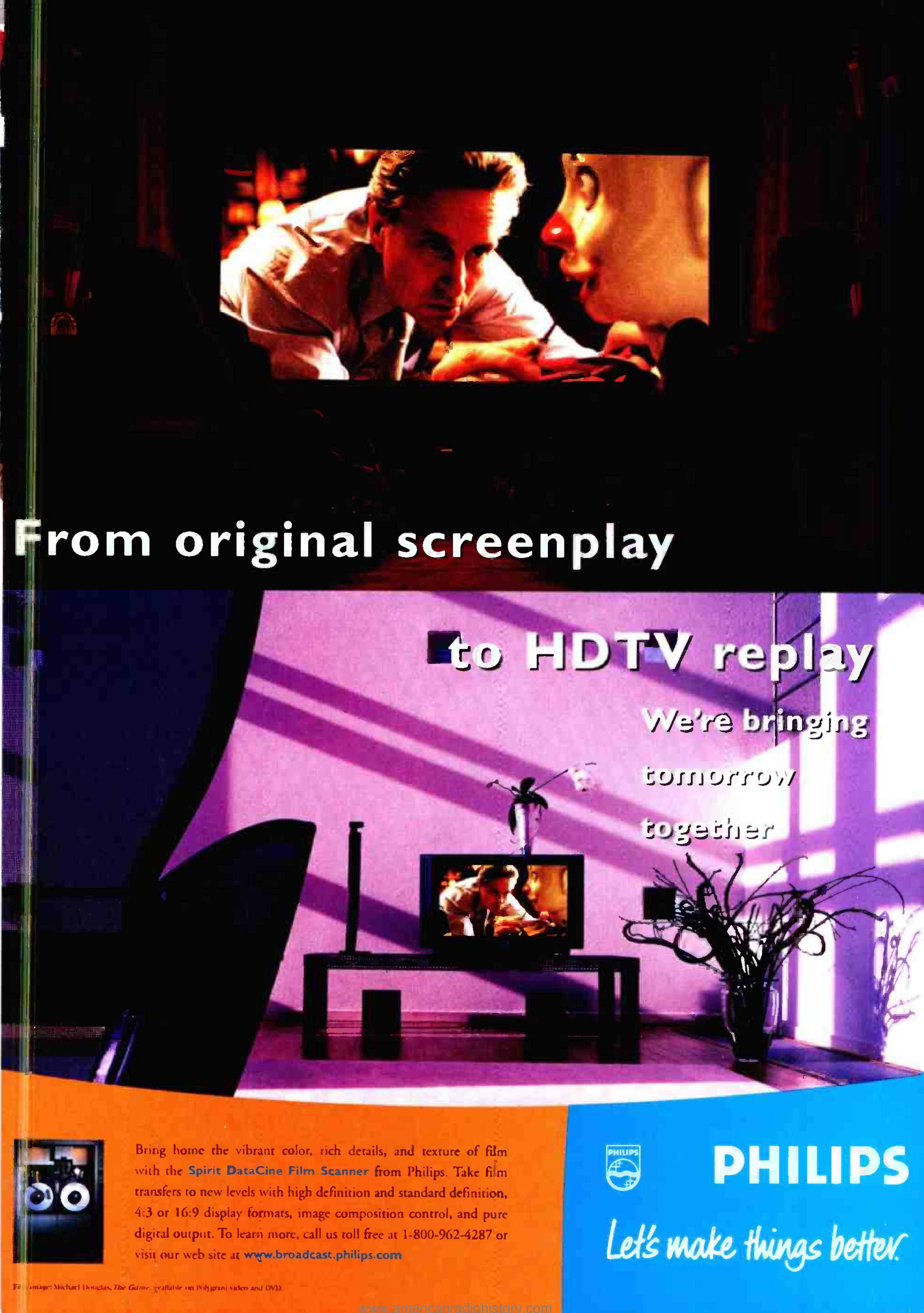
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New HD Products

Panasonic AK-HC830 1080i Series Cameras

Panasonic Broadcast and Digital Systems Company's AK-HC830 series of 1080i high-definition cameras are used for acquisition in the studio and the field. The AK-HC830 series provides a choice between hand-held or full-size camera heads, which are compatible with all standard $^2/_3$-inch lenses. Both the AK-HC880 studio camera and its companion, the AK-HC830 portable camera, feature three $^2/_3$-inch, 2-million-pixel FIT CCD imagers to deliver the full high-definition bandwidth of more than 1,000 TV lines of resolution.

The AK-HC880 and AK-HC830 include the latest advancements in digital signal processing technology, producing superb detail and color processing. The units offer a sensitivity of f/8 at 2000 lux, a signal-to-noise ratio of 54dB and a dynamic range of 600%.

The cameras use a copper and fiber-optic cable link to transfer HD video from the camera head to the CCU. Advanced all-digital, 16-bit, 74MHz processing provides a high degree of accuracy and stability. Users may choose between HD and SD lenses, depending upon application or budget.

NUCOMM Dual Digital HDTV Studio-to-Transmitter Link

The NUCOMM Dual Digital STL is designed for applications where a second microwave STL channel cannot be obtained for the DTV signal feed to the transmitter site. The Dual Digital system digitizes and compresses the analog signal or compresses the digital NTSC signal and multiplexes it with the 19.4Mbits/s ATSC signal. This baseband signal is then transmitted on one microwave STL (25MHz bandwidth channel).

NUCOMM's Dual Digital STL studio-to-transmitter link.

The system comprises a microwave transmitter and receiver, digital modulator and demodulator, multiplexer and demultiplexer, and NTSC encoder. The system also can be configured for hot-standby operation.

The MPEG-2 NTSC encoder provides a typical output data rate of 15Mbits/s to 20Mbits/s. That rate is then multiplexed with the 19.4Mbits/s ATSC signal to provide a combined data rate of 34.39Mbits/s to 39.39Mbits/s. This signal is modulated at 70MHz by NUCOMM's 70DMT7 modulator and then upconverted to the appropriate microwave frequency by NUCOMM's FT7 transmitter.

At the receiver end, the reverse process takes place. The FR7 receiver downconverts the microwave signal to 70MHz, and the baseband signal is then demodulated by NUCOMM's 70DMR7 demodulator. The output signal is demultiplexed, and the 19.4Mbits/s ATSC and NTSC encoded signals are recovered.

The HDW-500 high-definition VTR from Sony.

Sony and Pluto Create an HDCAM-Based Server

Sony Electronics and Pluto Technologies International have joined forces to collaborate on the market release of HyperSPACE HDCAM, a playout server for HDTV broadcast applications. HyperSPACE HDCAM is used for random-access station automation and as a high-definition disk recorder for post-production applications. The product was developed by a Pluto Technologies research team using advanced HDCAM compression technology from Sony Electronics.

The HyperSPACE HDCAM system allows broadcasters, cable operators, and post-production facilities to operate in a purely HDCAM environment, minimizing generational video quality loss.

With Sony's HDCAM format and Pluto's server architecture, the HyperSPACE HDCAM system uses HD-SDTI interfaces to transport the compressed HD video bitstreams between video servers and Sony's HDCAM family of videotape drives, including the HDW-500 editing VTR. This bitstream integration allows lossless transfers to and from HDCAM VTRs, or to multiple HyperSPACE units without recompressing. The system works within existing serial digital infrastructures and digital routers, allowing broadcasters and post-production facilities to migrate to DTV with minimal investment.

Miranda Stellar DTV/HDTV Format Conversion System

Miranda's Stellar series offers a flexible approach to DTV/HDTV conversion, with a modular architecture that permits users to tailor the system to the conversion needs and budget of a given facility. Stellar's environment supports a number of DTV/HDTV applications, including upconversion, downconversion, noise reduction, detail enhancement, color correction, A/D and D/A conversion, and image resizing.

The Stellar 4RU frame provides a modular housing environment for various DTV/HDTV conversion systems and tools. Through mixing and matching up to 12 front-end processing modules and 12 rear-end interface modules, users can build several conversion systems in the same 4RU frame. The Stellar frame is designed for full power redundancy, and power supplies are hot-swappable. The housing also offers a frame server for Ethernet communications support.

The Miranda Aquila upconverter system, a component of the Stellar series, accepts 4:3 or 16:9 (270Mb/s anamorphic or 360Mb/s), 4:2:2 signals (SDTV) and outputs 480p, 720p or 1080i HDTV signals.

Five of the 24 available slots in the Stellar 4RU frame are used to build an Aquila upconverter. The Stellar frame's modular architecture also permits Aquila systems to be mixed and matched with other DTV/HDTV tools and systems.

The Stellar format conversion system from Miranda.

NMT and FUJINON rumble at MSG!

Fujinon is proud to be a part of National Mobile Television's (NMT) groundbreaking HD-1 all-digital, high-definition mobile truck. Ten Fujinon lenses in all were selected for the HD-1...seven 66X lenses (HA66X9.5ESM) and three 20X lenses (HA20X7.5BEVM).

According to the executives at NMT, it was Fujinon's quick turnaround time, the company's past service history, and the lens' superb image quality that convinced them Fujinon was the right lens for the HD-1.

Look for high-definition sports telecasts on MSG and see why Fujinon is the clear choice.

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Directional antenna systems

BY DON MARKLEY

Textbooks about directional antennas usually start off stating that such devices are used to avoid placing signals into an undesired area or to increase the signal level in a desired area. Both may be applicable. Regarding the new DTV allocation tables, directional antennas are usually required to duplicate the service area of the existing NTSC station.

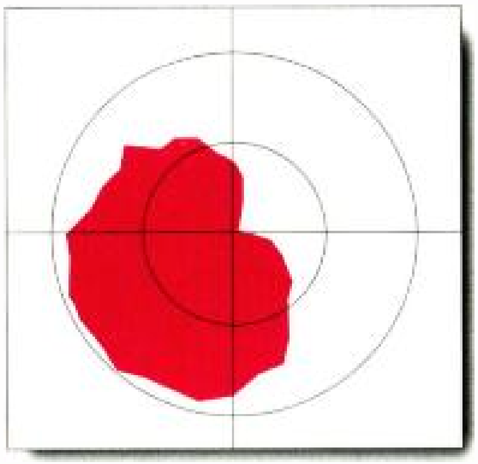


Figure 1. This pattern is to be used to replicate the service from a cardioid with a 15dB front-to-back ratio.

In developing the DTV table of allocations, the FCC determined the noise-limited service area for each NTSC station. An antenna pattern was then determined for the associated DTV facility which would, to the greatest possible degree, duplicate that NTSC service area. Unfortunately, for many of the stations the assigned directional pattern is impossible or difficult to attain.

Traditional directional antennas

Let's start by looking at the traditional directional antenna. NTSC directional antennas were usually used to increase the signal strength into the desired market area. Protecting the contours of other stations was typically not a consideration. NTSC station assignments were based on a strict mileage table. The theory was that stations were only guaranteed protection from interference in excess of that which would occur from fully spaced stations operating with maximum possible power and antenna height. Even then, there were some criteria that limited the antenna design. Section 73.685 of the Rules and Regulations spells out the limits on directional antennas and the documentation that must be provided to the Commission for their use. The primary requirement is a maximum-to-minimum ratio of not more than 10dB for VHF stations and 15dB for UHF. The intent was to insure that the protections provided by the directional pattern were maintained, even when the antenna was subjected to undesired influences such as ice. Those ratios have been waived in specific instances when reasonable cause could be given to the Commission. An example is a panel type antenna installed on a mountain with all of the market population confined in a narrow area.

The directional patterns for UHF antennas usually involve the use of slot radiating structures. The pattern is determined by the slot placement on the cylinder. In some cases, parasitic elements are added to a nondirectional antenna to shape the pattern. That method is still in use because of its simplicity and stability. Other units use panel radiators with the panels oriented and phased to establish the pattern. VHF antennas use a combination of radiator

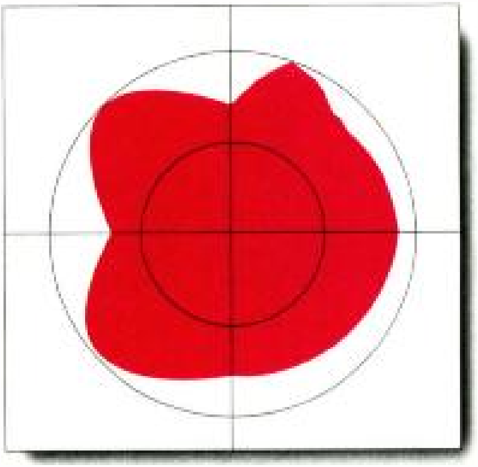


Figure 2. This pattern is to duplicate service from an omnidirectional antenna.

FRAME GRAB

A look at the consumer side of DTV

SDTV will be affordable: HDTV won't.

While consumers will love widescreen, they'll balk at paying $4000 for a TV set.

Source: Forrester Research www.forrester.com

orientation and parasitic elements to control the pattern shape.

All of the pattern determination is done during antenna manufacturing and design. No field adjustment is made. The measured pattern from the factory is normally necessary for licensing when protection is involved. Determining the pattern shape by field measurement after the antenna is installed is not acceptable under the Rules. Pattern measurement may be done on a full-sized antenna or on a model. It can also be done on a range or by near-field measurements in the vicinity of the radiators. In recent years, the state of the art in near-field measurements has progressed to the point that such measurements are equal to full-scale measurements on a range.

Some broadcasters have been reluctant to use directional antennas due to a mistaken belief that extensive field measurements would be required. They also thought that periodic readjustment of the antenna systems would be needed, as is the case for AM antenna systems. Not so, unfortunately, as that would create an engineer's annuity in excess of that which is being offered by DTV.

DTV patterns

The problem for broadcasters trying to implement DTV is obtaining the directional-antenna patterns specified by the Commission. Many of these patterns violate the rules for maximum-to-minimum ratio. At this time, the amount of leeway the Commission will allow is unknown. Many of the proposed patterns are not possible due to the shape of the pattern and/or the depth of the pattern minimums. If the 15dB ratio limit is to be maintained, many stations will find it impossible to meet their assigned maximum effective power. Absent a complete DTV interference study, stations cannot exceed the assigned pattern at any azimuth value. As shown on the attached patterns (See Figures 1-3), if the minimum values are not exceeded, it isn't possible to achieve the maximum values. The result is that projected service areas are not attainable.

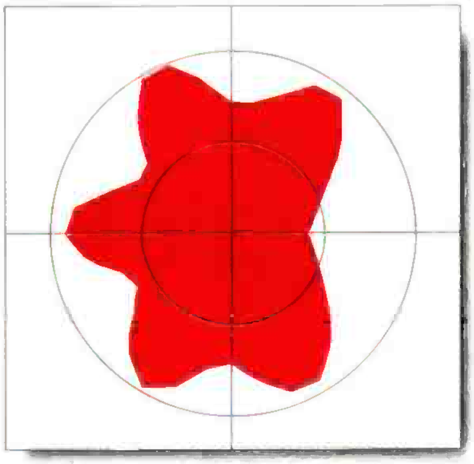
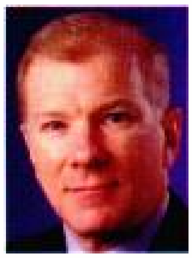


Figure 3: A pattern to equal the service from a broad cardoid.

As was discussed last month in this column, interference to NTSC service is going to occur as DTV stations come on line.

Receive antennas are available on the market with a 40dB front-to-back ratio, including some models with a parabolic-type reflector behind yagi type elements. Such antennas should help in eliminating the interference at cable head ends. As to the interference at individual viewer's locations, it may be necessary to simply tolerate the problem until everyone is digital. If that isn't acceptable, it may be possible to add temporary translators. Otherwise, about the only thing left is prayer. ■

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



NLE for news

BY ROLAND BOUCHER

Since its introduction almost 10 years ago, nonlinear technology has focused primarily on high-end and post-production applications where it helped to increase quality, productivity, and flexibility. In newsroom applications, in spite of the potential for increased speed and flexibility, nonlinear editors have largely been relegated to the A/B roll suites working on higher-production-value pieces such as feature stories, investigative reports, and news promos. Nonlinear technology has not successfully penetrated the core of hard news editing. For the most part, that function is still performed with two tape decks in cuts-only edit bays. This is primarily because the demands and time constraints of hard news editing translate into a completely different set of design requirements for nonlinear technology.

So can NLE do news?

Hard news editing can be defined as deadline-focused, deck-to-deck editing done primarily with two VCRs. If a typical station has six edit bays for news, five might be two-VCR hard news bays and one might be an A/B roll suite dedicated to feature stories, promos, etc. If NLE is to replace these cuts-only bays, what functionality is required?

Retain the cost and functionality of deck-to-deck editing with the added benefits of nonlinear technology. To meet the needs of newsrooms, an NLE system must deliver all of the promises of instant random access and computer-based technology at a price that is comparable to that of record decks. It must also retain the simplicity and creative techniques of deck-to-deck editing, including audio punch-ins, L-shaped cuts, three-point edits, etc. Such a system must possess the speed and efficiency required for hard news applications, including:

- •The ability to record directly from tape to disk with deck control. There should not be a separate digitizing step.
- •Keyboard commands for all primary edit functions.
- •Intuitive, easy-to-use screen layouts that focus the user's attention on the current task.
- •Simple transition effects such as dissolves and wipes.

The editing software must run on standard, off-the-shelf PCs using networking and storage systems under a Windows NT interface. Proprietary systems add to the acquisition cost and maintenance, and quickly fall behind the rapidly improving price/performance curve of standard PCs. Upgrading a proprietary system can be costly.

With the growing trend of multiskilled journalists and producers, a newsroom editing system should be simple enough to be operated by nontechnical people

The editor should be designed to allow journalists and producers to edit on desktop workstations. With the growing trend of multiskilled journalists and producers, a newsroom editing system should be simple enough to be operated by nontechnical people. However, it should also offer enough performance features for use in more traditional edit bays where more highly skilled staff may reside. The two systems should be the same or seamless in their appearance.

The NLE system needs to be able operate in a stand-alone configuration and as part of a larger workgroup. The system should be able to grow from a stand-alone configuration into tape-to-disk-based editing, thereby becoming part of a fully integrated, digital newsroom.

The editor needs to accept feeds from a compatible recording system and then integrate with a compatible playback device, as well as offer links to a broadcaster's newsroom computer system. It should also offer integration with browsing and logging stations elsewhere in the newsroom. Larger integrated solutions may require asset management to link metadata from different editors with rundowns and playback servers.

The editor should be designed to accept inputs from a variety of tape systems. Even with the trend toward compressed digital acquisition systems, traditional analog technology will be with us for some time. This means a newsroom NLE system should be able to handle compressed formats like DVCPRO and SX in addition to analog signals. Look for an upgrade path that will support direct tape-to-disk data transfers, including faster-than-real-time.

As you make the move to digital news production, it is important that you choose best-of-breed solutions tailored to individual production tasks. Make sure that the system you choose for hard news editing is designed for fast, efficient news editing and at the same time capable of working cohesively in a collaborative workgroup environment. ■

Roland Boucher is vice president of marketing, Vibrint Technologies, Inc., Bedford, MA.

Automated monitoring of almost 200 channels of video and audio programming was Primestar's goal for its new digital QA center.

Primestar's Digital QA Center

By Paul A. Catterson

Primestar recently took a dramatic step to increase its commitment to quality programming and customer satisfaction through a multimillion-dollar upgrade of its Quality Assurance and Network Control Center in Bala Cynwyd, PA. Primestar's facility is now capable of the downlink, monitoring, quality control, and pay-per-view scheduling of more than 500 channels of DBS. Though nearly 2000 miles from its headquarters and uplink origination site, this facility is an integral part of Primestar's operations. The upgraded facility also houses a Network Operations Center, tasked with monitoring each networked device and connection to identify hard failures and substandard performance levels.

Currently, Primestar provides programming distribution via GE-2, the GE Americom medium-power satellite at 85° W longitude and, additionally, is capable of testing on Tempo's 11 high-power DBS frequencies at 119°. Twenty-eight of American Sky Broadcasting's DBS channels at 110° may also become available to Primestar. The current service GE-2 satellite utilizes 24 60W Ku-band transponders to deliver its more than 160 programming channels to consumers via an 18" ChannelMaster dish and set-top integrated receiver decoder manufactured for Primestar by General Instruments.

The planning process

With over two million subscribers and a commitment to quality, Primestar was required to design a system which increased the monitoring capability of the facility due to the addition of programming channels while simultaneously alleviating strain on the operators and increasing their response time to faults. The solution came in the form of a balance of leading edge technology and procedural improvement. Primestar has created a streamlined system of error detection and correction, which, a few short years ago, would have required multiple operators and engineers, and substantial downtime, to perform.

Primestar's engineering and operations staff brainstormed to develop a sophisticated operation through the use of continuous video scanning and automated error detection, incorporated into an ergonomically efficient operator's control position. The Pro-Bel and Trilogy divisions of Chyron were asked to work alongside the engineering staff at Primestar to develop such a system.

Given the number of programming channels, it was determined that three control rooms, each containing two monitoring pods analyzing 96 sources apiece, would be required. The two-operator monitoring pod consoles each use eight Pro-Bel Procion System computers, scanning 12 channels of the Primestar service. The Procions are linked to the Pro-Bel System3 control interface which, in turn, communicates to the Pro-Bel routing switcher by telling it which crosspoints to switch to which Procion machines, and at what rate. With this preprogrammed criteria, each Procion sequentially scans the input video source, compiles the images in windows on a VGA screen in the monitoring pod console, and continually refreshes each source at a rate dictated by the Procion setup software. The Procion graphic user interface (GUI) allows the screen configuration to be completely user-definable — from image size and audio meter arrangement to machine control interface buttons and GPI controlled display changes.

Error-detection systems

A unique features of the Procion and System3 interface shines when reviewing the error-detection sequence. Through the numerous card-frames of Chyron's Trilogy audio and video loss-detection system connected to the System3, each satellite service channel can be monitored for loss of audio and loss of, or illegal, video signals. With acknowledgement of an error, the Trilogy system sends a contact closure to a GPI collector. The GPI collector then communicates through a purpose-built distributor to the System3, which alerts the associated Procion computer as to which channel faulted. The Procion display then converts the failed channel's display bezel to red or green (dictated by the level of error) to alert the operator to the condition. Simultaneously, System3 tells the routing switcher to switch the source in question via a secondary crosspoint to one of the two 29" primary QC monitor positions in the pod's monitor wall for a more detailed analysis. With all of these communications happening in a fraction of a second, the operator-response time is decreased dramatically, assisted by the fact that the new monitoring pod requires that each of the two operators view only four Procion VGA screens, rather than an array of conventional picture monitors.


The Pro-Bel HD series routers occupy only five racks, yet provide 160 crosspoints.

One of the challenges faced by the Trilogy and Primestar engineering teams was to define what criteria would constitute an error in the service. It was decided that in order to replicate what a typical subscriber would receive at home, the receiving devices for the Quality Assurance Center should be the same General Instruments IRDs sold in the consumer retail market. One of the inherent design characteristics of the GI device is that, upon loss of antenna input signal, it reverts to an internally generated sync pulse with burst, making identification of signal loss somewhat undeterminable. Shortly thereafter, the IRD would time out and generate an on-screen display to alert the consumer to the loss of service. Ultimately, Trilogy devised a loss-detection card capable of responding to immediate loss of pedestal, rather than loss of sync. This solution was helpful in allowing the loss-detection system to discriminate between what was extended black and what was loss of antenna signal causing IRD-generated artificial black. The audio system was a bit more conventional. The drop of either channel of audio below -48dB for more than 90 seconds dictated an error condition, sent the closure to another GPI collector/distributor pair, and the process continued as with the video.

Wiring and routing considerations

Because the Procion audio inputs are displayed in real time and not sequentially scanned (like the video sources) it was necessary to use a dedicated Procion input and Trilogy audio-detect channel for each channel of the Primestar service. With a total of 336 stereo audio channels being implemented (including the 30 PrimeAudio channels), a comprehensive interconnect scheme was required. The end result was a wall of 36 ADC I-WB ICON blocks which was 18 panels long, stacked two high, and occupying a 26-foot long section of Primestar's new BSS equipment room wall. This wall would serve as the primary interconnect from IRD distribution amplifiers in and out of the Pro-Bel MADI audio routing switcher, on to the monitoring pods and Trilogy loss-detection system. The Systems Group (TSG) of Hoboken, NJ, was selected as the systems integrator to provide the engineering documentation, system prefabrication, and installation and testing of the new facility. TSG recruited help from Gepco International to provide the Commscope VPM-2000 analog video cable, multipair analog audio cable, ADC jackfields, and the ADC ICON system. Fabrication of the audio wall cabling and punchdown to the panels was performed by Gepco at its Chicago plant, then shipped directly to

QA Center

frames with a full complement of (10) VEA-681 equalizing DAs for each.

The Primestar 392x168 analog audio routing switcher is based around the Pro-Bel HD series MADI and multiformat transcoder frames. MADI (Multiplexed Audio Digital Interface) is the adopted AES-10 standard for distributing 28 stereo digital audio channels over a single 75Ω coax or optical fiber cable and, until recently, was a format used primarily in the semi-pro digital multitrack recording industry. With this magnitude of signals and such a streamlined transport method as coax, the concern for physical mass of a MADI router with these crosspoint dimensions became a non-issue. Furthermore, as the central switching system of the router is based around a 75Ω system, the MADI routing switcher gets implemented very much the way a large video router does, with fan-in DAs and, in the case of Pro-Bel, a sophisticated output matrix contained within the two HD series MADI frames. Additionally, MADI has an advantage over conventional AES audio in that it does not multiplex the channels with any respect to pairs, allowing the user to manipulate each channel of a digital stereo signal independently. With all of the architectural and operational aspects of the digital audio router defined, there was only one task left to perform: the conversion of all the stereo analog audio channels of the Primestar service to AES and, ultimately, to MADI. This was accomplished through the use of the 3RU Pro-Bel multiformat transcoder frames. Each of the 14 5698 Pro-Bel coder frames accepts 28 stereo-pair inputs on the four rear-panel D-connectors, performs the 20-bit digital conversion at 48kHz, and spit out MADI on a 75Ω BNC for input to the MADI fan-in DAs. The output frames return analog audio after the D/A process from the 5699 decoders.

Early on, when considering the MADI router over more conventional approaches, the Primestar team had concerns over the potential for signal degradation through the dual digital conversion processes, and the benefits of the conversion solely for the switching of audio signals in the digital domain and compact system size. Ultimately, through the use of 20-bit conversion and the MADI nonblocking switching, the Pro-Bel system performs well. Conservatively racked to allow reasonable service area and expansion capability, the MADI routing switcher, with support from it's full family of transcoders, requires less than three equipment racks.

Putting it all together

In addition to the routing switchers, System3, and Procion, Pro-Bel was instrumental in providing CoreTech, a custom software development firm, with protocol translation for its interface to the routing switchers. The CoreTech system developed for Primestar, named *Guard*, is a timed-interval salvo switcher that allows various services to be switched from the routing switchers to the primary monitor wall at each pod at scheduled intervals. The GUI for Guard is a visual representation of the monitor wall on a VGA screen. The available sources live in a scrollable list on screen and the status of each monitor is displayed in it's respective box on the VGA. A user-friendly drag-and-drop method of source selection permits changes on the fly, and file recall allows instant reconfiguration of the wall should that be required.

The automation capabilities of Guard, the continuous signal scanning of Procion, and the error-detection characteristics of Trilogy combine with System3 to help Primestar extend quality DBS service well into digital TV era. ■

Paul Catterson is senior project manager/engineer for The Systems Group, Hoboken, NJ.

Equipment list:

576 Primestar integrated receiver/decoders
1 Pro-Bel HD-Series 384x160 analog video router
1 Pro-Bel MADI Series 392x168 MADI audio router
14 Pro-Bel 5698 stereo analog audio to MADI encoder
7 Pro-Bel 5699 MADI to stereo analog audio decoder
1 Pro-Bel System3 central control system interface
9 Pro-Bel 6170 System 2 controller frame(for HDseries RS)
19 Pro-Bel Assorted user control panels
38 Pro-Bel Procion video scanning/audio metering workstations
20 Trilogy Dual, video/Sync detectors
336 Trilogy Dual, audio modulation detectors
39 Leitch FR-684 10-cell analog video D/A frame
384 Leitch VEA-681 equalizing analog video D/A
32 Leitch FR-884 12-cell analog audio D/A frame
384 Leitch ASD-880 stereo Analog audio D/A
7 Leitch DTD-5225 2RU digital clock display
64 ADC Bantam audio jackfields
88 ADC 75Ω video jackfield
114 Sony color monitors
30 TDC LMS-1009 Dual nine-character tri-color under-monitor displays
18 TDC LMS-1018 Single 18-character tri-color under monitor displays
54 Dorrough 40-A2 dual stereo loudness meters
168 Logitek BV-4-A/APrime custom, dual stereo loudness meters
6 Logitek VTM-200 waveform/vectorscope monitoring system
325,000ft Comscope VPM-2000 75Ω coax
57,500ft Gepco audio cable
38,000ft Comscope RF cable
5,000ft Belden 9536 control cable
19,500ft Kings 2025-51-9 BNC connectors for VPM-2000
2,000ft. Belden 1694A 75Ω digital video coax

Design team

Primestar partners:

Gary Traver, vice president of broadcast operations
Dave Higgins, senior director of broadcast operations
Doug Hall, senior systems engineer
Raymond Mills, director of broadcast technology
Mitch Weinraub, director of broadcast origination
Andrew Brown and Greg Huttie, operations managers

Pro-Bel

Richard Hajdu, general manager, Pro-Bel U.S.
Jon Hammarstrom, director of technical services and project manager
Ken Tankel, project engineer
Dennis Yeomans, software specialist, Pro-Bel U.K.
David Wurm, installation/support engineer
Jeff Williamson, installation/support engineer

The Systems Group

Paul Catterson, senior project manager/engineer
Paul Rogalinski, integration manager
John Meusel Jr., production manager
Michael Ferentinos, integration supervisor

Custom software:
CoreTech, King of Prussia, PA
Primary cable supplier
Gepco International, Chicago, IL
Equipment racks
Electronic Enclosures, Pennsauken, NJ

Optional Program Play with Pitch Correction

Audio/Video Preread for A/B roll editing with 2 machines

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SONY

SYSTEMS DESIGN SHOWCASE

New ORLEANS

By Elton Jones

Three years ago, New Orleans city officials were trying to make due with a severely outdated cable access facility. Rather than make interim improvements, the city opted for a clean sweep. In an unusual arrangement, local Fox affiliate WVUE-TV won a five-year contract to build and operate an new cable facility for the city. A year ago, the new multiple-site installation for New Orleans Access Television (NOAT) was completed.

To date, NOAT is the first all-digital facility in Louisiana, with programming comparable in quality to that of any broadcast operation in the city. Implementing digital operations has supported WVUE's mandate to improve the quality of programming and engage the greater-New Orleans community.

The main NOAT installation is at WVUE, built in a previously unfinished portion of the station. This new construction consists of offices, conference and training rooms, four nonlinear edit suites, two studio control rooms, and a master control playback facility. NOAT sends four discrete channels of programming — cultural, educational, religious and government — via fiber optics to a Cox Cable facility for distribution. A second installation is at New Orleans City Hall.

As the upgrade began, basic facility sites existed, but WVUE management was committed to a full equipment review as the cornerstone of a digital plant that would address future needs and standards. Putting equipment in place that wouldn't quickly become obsolete was by far the biggest redesign challenge.

WVUE purchased equipment valued at $1.5 million, including more than 100 pieces of Panasonic equipment. DVCPRO has become NOAT's exclusive acquisition format, replacing aging 3/4" gear.

New Orleans Access Television Studios

The main equipment in this facility is digital and includes: a Hewlett Packard file server with Louth Automation, two Panasonic Smart-Carts with six internal DVCPRO VTRs and four external DVCPRO VTRs, a PESA digital router and distribution system, and Tektronix test equipment, as well as multiformat VTR source machines with two turbo media workstations to prepare material for air and three client computer workstations to

Access Television

New Orleans Access Television relies on two Panasonic DVCPRO Smart-Cart automated record/playback systems for on-air playback. Shown here is one of the two Smart-Cart systems.

Access Television

prepare playlists and schedule programs and announcements.

Master control playback

In evaluating tape formats for the on-air facility, WVUE looked at conventional analog formats and the new digital formats. Keeping the video in a digital component format to ensure overall high quality was important. After reviewing the various DV formats, Panasonic's DVCPRO was selected. Key factors included; a wider track, an added control track, an audio cue track, and the use of metal-particle tape, which is more durable than metal-evaporated tape. DVCPRO also has an optional SDI output. The 55dB S/N ratio was quite impressive as well. In addition, the DVCPRO camcorder's two-hour record capability is particularly well suited for NOAT's long-format work.

The other dominating issue was the selection of a robotic tape system for the playback facility. The cart system was required to hold several days programming and be able to run unattended for extended periods. While other large-capacity servers were reviewed, the Panasonic Smart-Cart won out. The system's 300-plus hour capacity and the fact that our primary EFP format would already be DVCPRO influenced the decision. This compatibility prevented a labor-intensive dub into a server vs. storing programs in a ready-to-air format.

One of the two NOAT control rooms. Louth Automation and the Grass Valley model 101 master control switcher are shown.

There are four stand-alone decks for playback on the current three channels. The system is controlled by a Louth ADC 100 automation system. The ADC-100 was chosen because of its expandability — it can control up to 16 devices. The various workstations of the Louth system are connected to a LAN. The workstations consist of media prep stations for preparing media tied to DVCPRO machines, client workstations used to manipulate playlists for the three channels, and the file server. The Louth system also controls a HP Media Stream file server, which has one input and four outputs with a nine-hour capacity and is RAID protected. The server is used for short-format material and repetitive long-format material, and was selected because of its expandability as well. The DVCPRO machines and HP have both SDI and AES I/Os. The HP system has six channels of audio for each channel of video. The video has SDI I/Os, and the audio is AES/EBU. The drives and redundant power supplies are hot swappable.

The routing switcher is a PESA Jaguar using Digital 601 with a 48x48 SDI video matrix and a 64x64 AES/EBU audio matrix. Embedded audio is not currently used. The router is used as a master control switcher for the three channels. Additional I/Os were purchased for future expansion. All signals from the edit bays and control rooms are routed and switched through the router, including various fiber-origination feeds for the cable channels.

All three playback channels are kept in a digital format until transmission. Miranda A/D and D/A converters are used for signal conversion when needed. A Chyron CODI is used for generating lower thirds and full-screen graphics as required. There are several interformat tape machines used for dubbing various formats to DVCPRO for air. Tektronix test gear is used to maintain signal quality.

Equipment list

Louth four-channel ADC-100 automation system
Bogen BTH-3140 tripod & fluid head
Canare cable
Canon PH15x7BIRS lens
Canon YH17x9.5BKTS zoom lens
Chyron Codi
Extron distribution amp
Gentner TS612 telephone system
Grass Valley Group 110-N production switcher
Grass Valley Group SCB-200N sync/test color bar
Hewlett Packard file server
Inscriber Mainframe Graphics/CG
Mackie 1604-VLZ audio mixer
Mackie MS1202-VLZ audio mixer
Miranda Quartet
Panasonic AG-2550 VHS VCRs
Panasonic AG-DS555 S-VHS edit VCR
Panasonic AJ-D230 DVCPRO recorder/player
Panasonic AJ-D650 DVCPRO VCRs
Panasonic AJ-D700LH14 DVCPRO camcorder
Panasonic AJ-D750 DVCPRO edit VCR
Panasonic AJ-LT75 laptop DVCPRO portable edit system
Panasonic AW-E560 color cameras
Panasonic monitors
Panasonic PT-M1085 video projectors
Panasonic Smart-Cart systems
Panasonic SV-3900 DAT
Panasonic WJ-MX20 video/audio
Panasonic WV-F565H color camera
PESA DA
PESA Digital 601 routing system
PESA Jaguar Digital audio router
Pro/Four cable
Shure M267 mic mixer
Sony CD player
Sony EVO-9500 Hi 8mm VCR
Sony PVW-D30K/C18 Betacam SP camcorder
Sony UVW-1800 Beta SP edit VCR
Symmetrix 551E parametric equalizer
Tektronix audio monitoring
Tektronix WFM-601M digital waveform monitor
Videotek ADA-16 audio DA
Videotek frame sync
Videotek RS-12A switcher
Videotek TSM-61 vectorscope
Videotek VDA-16 video DA
Videotek VSM-61 monitor
Vinten dollys
Vinten tripod & head
Winsted production console
Winsted racks

Design team

Devlin Design Group (lead design team)
Sizeler Architects
Centex Landis Construction

One of three edit suites. Shown is a Panasonic AJ-LT75 laptop editor.

Editing facilities

There are four edit bays. They feature Avids (a Media 1000 and an MC Express), a DVCPRO, and a U-Matic tape deck. The source machines are DVCPRO. There are graphic applications in each of the Avid machines, making them stand-alone islands. The third edit bay is based on Panasonic AJ-LT75 DVCPRO laptop editor. The fourth edit bay is U-Matic. All of the edit bays are fed as SDI Video and AES/EBU audio into the PESA switcher.

Control room

The control room consists of a GVG 110 video switcher, a Mackie console, an Inscriber character generator, and three Panasonic WV-F565 cameras in a studio configuration. Two DVCPRO machines are available for recording and playback. The output of the system is also fed into the routing switcher as SDI video and AES/EBU audio.

Field camcorders

There is a mixture of various EFP units, including Panasonic DVCPRO AJ-D700 2/3", AJ-D200 1/3" and AG-EZ1U DV-format camcorders. Each is fully equipped with the peripherals necessary for EFP work. The second installation at New Orleans City Hall includes two press room consoles. These rely on two AW-E560 3-CCD box-type cameras on remote control pan-and-tilt systems and record to DVCPRO VTRs and also feed a signal to the main control room at the city council chambers. They record city council meetings and other programs, and then feed them via fiber to the playback facility at WVUE-TV, and on to the Cox Cable head end.

The control room has a Tektronix Grass Valley switcher, DVCPRO VTRs, and four AW-E560 cameras on remote control pan-and-tilt systems. Two Panasonic PT-M1085U video projectors were installed in the city council chambers for playback of video programs, as well as computer graphics presentations. ■

Elton Jones is director of New Orleans Access Television, and director of corporate development for WVUE-TV.


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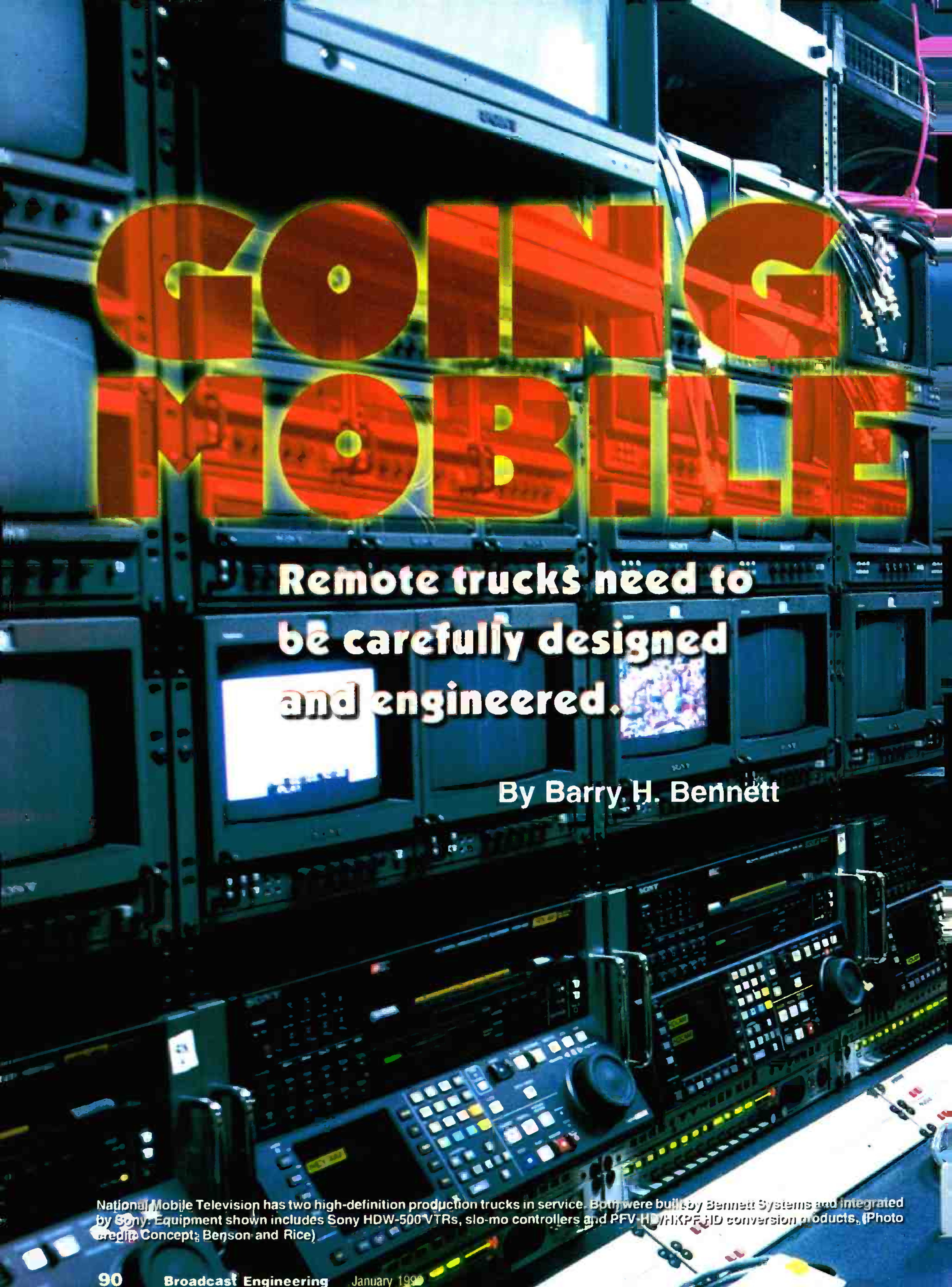


GOING MOBILE

Remote trucks need to be carefully designed and engineered.

By Barry H. Bennett

National Mobile Television has two high-definition production trucks in service. Both were built by Bennett Systems and integrated by Sony. Equipment shown includes Sony HDW-500 VTRs, slo-mo controllers and PFV-HD/HKPF HD conversion products. (Photo credit: Concept, Benson and Rice)

Deciding where to begin is often the hardest part of building a remote truck. In most cases, the process includes an engineering consultant; usually an outside contractor or possibly a member of your staff. A good analogy is consulting an architect before hiring a contractor to build your house.

The first step in this process is to clearly define the truck's purpose. Will the truck be used mostly for sports, news, entertainment, post production or all of these? In other words, does it have a primary purpose, such as providing for in-house production needs, or is this a *generic* truck which will be marketed to outside program suppliers?

Next, determine the truck's size. Is a 24' or 32' straight truck big enough for your needs, or will you need a 42', 48', or 53' rig? Is an expanding unit desired or required? If so, how much of the truck will need to expand? Single- or dual-expando? While an engineering contractor will be of great assistance in deciding these questions, you will need a rough idea of the direction you're leaning before hiring one. (How big of a house do you want? One story or two? How many rooms?)

Another consideration to address before spending time and money on consultants is the truck's basic equipment list. This is more complex than it may appear. Issues such as how many cameras, tape decks, and monitors are needed are only part of the answer. A parallel consideration is which format to use. Will this be an analog NTSC truck, a digital truck (perhaps 601), an HD truck, or some sort of hybrid? Hybrid trucks are the most likely, and perhaps necessary, in today's transitional world. The engineering contractor will assist you with these issues, but you will need a general idea of the desired direction before a consultant can provide much real assistance.

The final consideration is cost. Set some rough guidelines. It is important to match needs and budget in the early planning stages. There are huge differences between the cost of a straight 32' truck and a 53' expando, even if the same equipment was installed in each. Those additional costs go far beyond the difference in price of the basic "box." Also worthy of consideration are the unit's operating costs. Expandos typically require a tractor and CDL driver; the straight truck does not need a tractor and may or may not need a CDL driver depending on several factors.

Occasionally, I'm asked how much it costs to build a truck. The response is: "How much does it cost to build a house?" An accurate answer depends on numerous factors. In the case of the house, one must know how many stories, how many rooms, carpet or hardwood, shades or drapes, brick or aluminum, and on and on. The same is true when building a remote truck.

All the above factors are heavily interdependent. Vehicle type and size along with the equipment compliment and format play a major part. The schedule is also important. The impact of each of these major building blocks on each other is considerable. An engineering contractor can help a great deal with these decisions. Making a few preliminary decisions before bringing the contractor into the picture will smooth and hasten the entire design process. Of course, the smoother the project proceeds, the happier the accounting department will be.

Contractors

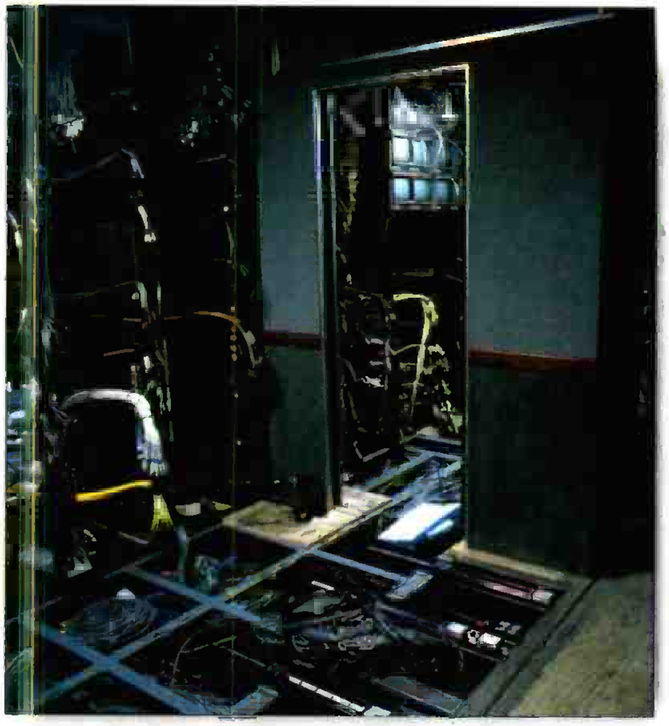
Once the initial decision-making process is complete, it's time to begin looking at the contractor or contractors necessary to get this truck on the road. In the mobile world, there are four major building blocks to consider; engineering, mechanical construction (including the body and all within), technical construction, and equipment suppliers. Various companies/contractors specialize in one, several, or all of these building blocks. Deciding how to proceed may be difficult. Among the choices are a turnkey approach, where a single company is hired to provide all services, including financing, or an approach where the individual portions of the project are controlled in-house. Part of this decision depends on the level of in-house expertise. Are in-house staff willing and able to be involved with some or all of the four major areas? If so, do they have the time available to devote to this project?

Are in-house staff willing and able to be involved with some or all of the four major areas?

Let's explore this further:

•Turnkey: In the turnkey approach, after contacting a large, full-service company, its in-house financiers, engineers and tradespeople will help you through the initial phases. The turnkey contractor will bring the rest of the decisions to your attention. Remember the four building blocks? Engineering, mechanical, technical and equipment will *all* be supplied by the turnkey contractor. It's a fairly uncluttered way to go, but some

Getting to this stage of truck operation requires months of time and years of engineering experience. Shown here are the support positions for the director. (Photo credit: Concept: Benson and Rice)



Much of the initial integration work involves getting the correct cables to the proper locations. Note the heavy-gauge welded cross members in the floor. Bolted construction will not stand up to the rigors of road work. (Photo credit: Concept: Benson and Rice)

areas deserve careful attention. As with many large companies, some of the individuality or personal attention provided by smaller, independent contractors may be lost. The contractor might have several other projects in the works at the same time as yours. For several reasons, expect to be steered towards goods and services (equipment and construction practices) the contractor is used to providing. These may or may not be what is expected or needed. Keep in mind that while turnkey contractors will make suggestions based on what *they* supply, they're usually more than willing to accommodate specific needs and requests. Don't be afraid to ask.

•**Non-turnkey:** In the individual contractor approach, the engineer or consultant will likely be the initial and primary contact for the project. Regardless of who builds the truck, the importance of sound engineering cannot be overstated. The engineer, be it one of your staff or an outside contractor, will ultimately be responsible for how well the truck works. There is an attitude in some quarters that engineering is a necessary evil — a cost that serves little purpose. Nothing could be further from the truth. An experienced engineering contractor, if employed early enough, can guide the project through the labyrinthine details, help with the equipment decisions, cost analysis, schedule, and selection of the remaining contractors. As with any construction project, a good engineering contractor will be experienced in evaluating all the project components. He or she will present you, the buyer, with sensible choices tailored to your needs and will analyze the interdependencies and interactions of all systems and components. The engineer will work closely with in-house technical and production people, your marketing department, clients and other contractors to design a truck that fills all of your needs. It is the contractor's job to make sure all the pieces fit together properly. A good engineering contractor can save you time, headaches and money.

•**Mechanicals:** The mechanical contractor is responsible for the trailer body and running gear, the environmental systems, power systems, racks, consoles, lighting, walls, floors, etc. — in short, the empty house. Presumably, some preliminary design work has begun. Have at least a rough floor plan before sitting down with the mechanical contractor. Along with your engineer (contract or otherwise), go over every detail of the physical truck with the mechanical contractor. The idea is to make sure that once the equipment and wiring installation begins, it all fits. Lighting needs to be over the consoles where it belongs. Switches should not end up inside racks. Ensure enough power and cooling for each of the racks, based on its contents. The power system needs to be large enough for the truck as presently conceived, and for the future. Likewise, sufficient rack space is needed for present and future needs. Raceways and conduits need to be installed and ceilings should be closed. These are all inputs that the mechanical contractor needs from the engineering contractor. *Potential* problems are much easier to fix than *actual* problems.

When undertaking the design and construction of an HD truck, several new and difficult issues must be considered. The HD truck is a different animal than the basic NTSC or even digital production unit we all know so well.

Monitor size will dictate the need for a complete redesign of the production area vs. conventional design. At mini-

Miles of wiring lie behind the racks and floors. Shown is the production control room during construction. The completed room is shown on page 92. (Photo credit: Concept: Benson and Rice) mum, you'll be faced with some custom-size racks to accommodate wide-screen monitors. Generally, monitors larger than the usual 9" will be required and will need to be 16x9 switchable until such time as our present formats and standards give way to pure HD.

HD equipment typically runs hotter and consumes more power than conventional equipment, thereby putting your cooling and power systems under some strain unless carefully engineered. Plan those systems accordingly.

In today's world, an HD truck is not only an HD truck; you'll need an analog NTSC layer and a digital (601) layer as well. All this adds up to increased demands on space, cooling and weight. Presumably, you will go the last few yards and install digital audio. That's more heat and weight. The truck is larger. The equipment is heavier and there is more of it — cooling, power, etc. It's easy to see how weight can quickly become an issue in this type of vehicle.

•Technical systems: This contractor must take the empty truck and turn it into a TV truck following the plans drawn up by the engineer. Specifically, this building block begins by studying the engineering drawings and discussing the project with you and your engineers (or contractors). This contractor actually makes the cables and cable harnesses, wires the patch panels, puts connectors on all the wiring, installs the wiring and equipment, and coordinates the entire installation process to get the truck out the door on time. This also includes what's known as *commissioning*, or making each piece of equipment, and the entire unit as a whole, work properly. It entails programming the routers, setting up DA levels, and testing each and every wire and system before the truck rolls out. There is usually a great deal of pressure on this contractor. As the last link in the chain, all the delays to date are expected to somehow vanish, allowing the original schedule to be kept. Providing sufficient time up front can make this contractor's job easier. The result is a better built truck. Any installation contractor has stories about the 12-week project that had to be done in six because of accumulated delays. Opening day at the ballpark won't wait. The truck will probably arrive in time for the first pitch (but not much before); however, the quality of the installation won't be the same that a full 12-week build would have allowed.

Keep in mind that because one company had a good or bad experience with a particular contractor, there may have been some specific reason.

At the heart of NMT's HD-2 truck is the live production area, which includes two Sony HDM-2830 and HDM series high-definition monitors and a HDS-7000 digital switcher with 30 HD digital outputs, three M/E controllers, and a HDME-7000 dual-channel DVE. (Photo credit: Craig Blankenhorn, CBS)

•Equipment selection: Selecting equipment in the industry's present state of format transition is a difficult and complex issue. There is the question of how many cameras, VTRs, etc. (now and later), and also which format(s)? Format issues are beyond the scope of this article; they encompass questions ranging from high definition to digital to standard definition, not to mention and all the variations therein. Equipment suppliers can help determine, on a piece-by-piece basis, what is needed now and whether it will fit with future needs. Suppliers should work closely with your engineers, and provide technical salespeople to assist in sorting through these complex issues.

The selection process

Now it's time to hire the specific contractors for the project. This selection process will be similar regardless of whether you choose to use turnkey or individual contractors. The easiest way to locate potential contractors is by word of mouth. There are numerous trucks on the road today, and *someone* built each and every one of them. Contact your peers in the industry and ask about their experience with one approach vs. the other (turnkey vs. individual) and the contractors involved. Keep in mind that because one company had a good or bad experience with a particular contractor, there may have been some specific reason. Don't accept or reject a specific contractor based only on one referral. Ask around. Keep careful notes. Word of mouth is one of the best tools for this task. Unfortunately, there's no "www.trucks-are-us.com/build" on the Web just yet.

I lean toward a contractor that has built *trucks*. There are plenty of companies with vast experience in fixed facilities, both small and large. However, once wheels are put under this facility and it starts moving around on a daily basis, its needs change in almost every conceivable way. Make sure that the experience level of your potential contractor measures up to the needs of your mobile facility.

Ask contractors for references and a list of trucks they've built. Interview your prospective contractor's past clients. Don't just talk to GMs or VPs, but also to the people who use the truck every day. If possible, get in touch with the field engineering personnel and production people. They can tell you if the finished truck lived up to its promise. Management personnel typically see only the bottom line — is the truck making money. The field personnel will tell you if things flow smoothly on any given shoot, or if each day is a struggle because of some failure of design or construction. Again, remember that just one opinion should not a decision make. Ask as many different companies and people as possible. Don't overlook asking your competitors for their opinions. In the small world of remote production, competitors are also likely to be clients. You will be renting their truck(s), and they will be renting yours.

Other issues

When evaluating contractors for selection, there are many specific items that lead up to the final decision to hire. Sometimes overlooked are seemingly small items that, in reality, are much larger issues. Conversely, what may look like a huge issue may, in fact, be relatively minor when weighed against all other factors in the project. Documentation, training, warranty, and support are often overlooked.

Ask for samples of documentation. Sometimes, there may be too much of a good thing. If finding the location of VTR C's digital super output means weeding through 200 pages of documentation, consider re-evaluating that particular contractor. On the other hand, no drawings or inaccurate drawings are just as bad. In a truck, and in the real world, information must be found quickly.

If you've used a turnkey contractor, they will usually be the first contact for warranty problems.

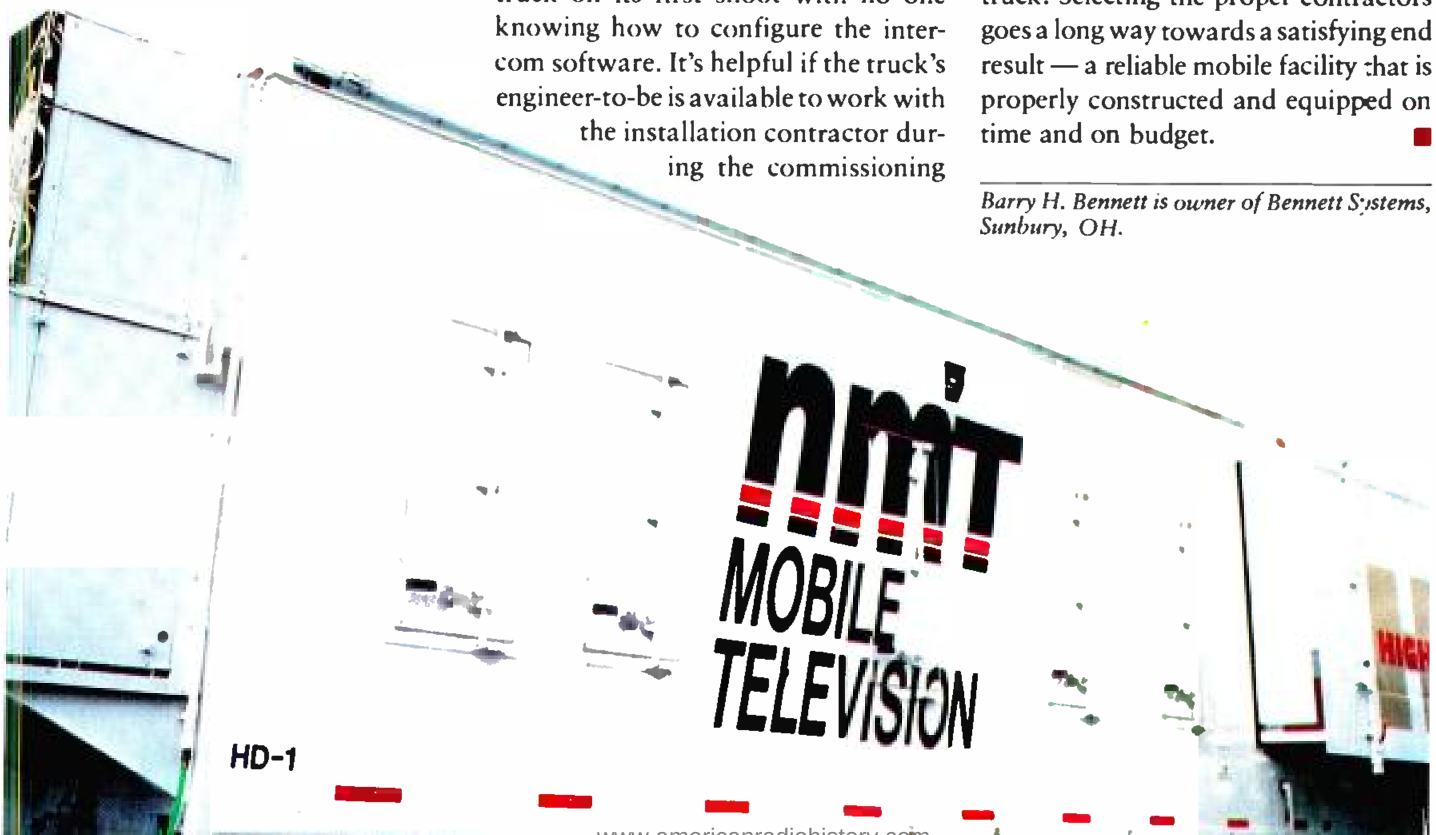
Make sure training is provided by one or more contractors. This will help you avoid situations like having the truck on its first shoot with no one knowing how to configure the intercom software. It's helpful if the truck's engineer-to-be is available to work with the installation contractor during the commissioning and testing phase of the project.

Warranty is another important and often neglected issue. You'll need assurance that the truck, the installation, the equipment, and the *system* will all be covered against the usual defects in materials and workmanship that any warranty provides. If you've used a turnkey contractor, they will usually be the first contact for warranty problems. If independent contractors and suppliers were used, make sure that they are capable of warranty support in their own areas. Again, an interview process with prospective contractors will be helpful. System problems are a more difficult issue. The biggest problem here is usually determining the real problem. Is it the equipment, its installation, or the way the system was designed? Are the contractors willing and able to tackle issues such as these?

Support is also an important issue. Few trucks on the road today are the same as when they left the shop. Needs and equipment change. Can the contractor(s) step in and assist with changes dictated by clients or the marketplace? Past performance is the only guide to contractor selection here.

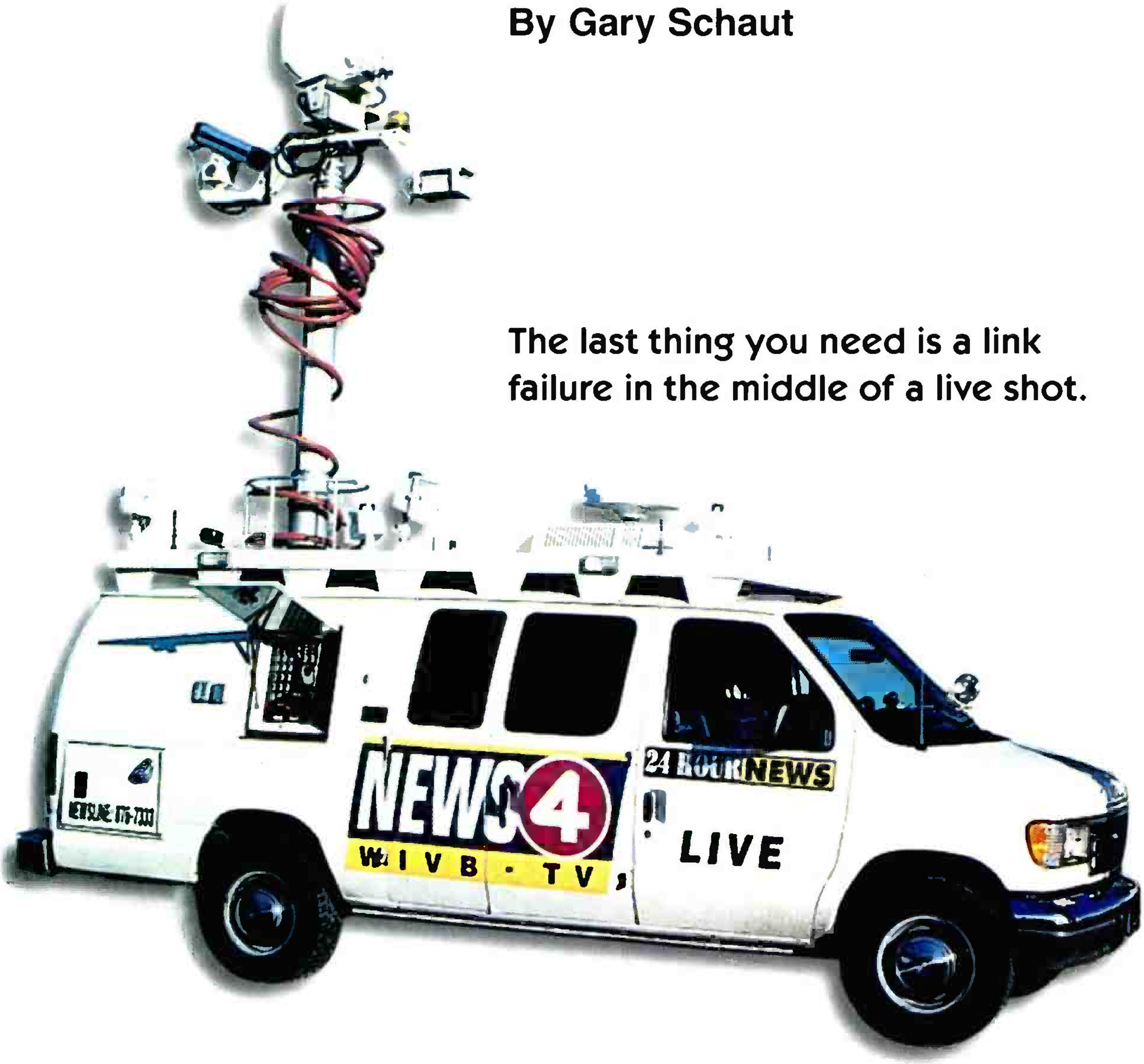
If correctly engineered and implemented, your truck will serve immediate needs and allow for future growth, format changes, new clients — whatever may come. As with all projects, sound engineering and construction practices implemented from the beginning will provide benefits throughout the life of the truck. Selecting the proper contractors goes a long way towards a satisfying end result — a reliable mobile facility that is properly constructed and equipped on time and on budget. ■

Barry H. Bennett is owner of Bennett Systems, Sunbury, OH.



Understanding ENG link failures

By Gary Schaut



The last thing you need is a link failure in the middle of a live shot.

It's a pleasant fall afternoon with the sun setting on the water. The sky is clear blue and the winds are calm. What looks like perfect weather for a live shot could be a recipe for disaster. Almost every ENG truck operator has experienced unexplained microwave link failures. Perfect ENG links that are set up an hour before the newscast can mysteriously fade before air time. A truck dispatched to a known good site can experience difficulty in establishing a link.

In Buffalo, NY, WIVB-TV's ENG truck operators and meteorologists have found a definite correlation between lost ENG signals and the presence of *thermoclines* and *inversion layers* in the lower atmosphere. Thermoclines are narrow boundaries between two air layers of different temperatures. Inversion layers are a type of thermocline that forms when air layers are cooled at different rates. These layers of warm and cold air can cause signal degradation or complete loss of signal by bending the ENG signal down into the ground or up into space.

Refraction happens

The bending of microwave signals passing through thermal layers of air is similar to the bending of light as it passes from air to glass. As light passes from air to glass, the light waves are bent (refracted) because the index of refraction is different in each of the materials (see Figure 1). There is a point, as the angle of the light striking the glass decreases, where all the light is reflected away from the glass. The angle at which this occurs is called the *critical angle*.

The laws of refraction/reflection hold throughout the electromagnetic spectrum, which includes visible light and microwave signals. As air density decreases, the index of refraction increases. Air density is affected by temperature. Thermoclines and inversion layers are areas where the temperature (and density) of the atmosphere changes drastically over a small distance. At normal outdoor temperatures, a five-degree (F) rise in temperature can cause a 1% decrease in density. Inversion layers and thermoclines can cause temperature changes of 15- to 20 degrees in less than 1000ft, producing a change in air density of 3- to 4%. This may not sound like much to worry about, but ENG signals may be hitting these layers at very shallow angles. A small density change will affect the critical angle, potentially resulting in a complete loss of signal.

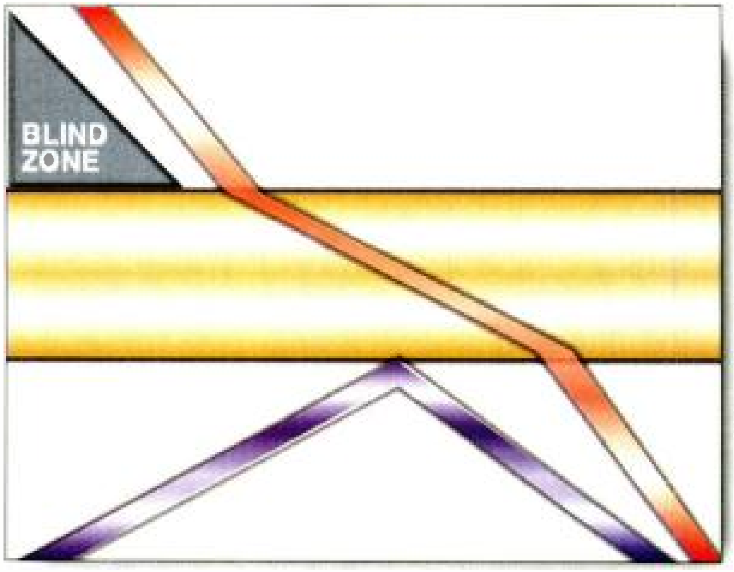


Figure 1: Light rays will change directions when passing through materials with different indices of refraction.

A major difference between refraction in glass and the bending of ENG microwave signals is that in glass, the loss of light transmission is a knife-edge effect; light transmission is suddenly and totally lost. With microwave signals penetrating thermal layers, the bending is far more gradual and prolonged. The effect is the loss of a signal over a period of seconds or minutes when thermal layers develop.

Thermocline stomping grounds

Two of the most common causes of low-level thermoclines are cities and large bodies of water (see Figure 2). During the cold winter nights, weather reporters talk about how the night-time temperature in the city will get down to, say, 30 degrees, but it will be much colder in the suburbs and outlying communities. Cities generate considerable heat. This can cause a bubble of warmer air to form over the city, with much cooler temperatures in the air surrounding the countryside.

In the same manner, a large body of cold water can produce a layer of cooler air over a lake and the surrounding area for several miles inland. In the area around the Great Lakes, there can be springtime air temperatures of up to 60 degrees inland while there is still a layer of ice and 32-degree water on the lake. This can cause a very sharp thermocline as the colder, lake-blown air drifts inland. The same effect can occur near the ocean on a warm spring day. The opposite occurs in the fall, when colder air is blown over warmer waters. Water surface temperatures can still be in the 40- to 50 degree range while the land is covered by the first snowfall of the season. This can cause warmer, moist air to be blown over areas near the water.

Inversion layers are pockets of warmer air that can form or be trapped in the cooler layers of air overhead. As long as these layers remain in the upper atmo-

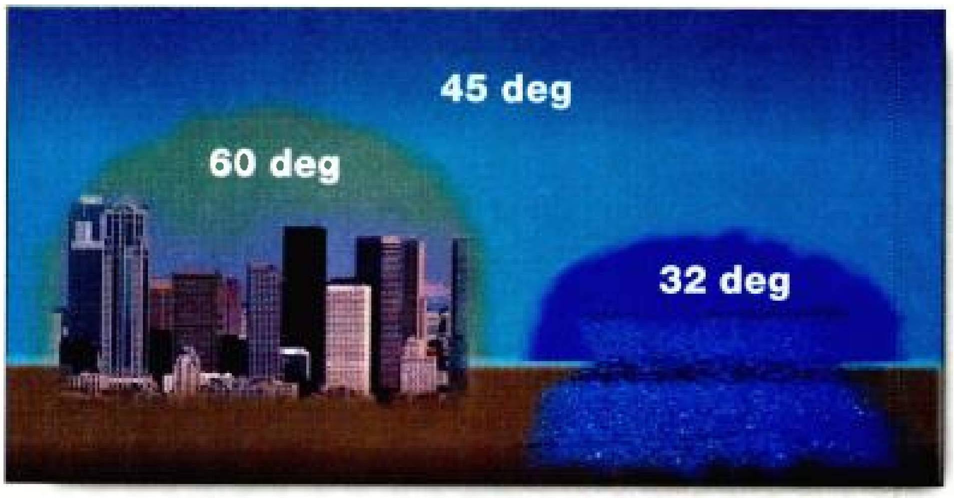


Figure 2: Cities and large bodies of water can influence the surrounding air temperatures, causing thermoclines and inversion layers.

Regardless of the age or power output of a station's ENG equipment, ENG link failures due to atmospheric conditions are possible, but in many cases preventable.

sphere, they do not affect ENG signals. Around sunset, inversion layers can descend to near ground level if there is a sudden, rapid cooling of the air near the ground. This is most often associated with dry, calm air. When the local weather forecasters are reporting low dew-point temperatures and calm wind conditions at sunset, inversion layers can form in the air just above ground level and interfere with microwave signal paths. A study of microwave signal strengths over fixed paths found signal losses in excess of 20db occurred during, and immediately after, sunset. During certain months of the year, sunset occurs immediately before, or during, many evening newscasts and ENG live shots. This can cause an ENG link established an hour or so earlier to fail. Knowing beforehand the months (or weeks) when sunset occurs during your newscasts can be helpful in preventing this type of failure.

Predicting potential link failures

In many cases, thermoclines and inversion layers can be predicted and possibly avoided. Those fortunate enough to work for a station with a weather office might find the solution as simple as going down the hall and buying the weather forecaster a cup of coffee. Meteorologists routinely track and predict the formation of local thermoclines and inversion layers as these layers impact the local weather. Maintaining a close working relationship with the station's meteorology staff can ensure accurate information on the location, timing and size of thermoclines and inversion layers in your operating area. Be sure the meteorologist knows that only low-level thermoclines pose a potential threat. Inversion layers and thermoclines that are over 5000ft overhead are no threat to ENG links — until they sink down into the signal path.

If there is no meteorologist in house, the NOAA offers radio broadcasts with hourly updates on local weather conditions. To anticipate the formation of low-level thermoclines, look for forecasted differences in temperatures. If the weather forecast calls for temperatures near the lakeshore to be warmer or colder than temperatures inland, a thermocline will likely build up along the shoreline. Likewise, if temperatures within the city limits are forecast to be much warmer than in the surrounding farm communities, a pocket of warm air may be building up over the city. Calm air and low dew-point temperatures at sunset are good indications that inversion layers may develop. Forecasts of ground fog, freezing rain, sleet, or smog alerts in cities are indications that low-level thermoclines exist. The Purdue University website (http://wxp.atms.purdue.edu/upper_air/skew/details.html) provides public access to the same raw data that meteorologists use for forecasting. Look for the skew-T charts. Learning to read these may take a few minutes, but once you know what to look for, it is easy to see if conditions are right for the formation of inversion layers.

Man-made thermal layers also exist. A few years ago, the Buffalo Bills football team moved its summer training

Figure 3: The microwave path that connected the Bills training camp to the studio was close enough to the steel mill to be effected by the radiated steam.

camp to Fredonia, NY (see Figure 3). WIVB-TV planned a series of live shots for the sports segment of the evening newscasts. The site was surveyed, and a temporary microwave link was established back to the studio. The link, which used the same ENG receive towers as the mobile ENG trucks, was turned on only during the live sports reports. The first time it was used on-air, the studio anchors introduced the training camp live shot just in time to see the link fade to snow.

Immediately after the newscast, the link returned just as mysteriously as it had disappeared. Technical checks were made, and no fault was found in either the ENG transmitter or receiver equipment. The next day, the link was again lost just a few minutes before the live report was scheduled to air. In both instances, the signals disappeared at the same time, about 18 minutes after the hour. When the ENG link from the training camp was left on for several hours, the signal faded to snow every hour at about 15 to 18 minutes past the hour, then reappeared about 10 minutes later. Knowing that the signal loss was as regular as clockwork, engineers armed with field strength meters and spectrum analyzers were sent out to detect the source of the interference.

It was found was that a steel-manufacturing facility just upwind of the signal path was unloading its coke ovens at 15 minutes past every hour. As the oven is unloaded, hundreds of tons of coke are exposed to the oxygen in the air and begin to burn. The burning coke is then rushed into a water spray room and doused with thousands of gallons of water, cooling the coke and creating a gigantic cloud of steam.

This 500 degree steam cloud drifted into the ENG signal path. As it was not possible to ask the steel mill to shut down, the live shots were moved up in the newscast to 10 minutes past the hour. The following year, an ENG relay tower was placed several miles away from the training camp so the ENG link could be doglegged around the steel mill's coke ovens.

An ounce of prevention...

There are long- and short-term solutions to preventing or restoring lost ENG links:

•Anticipate thermal layer formation. When ENG crews are sent to an area where problems have existed in the past and the weather conditions are right for thermocline formation, send a satellite truck instead. Notify the news department of the failure possibility and have a fall-back location for the live story. Send the ENG truck out early enough to move and re-establish signal if it becomes necessary.

•If possible, put your ENG truck (transmitter) and receiver on the same side of the thermal layer. Links are only affected by the layers through which the signal passes (see Figure 4). If a live shot next to the lake is lost, it may be restorable by moving the truck a couple miles inland. This may get the truck out from underneath the thermocline. If a link cannot be established from a rural area back to the studio in the city, it is possible that a rural ENG receive site could be used if available.

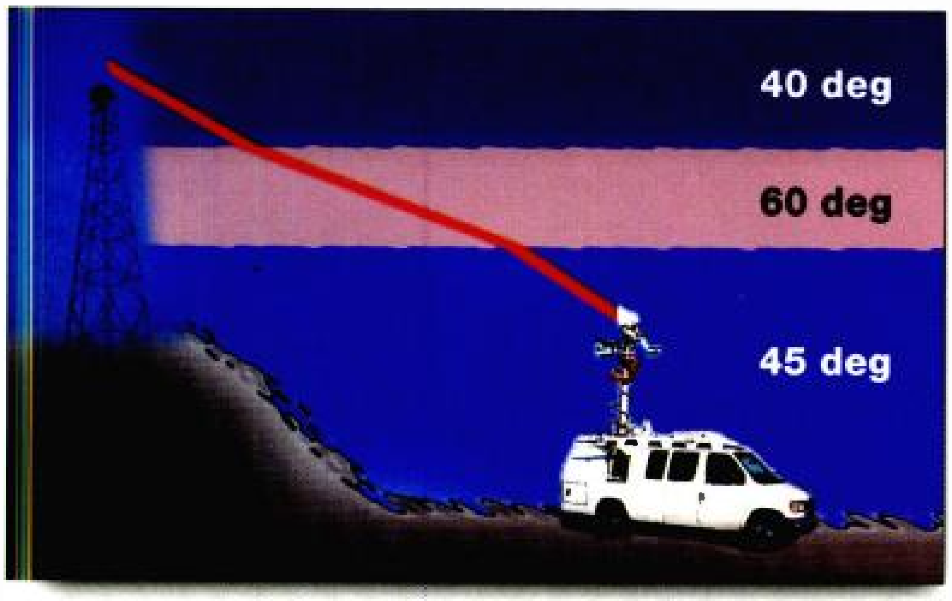


Figure 4: Knowing the height of transmit and receive antennas can help get you around trouble areas.

•Keep your ENG receiver and transmitter near the same altitude. Many ENG truck operators look for high ground when setting up their signal. When the ENG truck and crew are operating on a hilltop high above the city, they may find themselves above an inversion layer that has sunk down in between the hilltop and the city. A lost signal may be restored by moving downhill and placing both the truck and receive site below the offending inversion layer.

•Shorten the distance of the ENG link. Even if you can't get a signal out from the scene of a breaking story, you may be able to save the news report by getting a live shot or tape feed back from another location closer to your ENG receiver. Based on the inverse square law, moving the ENG truck 30% closer to the receive site not only doubles the signal strength, but also reduces the distance the signal travels through the thermal layer.

•In areas subject to frequent weather-related signal failures, plan additional ENG receive sites. These sites should be located away from the thermal layers that commonly affect your ENG shots. In Buffalo, thermal layers building up over the lakeshore cause problems. Pockets of warm air develop over the city in mid-winter, and occasional inversion layers descend below the hilltops that surround the city. WIVB-TV has two receive sites located in the urban area of Buffalo. One is near the shore of Lake Erie, the second is further inland. Recently a third ENG receive site was added on a hilltop 20 miles outside the city. ENG signals blocked by thermal layers over the city or lakeshore can now be received at this site.

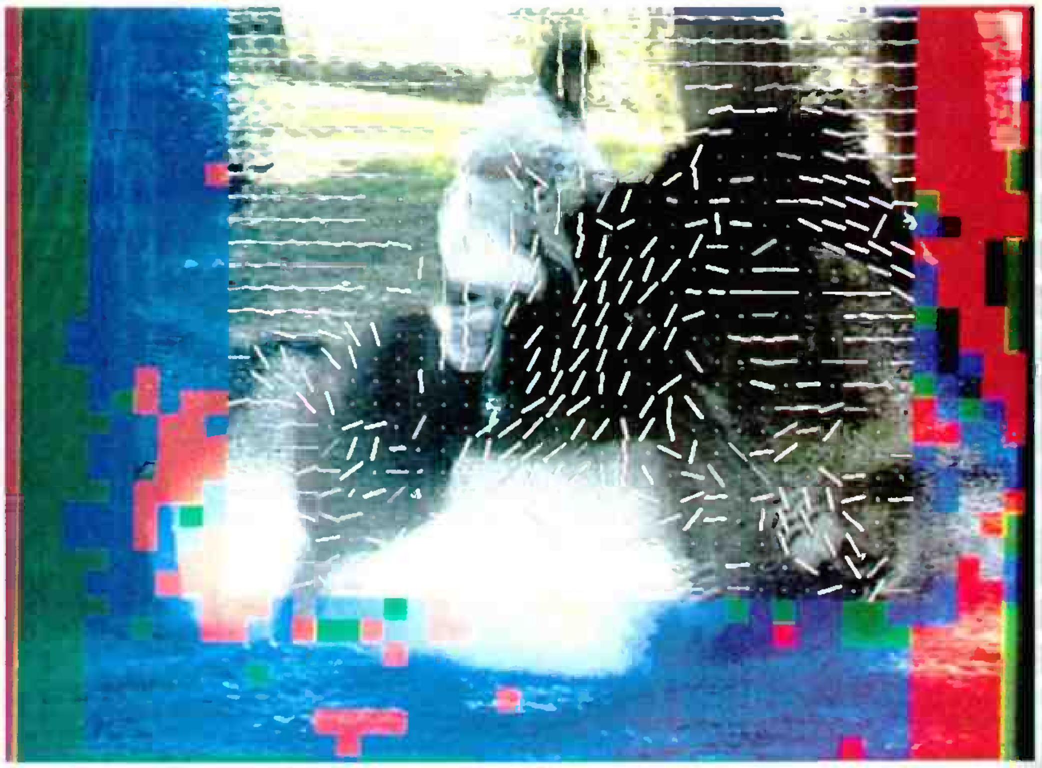
Having a basic understanding of the weather patterns in your area, along with the knowledge of how they can affect ENG links can often save a key live shot for the evening news. ■

Gary Schaut is a TV engineer at WIVB-TV, Buffalo.

Acknowledgement: The author wishes to thank Mr. Don Paul for his invaluable assistance in researching this article. Mr. Paul is the chief meteorologist at WIVB-TV and a member of the board of the American Meteorological Society.

MPEG-2: Challenges and opportunities in broadcast

By Paul Mears and Arun Ramaswamy



Motion compensation parameters in the MPEG bitstream can be analyzed using equipment such as the Snell & Wilcox MVA100 MPEG video analyzer. The overlays are split into two windows. One window shows lines representing direction and length of the first motion vector for each macroblock. The other window's color overlays indicate the direction of motion compensation for each macroblock. In the above photo, green indicates a forward predicted macroblock, red for backward and blue for bidirectional. (Images courtesy Snell & Wilcox)

The use of digital video compression and its impact on the broadcast industry has been a topic of much discussion in the last few years. The main issue today is that the bandwidth necessary to broadcast and store uncompressed digital signals is cost prohibitive. Without at least some type of compression, the practical implementation of DTV and HDTV would simply not be possible. Compression technologies give broadcasters the means to preserve bandwidth for the storage and distribution of the digital signals.

Several different compression schemes have emerged to address diverse video applications. In the broadcast arena, MPEG has risen to prominence. MPEG is an acronym for the Moving Pictures Experts Group, a joint committee of the International Standardization Organization (ISO) And International Electrotechnical Commission (IEC). MPEG-2, which is fast becoming the standard in broadcast applications, is specified by three documents: ISO13818-1, ISO13818-2, and ISO13818-3. All three describe generic specifica-

MPEG-2

tions and intentionally do not detail many aspects of implementation. Instead, they specify a compressed bitstream syntax. The standard leaves room for smart implementations of the MPEG encoder, compression algorithm, and the decoder. In essence, the system designer is given a basic tool set from which to make up systems incorporating greater or lesser degrees of sophistication.

MPEG basics

The structure of MPEG signals can be viewed as a hierarchy, as shown in Figure 1. At the top level of the hierarchy, the video bitstream consists of video sequences. Each video sequence con-

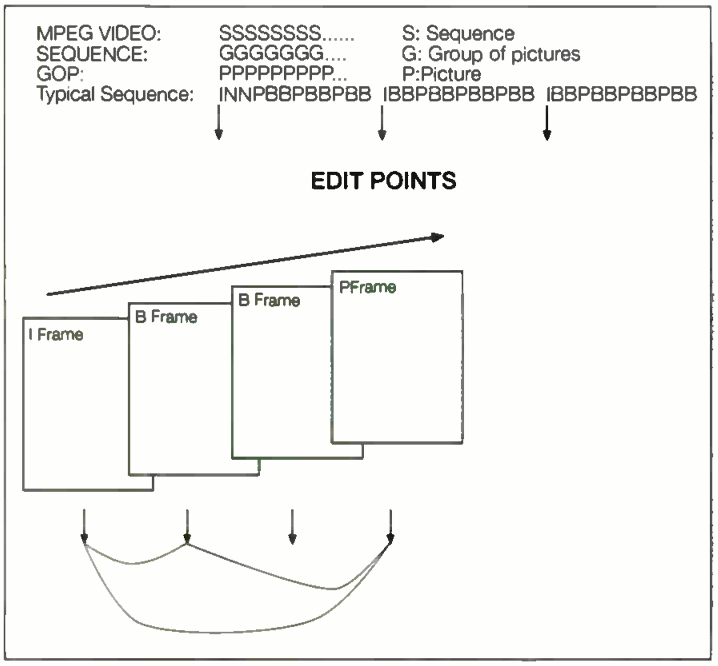


Table 1. The MPEG tool set

sists of a variable number of group of pictures (GOP). Each GOP contains a variable number of pictures. A picture can either be a frame picture or a field picture. In a frame picture, the two fields are coded together to form a frame, while field picture is a coded version of an individual field. There are three main types of pictures based on their compression schemes: intra (I), bidirectional (B), and predicted (P). The I pictures are coded by themselves, hence the name "intra." The coding technique for these pictures falls in the category of transform coding. Each picture is divided into 8x8 nonoverlapping pixel blocks. Four of these blocks are additionally arranged into a 16x16 block called a *macroblock*. The Discrete Cosine Transform (DCT) is applied to each 8x8 block individually. The transform exploits the spatial correlation of the pixels by converting them to a set of independent coefficients. This process allows the low-frequency, high-energy coefficients to be coded with a greater number of bits, while using fewer or zero bits for the high-frequency, low-energy coefficients. The high-frequency coefficients can be dropped because the eye lacks the ability to detect high frequency changes. Retaining only a subset of the coefficients reduces the total number of parameters needed for representation. The process is identical for the luminance and the chrominance pixel blocks.

With P and B pictures, MPEG delivers its maximum compression efficiency through a technique called motion compensation-based (MC) prediction, which exploits the temporal redundancy. Because frames are closely related, it is assumed that a picture can be modeled as a translation of the picture at a previous time. This makes it possible to accurately represent or predict the data of one frame based on the data of a previous frame. The process of prediction provides a significant reduction in the number of bits required to code a picture.

For B pictures, MC prediction and interpolation is performed using reference frames. Reference pictures include I and P pictures. The prediction is noncausal because it uses frames from the past and the future. B pictures provide the maximum compression. The B pictures are themselves never used for predictions and hence do not propagate errors.

MPEG also offers a number of features to facilitate the compression of analog and digital video. Under MPEG-2, these features are neatly packaged under profiles and levels. Each profile defines a subset of the syntax and each level additionally imposes a constraint, such as bit rate, resolution, etc., on the feature set. Profiles include simple, main, SNR scaleable, spatially scaleable, and high. The levels include low, main, high 1440 and high.

MPEG applications

• Storage: By lowering the total number of parameters required to represent a signal, compression allows more efficient use of storage. To achieve this, MPEG compression eliminates redundant data or, rather, represents redundancies in a more compact fashion. The MPEG compression algorithm is a clever combination of a number of diverse tools, each of which exploit a particular data redundancy (See Table 1). The end result is that the coded video needs a far lower bandwidth compared to the original, while maintaining extremely good quality.

The various redundancies present in the video signal data include spatial, temporal, psychovisual and coding. Spatial redundancy occurs because neighboring pixels in each individual frame of a video signal are related. The pixels in consecutive frames of a signal are also correlated, leading to substantial temporal redundancy. To add to it, the human visual system does not treat all the visual information with equal sensitivity. This leads to psychovisual redundancy. For example, the eye perceives changes to a greater extent in the luminance than in the chrominance. The eye is also less sensitive to high frequencies. Finally, not all parameters occur with the same probability in an image. As a result, they would not require equal number of bits to code them, leading to coding redundancy.

For audio, MPEG uses different encoding techniques, called *layers*. Three layers are available, but Layer II is the most commonly used. The MPEG-1 Layer II coding scheme is similar to MUSICAM (Masking, pattern-adapted, Universal Subband Integrated Coding And Multiplexing) coding, which

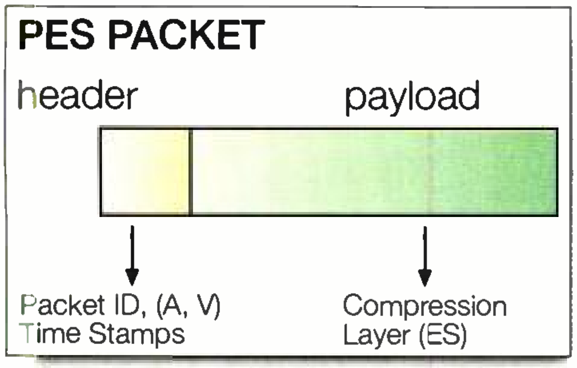


Figure 2. PES packet showing header and payload components

provides for the coding and compression of audio data. The MPEG audio encoding algorithm uses coding and quantization, and psychoacoustic modeling for the removal of redundant information.

•Transmission: In transmission applications, the challenge is to use bandwidth more efficiently to get more data through the same size pipe. The first step toward this in MPEG is system stream encapsulation, which combines the video and audio portions into one signal. These system streams can be broadly classified into two categories depending on whether they are used for storage or broadcast applications.

MPEG-1 system-stream and MPEG-2 program-stream formats are designed for use in closed systems where bit error rates are low, such as DVD, VideoCd and storage systems that support NVOD, VOD, or cable ad insertion. The system and program streams consist of interleaved audio and video packetized elementary stream (PES) packets. These variable length PES packets encapsulate the compression data. The header contains time stamps, which are samples of the common encoder clock and are used by the decoder to perform A/V synchronization (See Figure 2).

For lossy mediums, such as the real-time delivery of digital data over fiber, satellite, cable, ISDN or ATM, the MPEG-2 transport stream is used.

A transport stream consists of one or more programs. Each program is defined as a collection or a multiplex of individual program elements that share the same timebase. The transport bitstream is comprised of 188-byte length transport packets (See Figure 3). This size is small enough to keep the probability of error small in error-likely conditions, and yet large enough to keep the header small. Furthermore, the size is compatible with the ATM formats.

The header contains a program ID (PID) to identify the contents of the packet, along with timestamps known as the program clock reference (PCR). These timestamps are samples of the encoder's 27MHz clock and indicate the time of arrival (TOA) of the stream at the receiver.

The payload includes PES packets as well as dedicated-transport packets, known as program specific information (PSI), which are set aside to identify the structure of the stream.

•Editing: Storage and transmission applications were the driving force behind the adaptation of MPEG technologies. Initially it was thought that compression of video would only be done once the material was completely edited and ready for transmission; the point at which no further editing would be required. But as the use of MPEG has propagated, the need to edit video in a compressed form has become a reality and methods are being developed to allow for this.

The most obvious editing method is to decompress the MPEG stream, perform editing as normal in an uncompressed format, and then encode back into MPEG. The drawback is the sacrifice of quality, as the compression/decompression process tends to degrade the video signal. Moreover, such a technique can cause delays.

Another technique is to edit the MPEG stream directly. As discussed previously, MPEG video contains a combination of I, B and P frames. I frames are standalone and offer random access in the bitstream. Thus, an MPEG stream consisting entirely of I frames could be edited in the same way as uncompressed video. The downside is that I frames require the greatest percentage of bits and therefore there is no real advantage in terms of compression for broadcast applications. P and B frames require fewer bits but do not offer random access in the bitstream (because they are predictive frames and require information in other frames in order to be decoded). Thus there is a compression vs. random access tradeoff issue.

Typical GOP structures use one out of every 15 or 12 pictures as an I frame, which means that an edit point is available approximately twice every second.

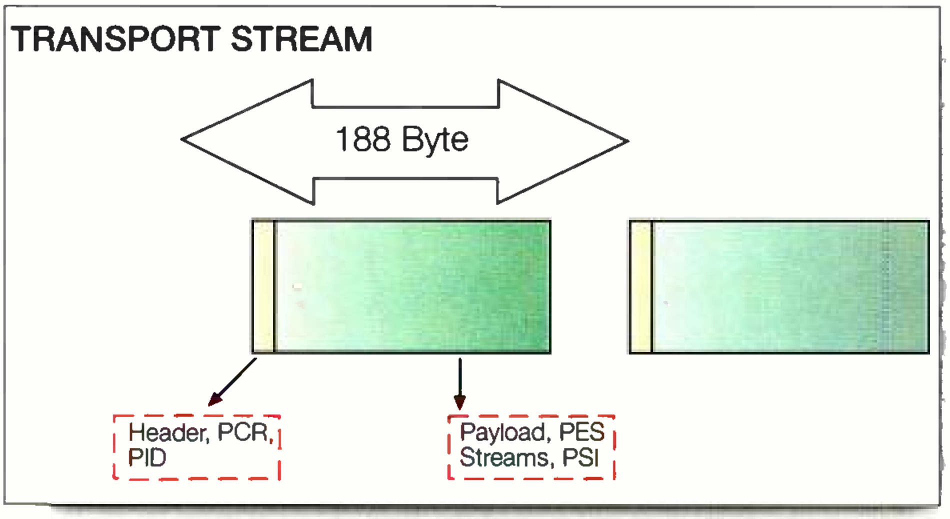


Figure 3. MPEG transport stream showing 188 byte transport packets.

To perform simple trimming, the following steps can be done. First, the edit in- and outpoints are identified. This can be done through timestamps that are present in the GOP header or may be present in the user data of the picture header. If the edit points happen to be on a I frame or a GOP boundary, no additional step may be necessary. However, if the edit frames are P or B frames, then they must be transcoded to I frames. Similarly the audio packets are also trimmed at appropriate points. Finally, the restamping or remultiplexing of the stream may be performed to maintain the timing and buffer integrity of the stream.

For most studio applications, edit points are frequent and high video quality is imperative. The MPEG 4:2:2 studio profile addresses this market. The

MPEG-2

compressed stream structure is either I only, which means editing can be done at all picture points, or IB or IP. In addition to an increased frequency of I frames, the chroma format is 4:2:2, unlike MPEG-1 which is always 4:2:0. This feature helps preserve the bandwidth characteristics of the chroma channels in chroma key and other special effects techniques. Finally the bit rates can be as high as 50Mb/s. The signal degradation on multiple encode and decode processes is also minimal, which makes the 4:2:2 studio profile attractive for production and post-production applications.

- **Splicing:** Digital splicing involves concatenating two MPEG streams, and is needed for digital ad insertion. Splicing can be seamless or nonseamless. One critical issue in splicing two different bitstreams is proper buffer management. It is imperative to prevent an overflow or underflow of the decoder buffers to facilitate a smooth and transparent transition at a stream splice point. In seamless splicing, the buffer fullness at the first stream's outpoint matches that of the second stream's inpoint. Seamless switching is more difficult to achieve, but nonseamless splicing is acceptable in a number of applications. In nonseamless splicing, a controlled underflow condition is allowed at the splice point. Moreover, a number of constraints are put on the bitstream to facilitate splicing. A splice countdown is typically embedded in the stream to inform the splicers of an impending splice point.
- **Trickmodes:** Performing fast forward and rewind is essential for a number of broadcast, cable, and interactive TV (ITV) applications. One way to fast forward or rewind a bitstream is to decode at I frames only. Once again, the speed depends on the frequency of the I frames in the bitstream. Trickmode information can be inserted in the bitstream, which can help a decoder pause, fast forward, slow, fast reverse or slow reverse the stream.

Using MPEG technology

MPEG is based on lossy compression. Quality degradation is therefore expected as the compression ratio is increased. MPEG-2, with its different levels and profiles, offers bit rates from 3- to 100Mb/s. Current broadcast applications employ video encoded between 6- and 15Mb/s at full CCIR resolution (720x480). The quality of the video encoded at these rates is perceived to be broadcast quality. Hence one should judiciously choose the bit rate and the video resolution with the application and the available bandwidth in mind.

Because MPEG is built on two distinct levels (compression and systems) failure modes are typically reserved to these two levels. For instance; in the compression level, encoding scenes that have a high degree of motion with an insufficient bit rate may result in macroblocking (discrete rectangular blocks on the reconstructed picture). Also, it is frequently better to decimate the video (employ SIF or half-horizontal resolutions) when encoding at low bit rates. That way, the picture is encoded with a larger number of bits distributed per macroblock. MPEG-1 allows for only frame encoding, meaning that the two fields are combined into a frame and the entire frame is then encoded. All the prediction and motion compensation is done at a frame level. This is not very useful for scenes with a lot of fast motion. MPEG-2 allows complex scenes to be encoded with the motion compensation and prediction operating at a field level.

Encoding systems with MPEG-2 technology can intelligently switch between frame pictures and field pictures while encoding static scenes and scenes with high motion. Other features of MPEG-2, resulting in better image quality include more precise alternate scanning patterns for the coefficients and separate VLC (variable length coding) tables for DCT coefficients in intra-macroblocks.

The MPEG-2 encoding process must ensure a hardware decoder can read the stream at a constant, even pace without running out of or accumulating too much data for the decoder's video and audio buffers. The bit rate of encoded content is contained in the sequence header of MPEG videostreams. In addition, each picture specifies a number called a video-buffering verifier (VBV) delay value, which tells the decoder how long to wait for data to accumulate in its video buffer before starting to decode the picture. The combination of the constant bit rate and the initial delay guarantees that all the data for the picture is available by the time it is needed. Without the delay, the decoder could potentially exhaust the buffer (starvation) or overflow the buffer before the picture is finished being reconstructed. An incorrectly encoded stream with bad values for either the bit rate field or the VBV delay field could cause timing problems, decoder lockups, macroblocking, or video stuttering when these streams are played.

MPEG standards are generic and universal in the sense that they specify a compressed bitstream syntax. This, in effect, unambiguously defines the decompression process and the decoder architecture. Furthermore, MPEG lays down normative limits for buffers on the standard target decoder. Because the standard target decoder is a hypothetical model in the encoder architecture, multiplexers can create compli-

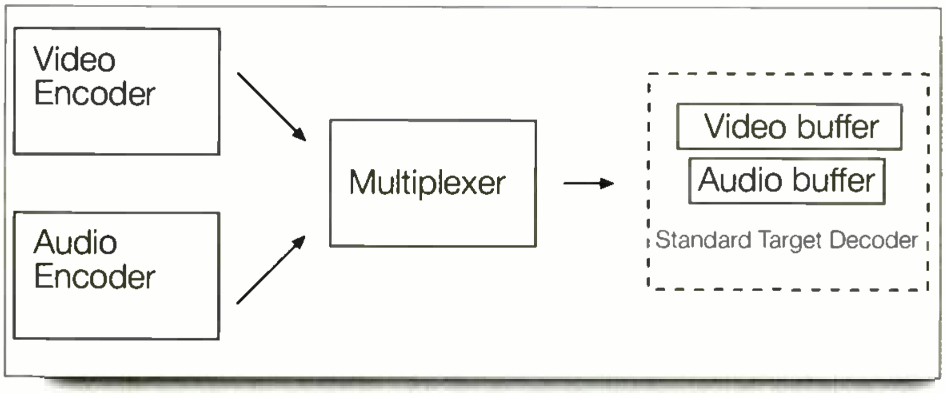


Figure 4. The standard target decoder is a hypothetical model in the encoder architecture that allows an encoder to create compliant streams without having to base its design on any particular decoder.

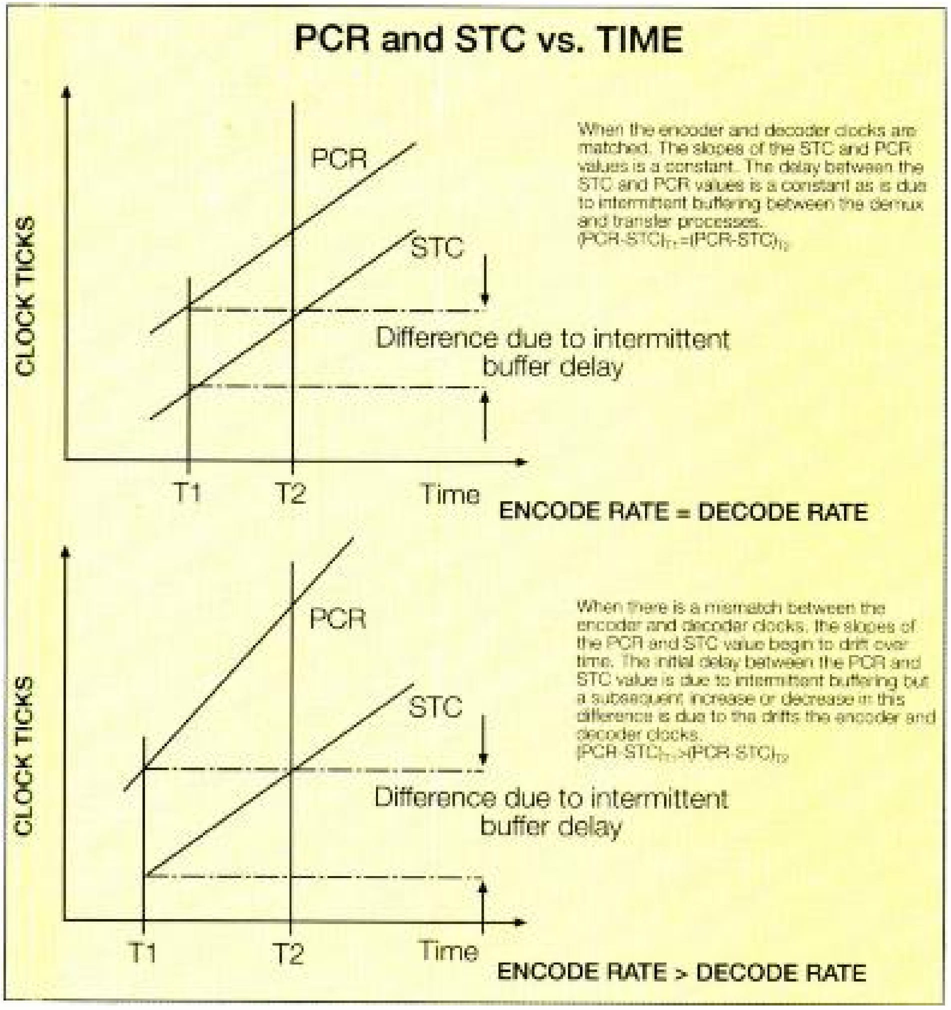


Figure 5. Part a) shows the relationship between the PCR value and the corresponding STC value when the encoder and decoder clock rates are matched. Part b) shows their relationship when the two clocks are mismatched.

ant streams without having to base their design around any particular decoder. MPEG-2 decoders also have standard target decoder buffers (T-STD) for both video and audio (See Figure 4). For ML@MP, these buffers are minimally 220kb for video and 4kb for audio.

Similarly, all MPEG-compliant decoders are required to have at least the minimum amount of buffer as mandated by the standard. A realistically designed decoder will have more than the minimum to compensate for network jitter. Because MPEG-compliant decoders can successfully decode and present an MPEG-compliant stream, this process ensures interoperability between encoders and decoders.

However, the standard does leave room for smart implementations of the encoder, compression algorithm, and the decoder. For example, encoders may have sophisticated rate-control algorithms, thus improving the quality of the pictures, and effecting product differentiation.

Two different data-flow models exist for delivery of data to an MPEG decoder. These two models, push and pull, are used in different environments. Typically, store and forward video servers with decoders directly attached through a bus employ a pull model dataflow, whereby the decoder pulls or requests data from a storage medium. In push-model decoding, a compressed datastream is broadcast by an encoder, and decoders must lock on to the received datastream. In the push implementation, to achieve synchronization the decoder's 27MHz clock needs to be locked to the encoder's 27MHz clock. For this, we need to be able to determine the exact value of the encoders 27MHz clock. PCR/SCRs are samples of the encoder's 27MHz clock that are periodically inserted in the MPEG stream. An external clock-recovery circuitry can then be used to extract the encoder's clock information. A second circuit, such as a VCO, is then implemented to adjust the decoder's clock to that of the encoder. When the two clock rates are matched, synchronization is achieved.

Figures 5 illustrates the relationship between the PCR value and a corresponding STC value when the encoder and decoder clock rates are matched, as well as when the two clocks are mismatched.

What to look for

In evaluating MPEG equipment, it is important first to understand the applications for which the equipment will be used. Typical studio applications require both storage and playback of video in a shared environment. Thus, behind the hardware that encompasses the encoder there must be multiple decoding engines and a storage and playback medium. Solutions might include separate stand-alone units. However, given the usual limited shelf space in most equipment rooms, its is likely that an integrated solution will be preferred.

MPEG processing equipment must be scaleable to handle both 4:2:0 and 4:2:2 profiles. Inherent with the 4:2:2 profile is the ability to preserve the vertical blanking interval (VBI). Teletext, closed captioning, timecode and other information that can be contained in the VBI from source material must be reliably captured on an encoder and must be reconstructed accurately on the output of a decoder. Because the decoder sets the constraints on the stream, encoders must be flexible enough to modify various encoding parameters to match the requirements of the decoder.

The future of MPEG

Even as MPEG-2 moves toward becoming the *de facto* standard for broadcast applications, new MPEG standards are emerging. MPEG-4 is aimed at low bit rate applications such as video-over-Internet, mobile multimedia, and interactive video games. MPEG-7, the newest standard, is targeted toward identifying and searching for multimedia content that exists in different forms today. These new standards, while not immediately relevant to the broadcast industry, may become important considerations as broadcast, computer and telephony industries continue to converge. ■

Paul Mears is vice president of operations and Arun Ramaswamy a scientist for Vela Research, Clearwater, FL.

Decision-making traps

BY KARE ANDERSON

Last month's column outlined some mental traps that, if unnoticed, can blindside us into making faulty decisions. We often make the mistake of *anchoring*, which is to disproportionately weigh the first information we receive and make a judgement based on that initial impression, thereby maintaining the status quo and justifying past actions. What follows are more common decision-making mistakes.

The confirming-evidence trap

The confirming-evidence trap is a bias that leads us to seek out information supporting only our existing beliefs, while avoiding any contradicting information. This bias not only affects where we go to collect reinforcing evidence, but how we interpret evidence. It leads us to put too much weight on supporting information and too little on that which conflicts.

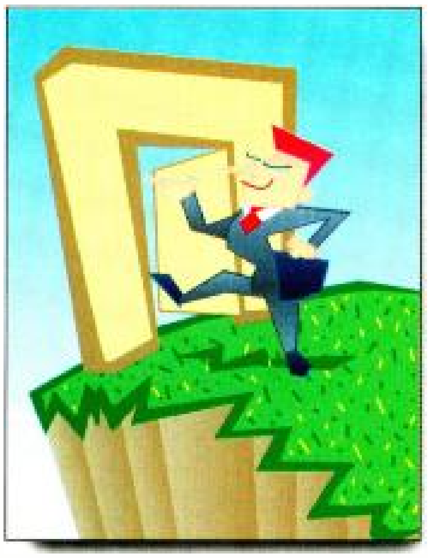
There are two subtle and pervasive ways we let our emotions bias balanced judgement. One is to subconsciously decide *what* we want to do before we figure out *why* we want to do it; the other is our inclination to engage those things we approve of while avoiding those we do not.

To avoid these traps, decide whether you are examining all the evidence with equal rigor and avoid the tendency to accept confirming evidence without question. Build counterarguments for yourself by asking what strong reasons you might have to do something else. Be honest with yourself about your motives and resolve whether you are gathering information to help make a good choice or simply looking for evidence confirming what you want to do. In seeking advice from others, do not ask leading questions. They make your inclination evident and thereby bias the perspective of others as well.

The framing trap

The way in which you make a decision is often determined by how you view your choices or how you frame the questions around it. A frame can establish the status quo or introduce an anchor. It can push you to decide through justification of past actions or lead you toward confirming evidence. One such frame that can distort your decision-making is using a frame as a gain or a loss.

People are risk-adverse and will look for reasons to avoid a decision where a loss, however small, is possible — even if there is a larger chance for an upside gain. They also tend to adopt the framing of the situation as it is presented to them rather than restating the problem. Do not automatically accept the initial frame, whether created by yourself or another. Try to reframe the problem or opportunity in several ways to see it from different sides and with different potential outcomes. Also try posing decision-making situations in a neutral way that combines gains and losses or embraces different reference points. Throughout the decision-making process, ask yourself how your thinking might change if the framing changes.



Other traps

While we are often correct in estimating time, volume, distance and weight because such decisions are made frequently, we are less experienced when deciding on uncertain forecasts. We believe we are better at making forecasts or estimates than we actually are, thus setting the stage for decision-making blocks such as described above. In business we must be careful in avoiding the over-confidence trap.

However, being overly cautious or prudent in forecasting can also be faulty. When faced with high-stakes decisions, we tend to adjust our estimates or forecasts, thereby falling into the prudence trap.

Even if we are neither overly confident nor unduly prudent, we can still fall into the recallability trap when making estimates or forecasts. Because we frequently base our predictions on the results of past events, we can be overly influenced by dramatic events that leave us a strong impression. These events will distort your thinking and, because of this, you may assign a higher probability to potentially similar instances. To minimize the distortion caused by variations in recallability, carefully examine your assumptions.

Many of these traps work, not in isolation, but in concert with each other, thus amplifying their power to distort. When we make a hasty decision believed to be made on instincts, we are, if fact, often falling into a trap.

If readers have any response to my column or would like to share any other decision-making traps, please go to *Broadcast Engineering's* website at www.broadcastengineering.com. ■

Kare Anderson is a speaker and author.

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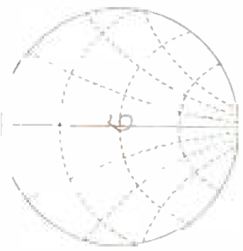

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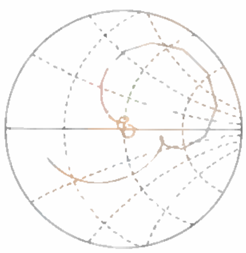

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Applied Technology

Panel antennas: Flexible solutions for the broadcaster

BY RAYMOND J. CARNOVALE, B.A.SC., MBA, P.E.

Many factors enter into the design of a panel-antenna array. When properly engineered, panel antennas can offer exceptionally good performance and a high degree of control of the horizontal and vertical radiation patterns. In the upper VHF (7-13), FM and UHF bands, multichannel operation over wide bandwidths is possible.

Panel antennas have been popular for multistation FM operation, but there have been fewer acceptances by TV broadcasters. Perhaps the traditional model of one station/one tower has led to a preponderance of top-mounted pylon or turnstile antennas. However, with the advent of DTV, broadcasters who traditionally may have installed pylon antennas are discovering that panel antennas can be an attractive alternative.

Planning ahead

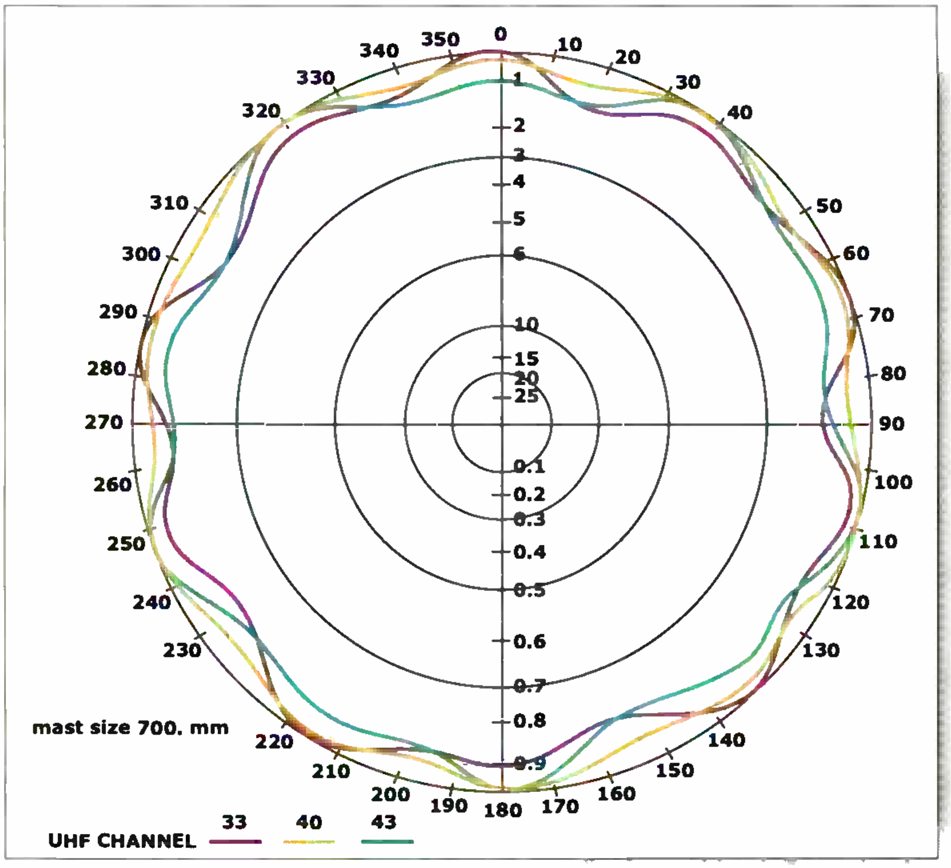
The DTV allocation table imposes significant directional radiation requirements on many broadcasters. Often, the directionality required for digital operation is inherited from the existing analog parameters. In other cases, spectrum congestion has required a compromise in permissible radiation in certain directions in order to allow an otherwise unusable channel to work. There are also some broadcasters, for example those in mountainous areas, who wish to directionalize in order to minimize multipath problems.

For existing UHF broadcasters assigned a UHF digital channel which is not N+1 or N-1, a panel antenna is likely the only way to achieve diplexed operation with the attendant cost reduction. Alternatively, there are markets where existing VHF broadcasters have been fortunate enough to be assigned omnidirectional UHF patterns. In this case, multicoupling two or more stations into the same antenna can realize significant economies of scale.

For the optimum design, several planning steps are necessary. The permissible effective radiation power in the directions of protected co- and adjacent-channel stations must be determined. These calculations will take into account the transmission path to the protected contours, and the allowable desired/undesired signal ratios (arising from co- or adjacent channel, and digital-to-digital or digital-to-analog interference considerations).

Next, the available aperture must be determined. For an existing tower, this determination may be an interactive process because of the limited additional loading that may be placed on the tower. In most cases, the antenna aperture is constrained by the maximum permissible additional loading, even though greater aperture would be beneficial to achieve the desired vertical gain. It is a popular misconception that the feasibility of adding an antenna to a tower is a function of weight. In fact, the dead vertical load of an antenna is somewhat trivial when compared to the weight of the tower. The real issue is the effective surface area presented by the antenna, its mounting hardware and transmission lines.

Third, the geometry of the tower should be analyzed. The tower-face width and orientation, as well as the



A well-designed, five-channel antenna can provide several benefits. With 16 bays, the power handling capacity can be 160kW. The pentagonal cross section allows internal climbing for inspection and repair. Circularity of a decibel or better and total bandwidths over multiple channels are possible with careful design.

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location of guys, are critical factors that affect the final array design.

For panel antennas, the depth of nulls in the horizontal pattern is a function of the panel spacing and orientation, as well as phase and amplitude. In the case of VHF or FM arrays, it is desirable to keep the panels as close to the tower face as possible to avoid deep nulls and to minimize torquing of the tower under gusting wind conditions.

Designing the antenna

When designing the actual antenna, the major lobes of the antenna pattern should generally be in line with the aiming azimuths of the panels. The first iteration of a panel antenna will likely start with the panels aimed toward the areas of target coverage. For each panel, the following parameters can be varied: azimuth, distance (from the array geometric center, which may or may not correspond to the geometric center of the supporting structure), offset (left or right of the aiming azimuth), phase and power ratio. Manufacturers have computer programs that allow these parameters to be varied and the effect of the changes to be overlaid on previous patterns.

Panel antennas consist of a radiating dipole mounted in front of a screen reflector. Over the years, two styles of panels have evolved; those with straight dipoles and those with bent dipoles. Bent-dipole panels have a broader half-power beam width, and as a result, are well suited to mounting on triangular support structures in a three-around configuration. Straight dipole panels are more suited to square support structures.

Given that a typical VHF or FM antenna has three panels per bay, there are at least 15 parameters that can be varied. An experienced design engineer develops an intuitive feel for the cause-and-effect relationships.

Having determined the available aperture, the vertical gain of the antenna, and the horizontal directivity, the transmitter power required to achieve the maximum required effective radiated power (ERP) can be estimated. It should be kept in mind that as the maximum ERP increases, the depth of the nulls must also increase to keep the radiation towards the protected contour constant.

For antennas that do not have equal power to each panel, some economies can be realized by using a *panel split*. If a power ratio of 9:9:1 is required, this can be achieved by mounting six panels on two faces and two on the third. This is because the power ratio is the square root of the field contributions from the individual panels. The square root of nine is three; therefore, three times as many panels are required on the high-power faces.

VSWR optimization has become a science in itself. In simplest terms, it is desirable to have all reflected voltage vectors add to zero at the main power divider. The phase of the reflection is twice the phase delay of the cable (i.e. the signal goes forward, is reflected and travels the same distance back to the power divider). By judiciously choosing the phase delay, the voltage vectors cancel. Typically, in antennas using three panels per bay, the panels are fed 120 degrees out of phase. In the case of four-panel arrays, the panels are fed 90 degrees out of phase. This technique can be applied as well in the vertical plane, resulting in an antenna that is extremely well compensated.

Given that a typical VHF or FM antenna has three panels per bay, there are at least 15 parameters that can be varied.

Five-sided arrays

UHF panel antennas present a particular challenge. Because UHF wavelengths are so short (fractions of a meter), it is necessary to mount the panels on a relatively narrow cross section. Four-sided omnidirectional UHF arrays capable of meeting a criterion of +/- 2dB, are 580- to 640mm square. If high power handling is desirable (i.e. above 30kW), the power dividers and harness tend to fill the supporting spine and internal climbing and maintenance is virtually impossible. In order to solve this problem, several manufacturers have developed modified UHF panels with narrower beam widths and pentagonal mounting. The five-sided arrays have several benefits:

- A typical omnidirectional antenna with a nominal vertical power gain of 30 requires 16 bays, or 80 panels in total, representing a power handling capability of 160kW.
- The pentagonal cross section is large enough to allow internal climbing, inspection and repair of the harness.
- With careful design, circularity of a fraction of a decibel can be achieved on a single channel, and is substantially better than 2dB across several channels.

An interesting byproduct of the digital TV rules is the removal of the "omni-loophole." Under the analog rules, antennas that had horizontal directivity of +/- 2dB did not have to factor the horizontal gain into the calculation of maximum effective radiated power. However, with the digital rules we must add the horizontal directivity to the vertical power gain. If you are fortunate enough to have an omnidirectional allocation, but are not careful about the degree of horizontal directivity, you may be penalizing yourself unnecessarily. Another consideration in the design of high-gain UHF panel arrays is the effective deflection of the antenna at operational wind speeds. Stiffness of the mounting spine is a subtlety that must not be overlooked, especially when coupled with the deflection of the tower. Note that operational wind speeds are usually significantly lower than the design wind speed.

Panel antennas offer the broadcaster a great deal of flexibility in tailoring the radiation pattern to special needs. Multistation operation at high power levels is possible over bandwidths of 25 to 30 channels. Changes in radiation pattern are feasible after installation by changing the power-division ratios. For those desiring near-perfect omni patterns, five-sided arrays are an innovative answer. ■

Raymond J. Carnovale, B.A.Sc., MBA, P.E., is president of LeBlanc Broadcast Inc., and has been in the broadcast industry for over thirty years.

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Applied Technology

The Synctrix FiberHydrant

BY RICHARD BAUARSCHI

The floodgates of ATM's (asynchronous transfer mode) high transmission speeds, over public and private networks, are about to be opened. To meet this demand, video production, telecommunications transmission and other enabler technology companies have begun manufacturing innovative ATM-based video data transmission products.

One such product is the Synctrix FiberHydrant, a system that converts digital video, audio, timecode and RS-422 control data to ATM cells for transmission at OC3 (155Mb/s) over switched virtual circuits (SVCs). Video compression ratios are user-selectable, ranging from a visually lossless 2.5:1 down to 100:1, along with uncompressed digital audio. Upgrades to transmit uncompressed digital video (D1 at 270Mb/s) and mezzanine-level HDTV (360Mb/s) using OC-12 (622Mb/s) are planned for release next year.

Physically shipping a D1 or DigiBeta tape across town or cross-country by courier will become antiquated, limiting and costly. Likewise, time-consuming and expensive satellite circuit booking and video switching will soon make little economic sense in a high-bandwidth future of plenty.

Expanding capacities

The universe of telecommunications and data networking capacity is expanding beyond mere exponential growth. With the advent of wavelength division multiplexing (WDM), the bandwidth of each fiber has increased forty-fold with more to come. The result of this trend will be a dramatic reduction in the cost of bandwidth. In order to make up for this, the telecommunications industry will begin to offer new services. Today's low-bandwidth teleconferencing, in-house local-area networks, or streaming media servers on the Internet are just the beginning of what will be possible.

Carriers today can service remote news bureaus, arrange to backhaul multiple DTV transport streams, or even accommodate network program distribution using MPEG-2 at professional levels and profiles. Besides paying for a high monthly flat-rate service, which may be used only a few hours, customers are limited in bandwidth to what can be transported by old analog TV-1 fiber circuits or the digital DS-3 lines at 45Mb/s.

The next step will be to transition from dependence on permanent flat-rate lines to an access fee plus usage-based billing. Therefore, when dialing up video bandwidth, customers pay as they go for connect time. This telephone-call business model is known as a *switched virtual circuit* (SVC).

The ATM edge switch doesn't stop there. ATM was designed to accommodate video, voice and data traffic all in the same transmission environment. Considerable dollar savings could be realized by consolidating many business connections to the world through ATM.

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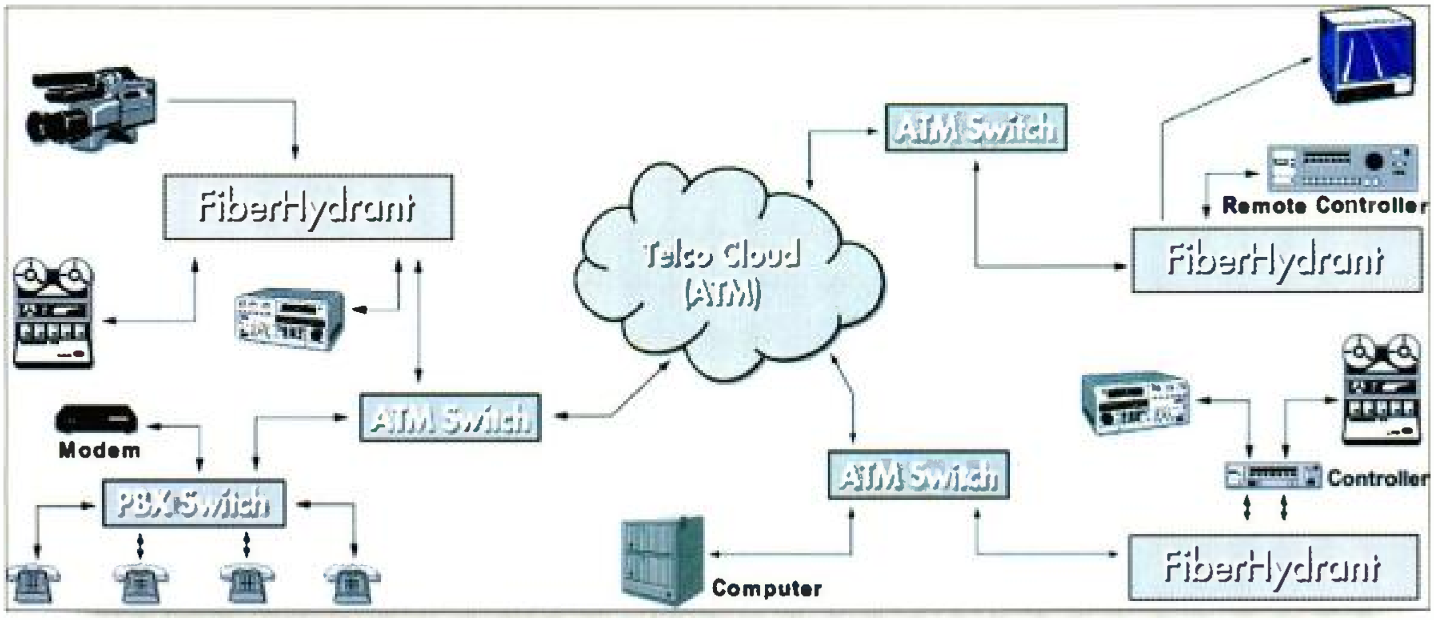

FiberHydrant provides the capability to send/receive video and controller information from a variety of locations over ATM networks.

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or using an Internet browser. In addition to local control, FiberHydrant can be operated remotely via Ethernet LAN when using a java-enabled computer. When logging in, FiberConnect defaults to the IP address of the local host, or the user can specify and connect to another FiberHydrant on the LAN.

Fiberhydrant features

The front panel of the rackmounted hardware is made up of functional icons and indicator LEDs that report system status at a glance. At the heart of the Windows NT-based FiberHydrant is a 533MHz Alpha CPU. The rear panel connections are a combination of a professional VTR, desktop computer and network hub.

Besides the familiar IP address that DNS servers use to identify network locations, the FiberHydrant also has a network services access point (NSAP) address, the equivalent of an ATM "phone number." All this information is organized in the GUI under the system screen. Password protection keeps the system configuration secure.

Having selected a source or destination from the location list, the user can set up to send or receive signals using a full-screen graphical representation of the back panel connections. Connector graphics are overlaid with color indicator icons that represent the status of each I/O. A control screen is provided with VTR-style icons to allow remote operation with shuttle and jog.

Upon reviewing the status log screen, the user will have a listing of all the connections made, including the signal name, locations, and start and end times. A separate error log keeps track of the type of complaints encountered with modems.

Separate GUI slider controls are provided for each signal.

The FiberHydrant solution to early ATM problems related to latency and cell jitter implements separate dynamic transmits and receives frame buffers to ensure smooth signal flow. Separate GUI slider controls are provided for each signal. Video, audio and timecode can each be buffered up to 15 frames in field increments to maximize quality with minimum latency.

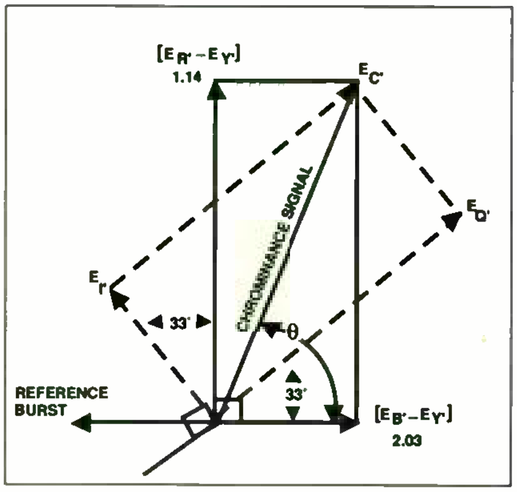
On the virtual edge

With FiberHydrant at the virtual edges of the video plant interfacing to an ATM fiber network, facilities can extend the reach of video, audio, timecode and RS-422 routing switchers. ATM's interoperability will make it a pervasive technology across MANs (metropolitan-area networks) and WANs. As backbone infrastructure develops, ATM's extensibility will merit contribution-quality and uncompressed HDTV over OC-48 (2.488Gb/s) and beyond. ■

Richard Bauarschi is director of marketing for Synctrix Inc., Glendale, CA.

Their specs.

Our specs.



The best video demod specs. *Guaranteed.*

Because you can't afford to take a chance with the quality of your video signal, you need a demodulator you can count on.

That's why, with every **msi 320** video demodulator, Modulation Sciences includes serial-numbered production test data for that specific unit, not just a preprinted spec sheet with non-guaranteed, typical data. And our specs, measured with the finest industry recognized test equipment, trace back directly to Government standards.

The **msi 320** delivers performance comparable to the legendary 1450* at a price thousands of dollars less than you would expect to pay. That's because it's based on an original design by Modulation Sciences that maximizes use of advanced integrated circuits and other parts intended for DTV, and minimizes use of expensive custom-engineered components. An easy to use, dual function, knob is the only front panel control on the **msi 320**, and its 2-line, 40-character display is easy to read in any light condition. It has only 8 internal adjustments, so calibration is easy and inexpensive. It also includes a Nyquist SAW filter, selectable line zero-carrier reference, synchronous video detection, continuous all-channel tuning and a host of other advanced features you would expect to find only on much higher-priced demods.

But don't just take our word for it. Check out the specs yourself, and you'll see what a great value the **msi 320** really is.

*1450 is a mark of Tektronix, Inc.

modulation sciences inc.
12A World's Fair Drive Somerset, NJ 08873
Toll Free: (800) 826-2603 Fax: (732) 302-0206
www.modsci.com e-mail: judymueller@worldnet.att.net

Circle (51) on Free Info Card

Transmitters: By the numbers

NTSC Transmitters

Manufacturer	Model	Power range	Band	Efficiency	Amplifier	Cooling method
Acrodyne # 275	TLU	1W-2KW	UHF	33%@2KW	Solid State	Air
Acrodyne # 276	TLV	10W-400W	VHF	8%@400W	Solid State	Air
Acrodyne # 277	TRU	500W-25KW	UHF	61%@25KW	SS/Tet./Diacrode	Air & Water
Acrodyne # 278	TRH/L	500W-30KW	VHF	49%@30KW	SS/Tetrode	Air
ADC Broadcast Systems # 279	Visionary Series	20KW-280KW	UHF	NA	IOT (1-4)	Air/Water
ADC Broadcast Systems # 280	840A	10KW	UHF	NA	Diacrode	Air
ADC Broadcast Systems # 281	100/800 Series	10W-6KW	V/UHF	NA	Solid State	Air
Advanced Broadcast Systems # 282	ABS-TC	20KW-280KW	UHF	43%@220KW/BLK	IOT (1-4)	Air or Water
Comark # 283	Optimum	250W-60KW	VHF	45%@30KW	Solid State	Air or Water
Comark # 284	Ultimate	250W-60KW	UHF	45%@30KW	Solid State	Air or Water
Comark # 285	IOX Series	10KW-300KW	UHF	73%@150KW	IOT (1-6)	Air or Water
DB Elettronica SpA # 286	MTU 1000/S	1KW	VHF	52%@1KW CH4	Solid State	Air
DB Elettronica SpA # 287	MTU 1000/S	1KW	UHF	46%@1KW CH22	Solid State	Air
EMCEE # 288	TTU 4999	5KW	UHF	32%@5KW	Tetrode (1)	Air
Energy-Onix # 289	Eco Line	4KW-50KW	VHF	67%@10KW CH10	Tetrode (1)	Air
Energy-Onix # 290	Eco Line	4KW-50KW	UHF	57%@50KW CH50	Tetrode (2)	Air
Harris # 291	SigmaPLUS	20KW-280KW	UHF	61%@280KW	IOT	Water/glycol
Harris # 282	Platinum HT	1KW-60KW	VHF	49%@60KW	Solid State	Air
Itelco # 283	T-Series	20KW-300KW	UHF	83%@300KW	IOT	Air/Liquid
Itelco # 284	T-Series	400W-60KW	V/UHF	53%@60KW	Solid State	Liquid
LARCAN # 285	HDR	10KW-120KW	UHF	NA	IOT	Air/Water
LARCAN # 286	M Series	1KW-60KW	V/UHF	NA	Solid State	Air
LARCAN # 287	MX & XLS	1W-1KW	V/UHF	NA	Solid State	Air
Rohde & Schwartz # 288	NM500	1KW-20KW	VHF	NA	Solid State	Air
Rohde & Schwartz # 289	NH500	.8KW-40KW	UHF	NA	Solid State	Air
Technosystem # 290	SS/Tube/IOT	1KW-120KW	V/UHF	NA	SS/IOT	Air/Water

DTV Transmitters

Manufacturer	Model	Power range	Band	Pwr Consumption/efficiency	Amplifier	Cooling method
Acrodyne # 291	AuD	250W-4KW	UHF	24KW@4KW Avg.	Solid State	Air
Acrodyne # 292	AuD	4KW	UHF	18KW@4KW Avg.	Diacrode	Air
Acrodyne # 293	AuD	4KW-24KW	UHF	105KW@24KW Avg.	Tetrode	Liquid
Acrodyne # 294	AuD	25KW-100KW	UHF	420KW@100KW Avg.	Diacrode	Liquid
ADC Broadcast Systems # 295	Visionary DT Series	12.5KW-140KW	UHF	NA	IOT (1-4)	Air/Water
ADC Broadcast Systems # 296	DT840A	5KW	UHF	NA	Diacrode	Air
ADC Broadcast Systems # 297	DT800	5W-2KW	UHF	NA	Solid State	Air
Advanced Broadcast Systems # 298	ABS-TC-D Series	40KW-400KW	UHF	Overall eff. 27%@330KW Peak	IOT (1-4)	Air or Water
Comark # 299	Optimum	100W-15KW	VHF	22%@7.5KW@CH10	Solid State	Air or Water
Comark # 300	Ultimate	100W-15KW	UHF	22%@7.5KW@CH22	Solid State	Air or Water
Comark # 301	DCX Series	10KW-100KW	UHF	28%@50KW@CH22	IOT (1-4)	Air or Water
Comark # 302	Advantage	10KW-100KW	UHF	28%@50KW@CH22	IOT (1-4)	Air or Water
EMCEE # 303	TTU2500HD	2.5KW Pk	UHF	16%@2.5KW	Tetrode	Air
Harris # 304	Diamond	5KW-100KW	UHF	125KW@100KW Pk	Solid State	Air
Harris # 305	Sigma CD	40KW-400KW	UHF	93KW@100KW Pk	IOT	Water/glycol
Harris # 306	Platinum CD	1KW-60KW	VHF	24KW@10KW Pk	Solid State	Air
Itelco # 307	T-Series	10KW-75KW	UHF	32%@75KW@CH50	IOT	Air/Liquid
Itelco # 308	T-Series	450W-100KW	V/UHF	52%@30KW@CH10	Solid State	Air/Liquid
LARCAN # 309	LANDMARK	100W-100KW	UHF	NA	SS/IOT	Air/Water
LARCAN # 310	Digital M	1KW-10KW	VHF	NA	Solid State	Air
NEC America #311	DTV-20	250W-9KW	VHF	28KW @ 5KW AVG or 20KWPK	Solid State	Air or Water
NEC America #312	DTU-10	250W-9KW	UHF	38KW@5KW AVG or 20KWPK	Solid State	Air or Water
Rohde & Schwartz #313	NV500	.25Kw-4KW	UHF	NA	Solid State	Air
Technosystem #314	SS/Tube/IOT	250W-30KW	V/UHF	NA	SS/IOT	Air/Water

Tables summarize information provided by vendors. Note that efficiency and power consumption are extremely controversial factors. Be sure you understand how the efficiency of a transmitter is measured and that you're comparing equal conditions between products. Use the reader response number after the manufacturer name to receive detailed information on transmitter lines.

WIRELESS FOR THE YEAR 2000... AND BEYOND!

It's a tough RF world out there – and it's getting tougher. Fewer open TV channels. More wireless everywhere. And advanced digital television will soon be coming to a city near you.

Vega's EMP (Embedded Micro-Processor) Series takes these challenges in stride, while giving you the Emmy award winning audio quality you've come to expect from Vega.

EMP technology in the transmitters offers "intelligent" frequency agility and audio control, allowing you to reprogram UHF frequencies as often as needed, along with precise digital control of mic gain.

The receiver's embedded microprocessor is intelligent enough to shut itself off when it's not needed, removing any possibility of digital interference with itself or other units.

Of course, the EMP Series also has all the performance, features and reliability needed for the toughest applications.

Vega's EMP Series – specifically designed to meet the challenges of the year 2000 and the coming century.

For more information on the EMP Series, see your Vega dealer or call us at 1-800-877-1771.

Vega Wireless Technology, named winner of the 1996 Emmy for Pioneering Achievement in the Development of Wireless Microphone Technology for Broadcast.*

© NATAS/ATAS

EMP SERIES

VEGA

SYNTHESIZED UHF WIRELESS

MAKING HISTORY BY DEFINING THE FUTURE.

Circle (52) on Free Info Card

VEGA
9900 East Baldwin Place
El Monte, CA 91731
(800) 877-1771
(626) 442-0782

High-speed DVCPRO nonlinear editing system

Panasonic Quickcutter: transfer video editing workstation that incorporates editing software that simplifies story editing for many types of programs; the built-in DVCPRO recorder/player in its tower system can transfer at 4X speed for nonlinear editing; the built-in hard disk can store approximately 70 minutes of images and sound; optional external SCSI arrays bring total digital video storage to more than three hours; 800-528-8601; fax 323-436-3660; www.panasonic.com/PBDS

Circle (250) on Free Info Card

DV/1394 Interface option

Pinnacle RealTime interface option: allows RealTime and RealTime NITRO users to move between DV and analog file formats; allows video editors to incorporate source material from most analog or digital sources and to output to most digital analog devices; 650-526-1600; fax 650-526-1601; www.pinnaclesys.com

Circle (251) on Free Info Card

MPEG-2 dual encoder

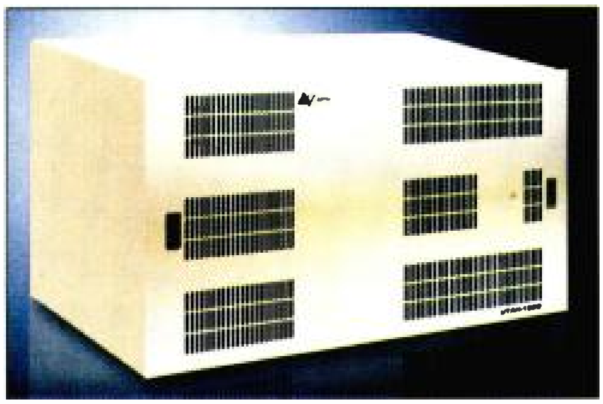
Lucent Digital Video EVA-200: delivers complete video and audio encoding for two programs on one compact circuit card; the unit is a two-channel SD encoding system using MPEG-2 MP@ML (4:2:0) up to 480x720x29.97Hz or which can be configured for PP@ML (4:2:2); 407-662-7254; fax 908-582-3662; www.lucent.com

Circle (253) on Free Info Card

Enhanced video router and Mini Master Control

Artel Video Systems UTAH 1500: HDTV router to be used in conjunction with HDTV Mini Master Control, providing broadcasters and post-production houses a migration path from analog to digital broadcasting; fully scalable 32x32 video routing switcher that allows users to start with a 4x4 system and add ports as required; with Mini Master Control, can be used simultaneously as an HDTV house router, as well as for master control for on-air broadcast; 508-303-8200; fax 508-303-8197; www.artel.com.

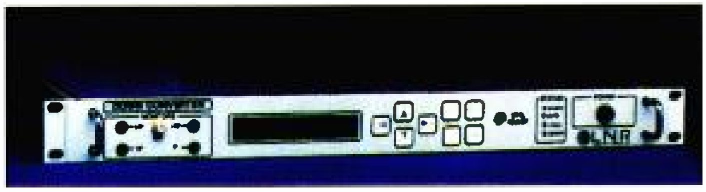
Circle (255) on Free Info Card



DTV study software

EDX Engineering Inc. TVSR version 4.0: for Windows 95/98/NT, performs complete DTV coverage and interference studies in compliance with FCC Bulletin OET-69, as well as LPTV-DTV, translator-DTV and traditional TV spacing and interference contour studies; features familiar GUI, multitasking with other Windows applications, use of Windows printer drivers, meaningful toolbars and clipboard support; 541-345-0019; fax 541-345-8145; www.edx.com.

Circle (252) on Free Info Card



Dual-band downconverter

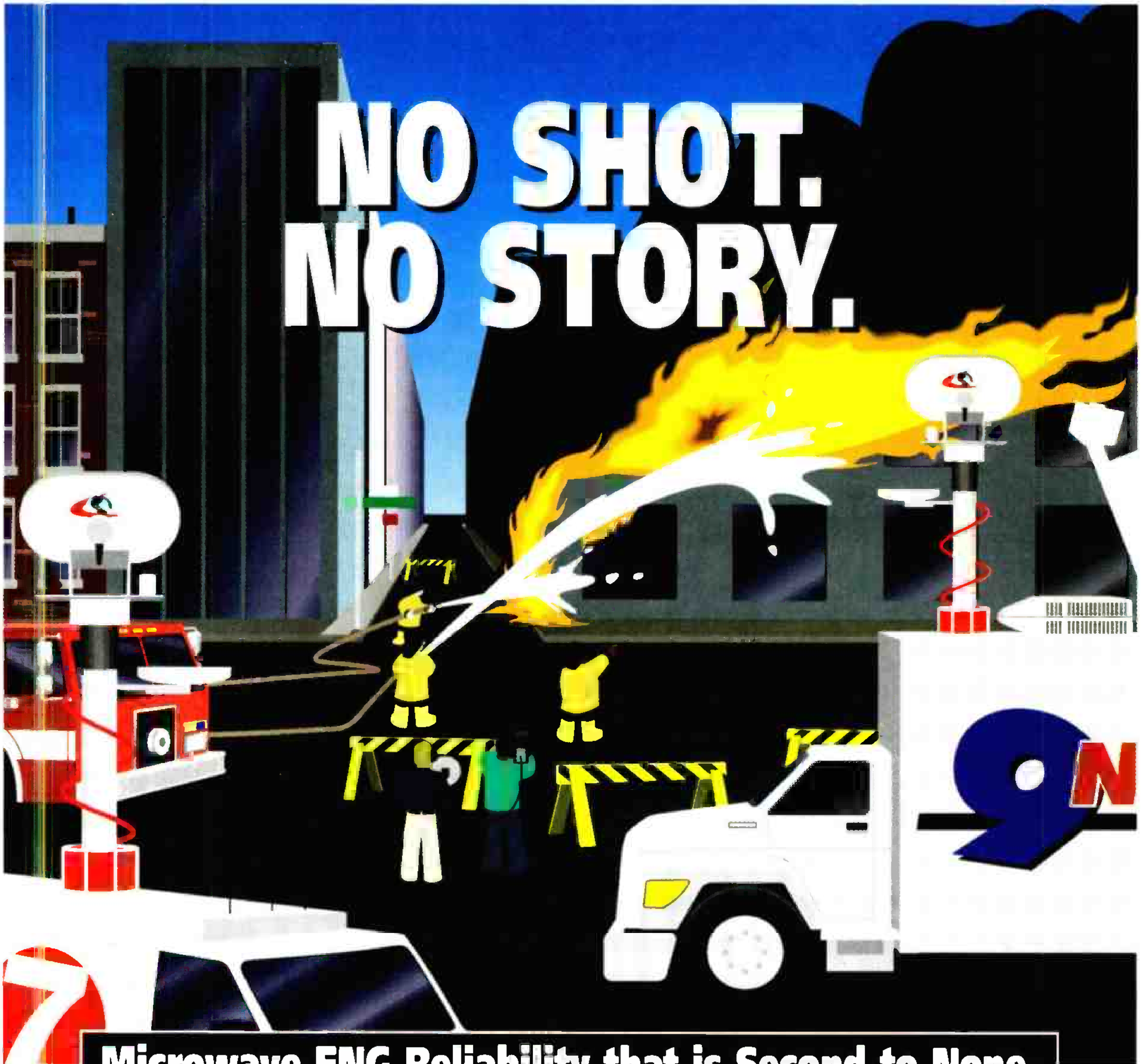
LNR Communications Model DC4/11M-D6: C- and Ku-band satellite downconverter, in a single-rack unit chassis; permits users to select any frequency in either C- or Ku-band, frequencies are selectable in 1KHz steps; designed for critical monitoring and intercept stations where space is needed; the downconverter is an outgrowth of LNR's M-series C- or Ku-band converters; 516-273-7111; fax 516-761-5454; www.lnr.com.

Circle (254) on Free Info Card

Compact disc player for multiple uses

Tascam Professional Division CD-450: designed for the recording studios, sound contractors, broadcast facility or disc jockey, features auto-cue and auto-ready functions, call and end-of-message (EOM) functions, fader and event-start capability, incremental play, numeric keys for easy programming, and connectors needed to interface with other equipment; 213-726-0303; fax 213-727-7635; www.tascam.com.

Circle (256) on Free Info Card


NO SHOT.
NO STORY.

Universal DTV format converter

Panasonic Broadcast & Digital AJ-UFC1800: converts essentially any video format to any other format, making it possible to convert TV signals between all video formats recognized under the ATSC-DTV standard; can adjust picture aspect ratios with pan-and-scan functions; can insert or remove 3:2 pull-down film conversion and can be programmed to convert other scanning formats; supports multiple frame rates, including 60-, 50-, 30- and 24Hz; 323-436-3500; fax 323-436-3660; www.panasonic.com/PBDS

Circle (257) on Free Info Card

High-resolution projector for large-screen applications

Digital Projection *POWER* 7gv: large-screen presentation, entertainment and multimedia projection system engineered to project a brighter, sharper video and graphics in large-venue applications; based on three-chip digital light processing (DLP) technology, uses 1024x768 digital micro-mirror devices (DMD) and achieves 6500 ANSI lumens with optimal color and clarity; 770-420-1350; fax 770-420-1360.

Circle (260) on Free Info Card

Battery charging system

Cool-Lux Delta Force: for NiCd and NiMH cells; includes a computing micro controller monitoring the battery's voltage current and other variables; features long battery life, auto shutoff of charge when detecting a defective cell, complete charge; batteries are field-ready 24 hours a day; 805-482-4820; fax 805-482-0736; www.cool-lux.com.

Circle (258) on Free Info Card

24P mastering studio recorder

Panasonic D-5 mastering VTR: switchable between 1080i and 1080p; records and plays at various frame rates, including 60i, 50i, 24p and 30p; HD serial input at 1.5Gb/s is standard, and an SDTI input is available; incorporates metadata recording/playback capability and offers optional compressed multichannel audio (Dolby-E); offers a 74.25Mhz sampling rate and 10-bit, 4:2:2 signal processing; 323-436-3500; fax 323-436-3660; www.panasonic.com/PBDS

Circle (259) on Free Info Card

Now Shipping

Digital audio recording system

Sony Electronics DARS-AME Tape: high-quality audio tape for eight-track, digital tape recording systems provides durability and keeps head wear to a minimum; provides good match for DTRS eight-channel equipment like Sony's PCM-800 model; available in 60- and 120-minute formats; 800-635-7669; www.sony.com.

Circle (269) on Free Info Card

HD master control and HD production switcher

Tektronix Grass Valley M-2100 HD master control and 110-HD production switcher: units enable HD digital picture quality in a widescreen format and allow a choice of HDTV software configuration formats from the same unit without requiring modification; switchable between 720p and 1080i; both run at either 59.94- or 60Hz; 800-547-8949; fax 800-547-8949; www.tektronix.com/VND.

Circle (270) on Free Info Card

Storage drives for post-production

Avid iS Plus Series: new line of storage devices for the post-production marketplace; incorporates 10K rpm drive technology; available in 9GB and 18GB capacities that work in conjunction with Avid MediaDock removable storage system; designed for use with Avid's Media Composer nonlinear editing system and Digidesign ProTools audio editing system; features a 40% increase in data transfer rates and overall performance; 978-640-6789; fax 978-851-0418; www.avid.com.

Circle (271) on Free Info Card

Management and stillstore solution

Pinnacle Systems Lightning Software 3.2 and Lightning 500: 3.2 software features new transitions including pushes up, down, left or right, plus slides up, down, left or right; options include a titling features that allows Lightning family products to integrate with PostDeko character generation application, allowing titles to be altered or deleted at any time; Lightning 500 is the second member of the Pinnacle's Lightning family of advanced image store solutions; 650-526-1600; fax 650-526-1601; www.pinnaclesys.com.

Circle (272) on Free Info Card

Circle (45) on Free Info Card

Circle (46) on Free Info Card

3D video effects system

Pinnacle Systems AlladinPro: a high-quality single- or dual-channel 3D video effects system; complements Digital-S, DVCPRO and DV formats; WindowsNT-based open system is BroadNeT compliant; studio tools option adds a character generator and a paint system; 650-526-1600; fax 650-526-1601; www.pinnaclesys.com

Circle (261) on Free Info Card

Network capabilities added to management system

Gentner Communications Corporation Version 1.9 and Network Module: new software for Remote Facilities Management (RFM) system used to monitor and control mission critical operations; enables users to access the GSC3000 RFM system through wide area networks and corporate intranets; features include increased programmability, prioritization of alarms and alarm enhancements; 801-975-7200; 801-977-0087; www.gentner.com.

Circle (263) on Free Info Card

Nonlinear finishing systems software

Scitex Digital Video SPORT: software for the Sphere family of nonlinear finishing systems; designed for broadcasters, the software facilitates recording and management of multiple feeds and provides for fast creation of news and sports highlight packages; can be used with stand-alone or networked Sphere systems; now standard on all VideoSphere systems; optional for StrataSphere and DigiSphere; 888-846-7017; fax 650-369-4777; www.scitex.com

Circle (262) on Free Info Card

Operating system for automation systems

Philips QNX OS: a modular, highly scaleable unit built around a small pre-emptable kernel; includes real-time characteristics such as fast boot-up and low-interrupt latencies; device and network drivers can be stopped or started anytime; the system will continue to run even if there is a problem in one module; supports many networking protocols and provides transparent access to any process, device or file on the network; provides extensive development, debugging and GUI-building tool sets; 800-962-4287; fax 801-972-0837; www.news.philips.com

Circle (264) on Free Info Card

Single-format routers

Network ProXL 32x32: 19-inch, 3RU routers with a 4-inch depth; the digital video, VD3232, comes with 540Mb/s; the analog video, V3232, with 125MHz bandwidth and the stereo balanced audio router, A3232, has a 100kHz bandwidth; all feature new, easy-to-operate 32-CrossSoft PC software; +47 33 48 99 99; fax +47 33 48 99 98; www.network-electronics.no

Circle (265) on Free Info Card

Digital audio cable

Gepco International Inc. 552608GFC: thin-profile, eight-pair digital audio AES/EBU snake cable; intended for cable assemblies with multi-pin connectors, studio and rack interconnect, or medium-length permanent installation runs; well suited for terminating to the high-density multi-pin connectors that are found on many of the new digital audio consoles, multitrack recorders and routers; 312-733-9555; fax 800-966-0069; www.gepco.com.

Circle (267) on Free Info Card

Advanced digital tape

Sony SXA and DVCAM master tapes: the SXA is designed to optimize the performance of Betacam SX VTRs and camcorders for broadcast users, and has a strengthened metal binder system; the DVCAM Master features a diamond-like coating (DLC) layer on the tape surface ensuring high durability; incorporates a 16kb IC chip for holding index addresses and other shooting data; 800-635-SONY; fax 201-358-4058; www.sony.com

Circle (266) on Free Info Card

Pan-and-tilt system

Panasonic AW-PH300: features a "soft-landing" mechanism that ensures smooth starts and stops with accurate positioning; the mechanism has a noise level of less than NC30 and gives a pan range of 300° at maximum speed of 25°/s and a tilt range of 190° at 20°/s; can be ceiling mounted or inverted for table or tripod support; takes a maximum camera and lens weight of 4kg, which is matched to Panasonic's AW-E560 digital camera; the AW-RP301 controls one AW-PH300 head; the AW-RP501 hybrid control panel adds camera control functions for an integrated system when used in conjunction with the AW-E560 camera; 800-528-8601; fax 323-436-3660; www.panasonic.com/PBDS

Circle (268) on Free Info Card

QUICK DIAL 74

SONY

DSR-200A

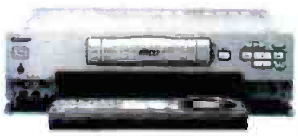
3-CCD Digital (DVCAM) Camcorder

Combining a compact and lightweight body with the superior picture quality of DSP (Digital Signal Processing) and the DVCAM format, the DSR-200A is the ideal acquisition tool for video journalists, event and wedding videographers, stringers and production houses. 500 lines of horizontal resolution, 48kHz or 32kHz digital audio, three hour record time, and minimum illumination of 3 lux is only the beginning. Other features include 16:9/4:3 capability, Steady Shot, high resolution 1-inch viewfinder, time code operation, time/date superimposition and an IEEE-1394 interface for direct digital output. Offers full automatic as well as manual control of focus, iris, gain, white balance and shutter speed.

- Variable servo 10X optical power zoom lens goes from 5.9 to 59mm in 1.7 to 24 seconds. The manual zoom rocker is continuously variable right up to where the digital 20X zoom kicks in.
- Sony's Super Steady Shot reduces high frequency camera shake without compromising image quality. SteadyShot uses horizontal and vertical motion sensors that allow it to work accurately while zooming, moving (even shooting from a car), and shooting in low light conditions.
- Has digital effects including audio and video fade, overlap and Slow Shutter.
- Automatic and manual focus. Iris, shutter, gain and white balance. Iris is adjustable in 12 levels from F1.6 to F11, shutter from 1/4 to 1/10,000 of a second in 12 steps. Gain from -3dB to +18dB in 8 steps.
- Zebra Pattern Indicator, built-in ND filter.
- Custom Preset function lets you preset, store and recall custom settings for color intensity, white balance (bluish or reddish), sharpness and brightness.
- Stores Photo, Date/Time, Shutter Speed, Iris, Gain and F-stop for easy recall. So if you have to re-shoot, you know your original settings for every scene and frame.
- Records Drop/Non-Drop Frame time code. Time code can be read either as RC time code or as SMPTE time code.
- Has a large 1-inch B&W viewfinder with 550 lines of resolution for easy focusing even in low contrast lighting situations. Separate information sub panel displays time code, battery time, tape remaining and other camcorder functions without cluttering up the viewfinder.
- Records 16-bit/48kHz audio on one stereo track or 12-bit/32kHz with two pairs of stereo tracks (L1/R 1, L2/R2), so you can add stereo music or narration.
- One-point stereo electret condenser mic for clear stereo separation. Directivity can be selected from 0°, 90° & 120°.
- Automatic & manual (20-step) audio level record controls. Monitor audio with headphones or from the LCD panel which has an active VU meter.
- XLR input connectors for mics and audio equipment.

DSR-200A Field Package:
- DSR-200A Camcorder • NPA-1000/B Battery Case Adapter
- 3 NP-F930/B 7.2v 4000 mAH Batteries
- AC-V900/B AC Adapter, Triple Battery Charger
- VCT-U14 Tripod Adapter • LC-2000CP System Case

DSR-30 DVCAM Digital VCR



The DSR-30 is an industrial grade DVCAM VCR that can be used for recording, playback and editing. DV standard 4:1:1 sampling digital component recording with a 5:1 compression ratio provides spectacular picture quality and multi-generation performance. It has a Control L interface for editing with other Control L based recorders such as the DSR-200A DVCAM Camcorder or another DSR-30. It also has a continuous auto repeat playback function making it ideal for kiosks and other point of information displays. Other features include high quality digital audio, IEEE-1394 Digital interface and external timer recording. The DSR-30 can accept both Mini and Standard DVCAM cassettes for up to 184 minutes of recording time, and can playback consumer DV tapes as well.

- Records PCM digital audio at either 48kHz (16-bit 2 channel) or a 32kHz (12-bit 4 channel).
- Equipped with Control L, the DSR-30 is capable of SMPTE Time Code based accurate editing even without an edit controller. Built in editing functions include assemble and separate video and audio insert.
- By searching for either an index point or Photo Data recorded by the DSR-200A camcorder, the DSR-30 drastically cuts the time usually required for editing. The DSR-30 can record up to 135 index points on the Cassette Memory thanks to its 16K bits capability.
- Audio lock ensures audio is fully synchronized with the video for absolute precision when doing an insert edit.
- Built-in control tray has a jog/shuttle dial, VCR and edit function buttons. The jog/shuttle dial allows picture search at ±1/5 to 15X normal speed and controls not only the DSR-30 but also a player hooked up through its LANC Interface.
- DV In/Out (IEEE 1394) for digital dubbing of video, audio and data ID with no loss in quality.
- Analog audio and video input/outputs make it fully compatible with non-digital equipment. Playback compatibility with consumer DV tapes allows you to work with footage recorded on consumer-grade equipment. Tapes recorded in the DSR-30 are also compatible with Sony's high-end DVCAM VCR's.

PVM-14N1U/14N2U & 20N1U/20N2U

13-inch and 19-inch Presentation Monitors

With high quality performance and flexibility, Sony's presentation monitors are ideal for any environment. They use Sony's legendary Trinitron CRT and Beam Current Feedback Circuit for high resolution of 500 lines as well as stable color reproduction. They also accept worldwide video signals, have a built-in speaker and are rack mountable. The PVM-14N1U/20N1U are designed for simple picture viewing, the PVM-14N2U and 20N2U add RGB input and switchable aspect ratio.

They Feature:
- 500 lines of horizontal resolution
- They handle NTSC, NTSC 4.43, PAL, and SECAM
- Picture (chrome, phase, contrast, brightness) and setup adjustments (volume, aspect ratio) are displayed as easy-to-read on screen menus.
- Closed captioning is available with the optional BKM-104 Caption Vision Board.

PVM-14N2U/20N2U Only:
- (Last Input Switch) - Contact closure remote control allows you to wire a remote to an existing system so that the monitor's input can be remotely controlled to switch between the last previously selected input and the current input.
- 4:3/ 16:9 switchable aspect ratio

PVM-14M2U/14M4U & 20M2U/20M4U

13-inch and 19-inch Production Monitors

Sony's best production monitors ever, the PVM-M Series provide stunning picture quality, ease of use and a range of optional functions. They are identical except that the "M4" models incorporate Sony's state-of-the-art **HR Trinitron** CRT display technology and have SMPTE C phosphours instead of P22

- HR Trinitron CRT enables the PVM-14M4U and 20M4U to display an incredible 800 lines of horizontal resolution. The PVM-14M2U and 20M2U offer 600 lines of resolution. M4 models also use SMPTE C phosphours for the most critical evaluation of any color subject.
- Dark tint for a higher contrast ratio (black to white) and crisper, sharper looking edges.
- Each has two composite, S-Video and component input (R-Y/B-Y analog RGB).For more accurate color reproduction, the component level can be adjusted according to the input system. Optional BKM-101C (video) and BKM-102 (audio) for SMPTE 259M serial digital input
- Beam Current Feedback Circuit
- 4:3/16:9 switchable aspect ratio
- True multi-system monitors they handle four color system signals: NTSC, NTSC 4.43, PAL, and SECAM.
- External sync input and outputcan be set so that it will automatically switch according to the input selected.
- Switchable color temp: 6500K (broadcast), 9300K (pleasing picture). User preset (3200K to 10000K).
- Blue gun, underscan and H/V delay capability
- On-screen menus for monitor adjustment/operation.
- Parallel remote control and Tally via 20-pin connector.

QUICK DIAL 72

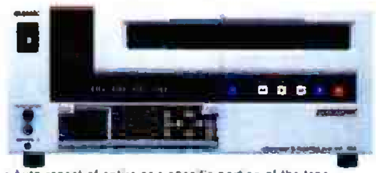
SONY UVW-100B

More affordable than ever, the UVW-100B offers 700 lines of horizontal resolution, 60dB S/N ratio, 26-pin VTR interface, compact design and ease of operation– making it ideal for field shooting applications.

- Three 1/2-inch IT Power HAD CCDs with 380,000 pixels attain sensitivity of F11 at 2000 lux (low light is 4 lux), S/N ratio of 60dB and 700 lines of resolution.
- Gain-up can be preset in 1dB steps from 1dB to 18dB.
- Auto Iris detects the lighting conditions and adjusts for the proper exposure.
- Clear Scan records computer monitors without horizontal bands across the screen. Shutter speed can be set from 60.4 to 200.3 Hz in 183 steps. Also has a variable high speed shutter from 1/100 to 1/2000 of a second.
- SMPTE LTC time code and UB generator/reader. Rec Run/Free Run, Preset/Regen are easily set. For multi-camera operation, genlock to an external time code is provided.
- Genlock input and built-in color bar generator.
- 26-pin VTR interface for feeding component, composite and S-Video signals to another VTR for simultaneous recording. Start/stop are controlled and external VTR status such as Rec and Tally are shown in the viewfinder.
- Diecast aluminum, 1.5-inch DXF-601 viewfinder is rugged yet comfortable while providing 600 lines of resolution.
- Large diameter eye cup reduces eye strain and simplifies focusing. Diopter adjustments (-3 to 0) compensates for differences in eye sight.
- Zebra level indicators, safety zone and center marker generator. Shows tape remaining and audio levels.
- 8-digit LCD display indicates time data, warning indications and video status. Battery status audio level are also shown in a bar graph meter.
- With Anton/Bauer Digital Batteries remaining battery power is displayed on the LCD panel and through the viewfinder.
- Weighs 15lb. with viewfinder, battery, tape and lens. Shoulder pad is adjustable, so you maintain optimum balance when using different lenses and batteries.

UVW-1200/UVW-1400A

Betacam SP Player • Player/Recorder



The UVW-1200 and UVW-1400A are non-editing VCRs which deliver Betacam SP quality and offer features for a wide range of playback and recording applications. RGB and RS-232 interface make them especially ideal for large screen, high quality video presentation, scientific research and digital video environments.

- Ideally suited for work in computer environments, because RGB signals can be converted into component signals and vice versa with minimum picture degradation.
- 25-pin serial interface allows external computer control of all VCR functions based on time code information. Baud rate can be selected from between 1200 to 38,400 bps.
- Built-in Time Base Stabilizer (TBS) locks sync and subcarrier to an external reference signal as well as providing stable pictures. High quality digital dropout compensator further ensures consistent picture performance.
- Equipped with two longitudinal audio channels.
- Both read LTC Time Code) and UB (User Bits). The UVW-1400A also generates LTC and UB (Free-Run/Rec-Run).
- Built-in character generator can display VTR status, time code, self-diagnostic messages, set-up menu, etc.
- Auto repeat of entire or a specific portion of the tape.
- Control of jog, shuttle, playback, record, pause, FF and REW with the optional SVRM-100A Remote Control Unit.
- Composite and S-Video as well as component via BNCs which are switchable to RGB output. The UVW-1400A has two switchable sync connectors and a Sync on Green.
- Built-in diagnostic function and hour meter.
- Initial set-up menu for presetting operational parameters. Settings are retained even after power is turned off.

UVW-1600/UVW-1800

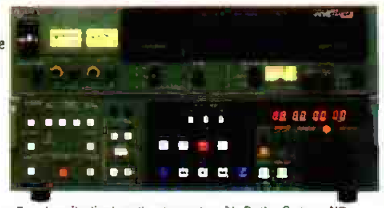
Betacam SP Editing Player • Betacam SP Editing Recorder

The UVW-1600 and UVW-1800 are the other half of the UVW series. They offer the superiority of Betacam SP with sophisticated editing features. They feature an RS-422 9-pin interface, built-in TBCs and Time Code operation. Inputs/outputs include component, composite and S-Video. **All the features of the UVW-1200/1400A *PLUS*—**

- Optional BVR-50 allows remote TBC adjustment.
- RS-422 interface for editing system expansion.
- Two types of component output: via three BNC connectors or a Betacam 12-pin dub connector.
- Frame accurate editing is assured, thanks to sophisticated servo control and built-in time code operation. In the insert mode of the UVW-1800, video, audio Ch-1/2 and time code can be inserted independently or in any combination.

PVW-2600/PVW-2650/PVW-2800

BETACAM SP 2000 PRO SERIES



Whenever versatility and no compromise performance is needed, there is only one choice. Legendary reliability and comprehensive support for its many users has established the PVW series as the standard in broadcast and post production. The PVW Series includes the PVW-2600 Player, PVW-2650 Player with Dynamic Tracking and the PVW-2800 Editing Recorder. They feature built-in TBCs, LTC/VITC time code operation and RS-422 serial interface. They also offer composite, S-Video and component video inputs and outputs. Most important they are built for heavy, every day duty.

- Built-in TBC's and digital dropout compensation assure consistent picture performance. Remote TBC adjustment can be done using the optional BVR-50 TBC Remote Control.
- The PVW-2600, PVW-2650 and PVW-2800 (generates as well) read VITC/ LTC time code as well as User Bits. Ext/Int time code, Regen/Preset, or Rec-Run/ Free-Run selections
- Built-in character generator displays time code or CTL data
- Set-up menu for presetting many functional parameters
- Two longitudinal audio channels with Dolby C- type NR.
- Recognizable monochrome pictures at up to 24X normal speed in forward and reverse. Color at speeds up to 10X
- Two types of component connection; three BNC connectors or a Betacam 12-pin dub connector. They have composite and S-Video signals as well

PVW-2650 Only
- Dynamic Tracking (DT) playback from -1 to +3 times normal speed.

PVW-2800 Only
- Built-in comprehensive editing facilities.
- Dynamic Motion Control with memory provides slow motion editing capability.

UHF WIRELESS MICROPHONE SYSTEMS

Consisting of 5 handheld and bodypack transmitters and 6 different receivers, Sony's UHF is recognized as the outstanding wireless mic system for professional applications. Operating in the 800 MHz band range, they are barely affected by external noise and interference. They incorporate a PLL (Phase Locked Loop) synthesized control system that makes it easy to choose from up to 282 operating frequencies, and with the use of Sony's pre-programmed channel plan, it is simple to choose the correct operating frequencies for simultaneous multi-channel operation. Additional features, like space diversity reception, LCD Indicators, reliable and sophisticated circuit technology ensure low noise, wide dynamic range, and extremely stable signal transmission and reception. Ideal for broadcasting stations, film production facilities, and ENG work.

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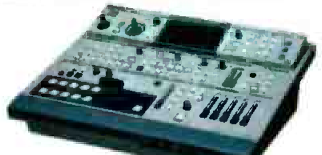
Panasonic WJ-MX50 Digital A/V Mixer

QUICK DIAL 74



- Four input switcher and any two sources can be routed to the program busses. • Two-channel digital frame synchronization permits special effects in each A/B bus
- Combination of 7 basic patterns and other effects creates 287 wipe patterns. • External edit control input for RS-232 or RS-422 serial controls. Also has GPI input.
- Wipe boundary effects: soft/border (bold, eight background colors available). • Digital effects:strobe, still, mosaic, negative/ positive, paint, B&W, strobe, trail, and AV synchro.
- Real-Time compression - entire source image is compressed inside a wipe pattern.
- Fade-in and fade-out video, audio, titles individually or synchronously faded .• Down stream keyer with selectable sources from character generator or external camera.
- "Scene Grabber" moves a pattern while upholding the initially trimmed-in picture integrity.
- Eight separate memories enable instant recall of frequently used effects. • 8 preset effects including: Mosaic Mix, Position Stream, Corkscrew, Bounce, Flip, Shutter, Vibrate, and Satellite .• Audio mixing capability of 5 sources with 5 audio level adjustments.

Canon IF+ Series Zoom Lenses

Canon's IF+ family of lenses are engineered to meet the needs of the next generation of broadcasting while meeting the standards of today. Besides having the widest wide angle lens available, the IF+ lens series have wider angles at shorter M.O.D. (Minimum Object Distance), provide higher MTF performance and incorporate Hi-UD glass for reduced chromatic aberration. In addition to superb optics they're all designed with Canon's "Ergonomic Grip" for fatigue-free shooting over an extended time. IF+ lenses are your assurance of unsurpassed quality and performance for today and tomorrow.

J15ax8B

A next generation internal focusing lens with the shortest MOD and widest angle of any standard lens, the J15aX8B IRS/IAS is a standard ENG lens that lets you shoot in tight or restricted areas at the closest mimimum object distance ever possible and capture more of the subject. It incorporates all the great features of IF+lenses including a built-in 2X extender, high MTF performance, HI-UD glass, square lens hood and Canon's "Ergonomic Grip".

J20ax8B IRS/IAS

Excellent for ENG, sports and production, the J20aX8B IRS/IAS lets you squeeze in shots from 8mm and still take you all the way out to 320mm with its built-in extender. Incorporates all IF+ features, plus is the only lens (besides the J9aX5.2B IRS/IAS) with aVari-Polar lens hood, enabling rotation of attached filters.

GLIDECAM INDUSTRIES V-16 AND V-20 Camera Stabilization Systems

The V-16 and V-20 allow you to walk, run, go up and down stairs, shoot from moving vehicles and travel over uneven terrain without any camera instability or shake. The V-16 stabilizes cameras weighing from 10 to 20 pounds and the V-20 from 15 to 26 pounds. They are both perfect for shooting the type of ultra-smooth tracking shots that take your audience's and client's breath away– instantly adding high production value to every scene. Whether you are shooting commercials, industrials, documentaries, music videos, news, or full length motion pictures, the Glidecam "V" series will take you where few others have traveled.

sachtler CADDY systems

QUICK DIAL 74

Sachtler quality is available to low budget users. The price of a CADDY system includes the 7-step dampened CADDY fluid head, ultra-light but rugged carbon fiber tripod, lightweight spreader and either a soft bag or cover. The CADDY fluid head features an adjustable pan arm, 7-step adjustment for quick counter balance and the self-locking Sachtler Touch and Go System.

CAD 01 Single-Stage ENG Carbon Fiber System:
- CADDY Fluid Head • ENG Single-Stage Carbon Fiber Tripod
- SP 100 Lightweight Spreader • Transport Cover 100

CAD 2A 2-Stage ENG Carbon Fiber System:
- CADDY Fluid Head • ENG 2-Stage Carbon Fiber Tripod
- SP 100 Lightweight Spreader • Soft padded ENG Bag

MILLER Fluid Heads and Tripods

Miller 20 -Series II Fluid Head

- Dynamic fluid drag control
- Sliding/quick release camera platform
- Weighs 4 lbs – handles up to 22 lbs.
- Counterbalance system compensates for nose heavy or tail heavy camera configurations and permits fingertip control of the camera throughout the tilt range.
- Includes independent pan and tilt locks, bubble level, dual pan handle carriers and integrated 75mm ball levelling.

Miller 25-Series II Fluid Head

- 100mm ball level fluid head • Robust, lightweight, low profile design
- Quick release camera platform • Weighs 7lbs.–handles up to 25 lbs
- Multi-step fluid drag system and integrated counterbalance system provide ultra-smooth, repeatable pan-and-tilt fluid control and finger-tip camera balance for ENG camcorders, industrial CCD cameras or small studio cameras

#601-Lightweight Tripod

- Weighs 4.5 lbs., supports up to 30 lbs.
- Minimum height down to 24", maximum height to 57"
- Folds down to 33". • Engineered from thermoplastic moldings, diecast alloy and hard anodized tubular alloy.
- Fast, one turn, captive leg locks
- Includes 75mm (3") ball levelling bowl

#649-2-Stage Tripod

- Two extension sections on each leg. Operates at low levels as well as normal heights without the use of mini legs
- High torsional rigidity, no pan backlash
- Weighs 6.6lbs., supports 50 lbs. • Very portable, folds to 27"
- Includes 75mm (3") ball levelling bowl

System 20 #339—Miller 20 Head, 601 Lightweight Tripod, On Ground Spreader
System 20 ENG #339—Miller 20 Head, 649 2-Stage Aluminum, On Ground Spreader
System 25 #500—Miller 25 Head, 611 Lightweight Tripod, On Ground Spreader
System 25 ENG #502—Miller 25 Head, 641 2-Stage Aluminum, On Ground Spreader

Vinten PRO-130 SYSTEMS

The Pro-130 tripod systems are perfect for today's on the move ENG cameramen. Lightweight, these systems have been specifically designed to provide a wider balance range to suit the latest DV, DVCPRO, DVCAM camcorder and camera/recorder combinations. All systems come complete with the PH-130 fluid pan & tilt head, choice of single or 2-stage ENG tripod, floor spreader and soft carrying case for easy transportation.
The PH-130 pan & tilt head incorporates Vinten's continuously variable LF drag system to provide smooth movement and easy transition into whip pan, together with a factory set balancing mechanism. Both the single-stage and two-stage legs are toggle clamp tripods are made from strong, durable aluminum with excellent height range capabilities.

VISION 8 AND 11 Lightweight Heads For the Future

Superbly engineered and designed for use in professional broadcast, educational and corporate productions, the Vision 8 and Vision 11 simultaneously provide the ultimate in lightweight support with exceptional robustness— even in the toughest shooting conditions.

Vision 8 Pan & Tilt Head

The incredibly lightweight Vision 8 provides smooth shots, whip pan action and quick set-up while supporting up to 23 lbs. Add the single-stage carbon fiber tripod and you have the lightest combination possible for that all important event— without sacrificing the reliability and robustness that you require.
- Simple external adjustment for perfect balance over the full 180° of tilt
- Infinitely variable drag with proven LF technology
- Calibrated drag knobs
- Flick on/flick off Pan and Tilt brakes
- Single rotation counterbalance
- Leveling bubble standard
- Standard 100mm leveling ball • Lightweight, only 5.9 lbs.

Vision 11 Pan & Tilt Head

Slightly heavier the Vision 11 offers additional capacity (up to 29 lbs.) plus it has illuminated controls to allow fast camera balancing and leveling even in poor lighting. Combine with a two-stage carbon fiber or aluminum tripod and you have a package with the biggest height adjustment yet the smallest to carry. Ideal for all ENG assignments.
- Simple external adjustment for perfect balance over the full 180° of tilt
- Infinitely variable drag with proven LF technology
- Back-lit and calibrated drag knobs
- Flick on/flick off Pan and Tilt brakes
- Digital counterbalance readout
- Illuminated leveling bubble • Standard 100mm leveling ball
- High load to weight ratio • Lightweight — only 6.2 lbs.

anton bauer

DIGITAL PRO PACS

The ultimate professional video battery and recommended for all applications. The premium heavy duty Digital Pro Pac cell is designed to deliver long life and high performance even under high current loads and adverse conditions. It's size and weight creates perfect shoulder balance with all camcorders.
- **DIGITAL PRO PAC 14 LOGIC SERIES NICAD BATTERY** 14.4v 60 Watt Hours, 5 1/8 lbs. Run time: 2 hours @ 27 watts, 3 hrs. @ 18 watts
- **DIGITAL PRO PAC 13 LOGIC SERIES NICAD BATTERY** 13.2v 55 Watt Hours, 4 3/4 lbs. Run time: 2 hours @ 25 watts, 3 hours @ 17 watts

DIGITAL TRIMPAC

Extremely small and light weight, the Digital Trimpac still has more effective energy than two NP style slide-in batteries. High voltage design and Logic Series technology eliminate the problems that cripple conventional 12 volt slide-in type batteries. The professional choice for applications drawing less than 24 watts.
- **DIGITAL TRIMPAC 14 LOGIC SERIES NICAD BATTERY** 14.4 v 43 Watt Hours, 2 3/4 lbs. Run time: 2 hours @ 20 watts, 3 hours @ 13 watts.

HyTRON 50 Battery

Weighing a mere 31oz (880 grams) and packing 50 Watt-hours of energy - enough to operate a typical ENG camcorder for two hours, the HyTRON 50 is the most advanced lightweight battery in the industry.
- Made possible by recent advancements in a cell technology originally designed for the mobile computing industry, it incorporates nickel metal hydride cells that provide the highest energy density of any rechargeable cylindrical cell available. High performance is further assured through the integration of Anton/Bauer InterActive digital technology.
- Equipped with an on-board "fuel computer" which monitors energy input and output as well as critical operating characteristics and conditions. This data is communicated to the InterActive charger to ensure safety and optimize reliability.
- In addition, remaining battery capacity information is available by means of an LCD display on each battery and in the viewfinder of the most popular broadcast & professional camcorders.
- Special low voltage limiter prevents potentially damaging overdischarge.

Specifications: 14.4 V, 50 WH (Watt Hours) 5-3/4" x 3-1/2" x 2-1/4", 1.9 lbs (88kg)
Typical runtime: 2 hours @ 25 Watts 3 hours @ 17 Watts

QUAD 2702/2401 Four-Position Power/Chargers

The lightest and slimmest full featured four position chargers ever, they can fast charge four Gold Mount batteries and can be expanded to charge up to eight. They also offer power from any AC main in a package the size of a notebook computer and weighing a mere four lbs! The 40 watt 2401 can charge ProPacs in two hours and TrimPacs in one. Add the Diagnostic/ Discharge module and the QUAD 2401 becomes an all purpose power and test system. The 70 watt QUAD 2702 has the module and is the ultimate professional power system.

Dual 2702/2401 Two-Position Power/Chargers

The DUAL 2701 (70 watt) and 2401 (40 watt) are sleek, rugged, economical two position Power/Chargers that have all the features of InterActive 2000 technology including DC camera output and LCD display. The DUAL 2701 will charge any Gold Mount battery in one hour, the DUAL 2401 charges ProPac batteries in two hours and Trimpacs in one. Compact, lightweight design makes them the ideal for travel. They can also be upgraded with the Diagnostic/Discharge Module and/or with Expansion Modules to charge up to 6 batteries of any type.

PROFESSIONAL VIDEO TAPES

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Fuji

Professional Grade VHS
PG-30 2.39 PG-60 2.59 PG-120 2.79

Broadcast Grade VHS Box
BGR-30 3.29 BGR-60 3.99 BGR-120 4.49

H471S S-VHS Double Coated
ST-30 6.79 ST-60 7.49 ST-120 7.69

M221 Hi 8 Double Coated

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P630HMP	4.99	E630HME	7.69
P660HMP	6.39	E660HME	10.29
P6120HMP	8.29	E6120HME	13.59

M321SP Metal Betacam (Box)
05S 17.95 10S 18.49 20S 19.95
30S 22.95 60L 31.95 90L 49.95

OP121 DVC PRO
12M (Med.) 7.99 23M 9.49 33M 11.99
63M 21.99 64L (Lg.) 22.99
94L 32.99 123L 42.99

maxell

Hi8 Metal Particle (XRM)
P6-120 XRM 6.99

Broadcast Quality HI8 Metal Particle
P6-30 HM BQ 5.39 P6-60 HM BQ 6.09
P6-120 HM BQ 7.99

P/I PLUS VHS
T-30 Plus 1.69 T-60 Plus 1.99 T-90 Plus 2.09
T-120 Plus 2.19 T-160 Plus 2.69

HGX-PLUS VHS (Box)
HGXT-60 Plus 2.69 HGXT-120 Plus 2.99
HGXT-160 Plus 3.99

BQ Broadcast Quality VHS (Box)
T-30 BQ 3.89 T-60 BQ 3.99 T-120 BQ 5.99

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Betacam SP
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B30MSP 16.99 B60MLSP 27.99 B90MLSP 39.99

Panasonic

Mini DV Tape
AY DVM-30 7.99 AY DVM-60 8.49
AY DVM-60 (10 Pack) each 7.99

DVCPRO
AJ-P12M (Medium) 8.49 AJ-P23M 9.99
AJ-P33M 13.49 AJ-P63M 22.99
AJ-P64L (Large) 24.99 AJ-P94L 34.99
AJ-P123L 44.99

SONY

Hi-8 Professional Metal Video Cassettes
P6-30 HMPX 4.59 P6-30 HMEX 7.99
P6-60 HMPX 6.49 P6-60 HMEX 10.99
P6-120HMPX 8.89 P6-120HMEX 14.99

PR Series Professional Grade VHS
T-30PR 2.39 T-60PR 2.59 T-120PR 2.79

PM Series Premier Grade Professional VHS
T-30PM 3.49 T-60PM 3.99 T-120PM 4.79

BA Series Premier Hi-Grade Broadcast VHS (In Box)
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KCS-10 BRS (mini) 8.29 KCS-20 BRS (mini) 8.99
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KCA-30 BRS 9.69 KCA-60 BRS 13.39

XBR 3/4" U-matic Broadcast Master (In Box)
KCS-10 XBR (mini) 8.79 KCS-20 XBR (mini) 10.19
KCA-10 XBR 9.29 KCA-20 XBR 10.69
KCA-30 XBR 11.99 KCA-60 XBR 15.69

KSP 3/4" U-matic SP Broadcast (In Box)
KSP-S10 (mini) 9.59 KSP-S20 (mini) 11.09
KSP-10 10.09 KSP-20 11.59
KSP-30 12.99 KSP-60 16.99

BCT Metal Betacam SP Broadcast Master (Box)
BCT-5M (small) 12.29 BCT-10M (small) 13.29
BCT-20M (small) 13.99 BCT-30M (small) 14.99
BCT-30ML 21.49 BCT-60ML 23.49
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Full Size DV Tape with Memory Chip
DV-120MEM 25.89 DV-180MEM 29.99

PDV Series Professional DVCAM Tape
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PDVM-32ME (Mini) 23.99 PDVM-40ME (Mini) 25.99
PDV-94ME (Standard) 34.99 PDV-124ME (Standard) 38.99
PDV-184ME (Standard) 49.95 PDVN-64N 27.50
PDVN-124N 34.95 PDVN-184N 43.95

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NewTek

Calibar 3-Oz. Pocket-Sized Test Generator

The size of a ball point pen and running on a single battery, Calibar is an NTSC test signal generator that packs a rack mount's worth of test equipment into a battery operated instrument. Calibar is the fastest, easiest and most portable way ever to calibrate video equipment. No patch bay racks. Just one cable. So besides giving you fast accurate readings in the studio, it's perfect for off-site events or trouble-shooting in the field.

- Designed for studio and field operation, it produces 24 test pattern functions at the touch of a button. 10-bit precision digital-to-analog conversion assures highly accurate signals.
- Calibar's combination of low cost, portability and full-featured operation makes it ideal for broadcast engineers, television production facilities and video post houses.
- Tuck Calibar in your pocket and you're ready to go. Touch the button to generate SMPTE color bars, touch it again to calibrate convergence and so on.
- With the supplied AC adapter, it also functions as a black burst generator.

CHYRON PC-CODI & PC Scribe

Text and Graphics Generator and Video Titling Software

PC-CODI incorporates a broadcast quality encoder and a wide bandwidth linear keyer for the highest quality, realtime video character generation and graphics display. A video graphics software engine running under Windows 95/NT. PC Scribe offers a new approach and cost effective solution for composing titles and graphics that is ideal for video production and display applications. Combined, their a total solution for real-time character generation with the quality you expect from Chyron.

PC-CODI Hardware:

- Fully-antialiased displays • Display and non-display buffers
- Less than 10 nanosecond effective pixel resolution
- 16.7 million color selections • Fast, realtime operations
- Character, Logo and PCX image transparency
- Variable edges: border, drop shadow and offset
- Full position and justify control of character and row
- User definable intercharacter spacing (squeeze & expand)
- Multiple roll/crawl speeds • Automatic character kerning
- User definable tab/template fields
- Shaded backgrounds of variable sizes and transparency
- Software controlled video timing
- User definable read effects playback: wipes, pushes, fades
- NTSC or PAL sync generator with genlock
- Board addressability for multi-channel applications
- Auto display sequencing • Local message/page memory
- Preview output with safe-title/cursor/menu overlay
- Composite and S-video input with auto-genlock select

PC-Scribe Software:

- Number of fonts is virtually unlimited. Also supports most international language character sets. Fonts load instantly and the level of anti-aliasing applied is selectable.
- Adjust a wide range of character attributes. Wide choice of composition tools.
- Characters, words, rows and fields can color flash
- Character rolls, crawls and reveal modes. Speed is selectable and can be auto timed with pauses. Messages can be manually advanced or put into sequences along with page transitions.
- Multiple preview windows can be displayed simultaneously.
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- Genlock using separate sync input for working in professional video suites
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MCXpress Features:

The ideal tool for video and multimedia producers who require predictable project throughput and high-quality results when creating video and digital media for training, promotional/marketing material, local television and cable commercials, CD-ROM and Internet/intranet distribution. Based on Avid's industry-leading technology, it combines a robust editing functionality with a streamlined interface. Offers integration with third-party Windows applications, professional editing features, powerful media management, title tool and a plug-in effects architecture. It also features multiple output options including so you save time and money by reusing media assets across a range of video and multimedia projects

TARGA 1000/MCXpress Turnkey Systems:

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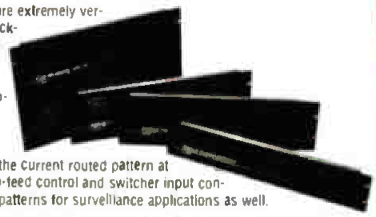

Knox's family of high performance, 3-channel routing switchers are extremely versatile, easy-to-use and very affordable. Housed in an ultra-thin rack-mount chassis they accept and route (on the vertical interval) virtually any video signal, including off-the-air and non-timebase corrected video. They also route balanced or unbalanced stereo audio. The audio follows the video or you can route the audio separately (breakaway audio). Each of the switchers offers manual control via front panel operation. They can also be controlled remotely by a PC, a Knox RS Remote Controller, or by a Knox Remote Keypad via their RS-232 port. Front panel LEDs indicate the current routed pattern at all times. Knox switchers are ideal for applications such as studio-feed control and switcher input control, plus they have an internal timer allowing timed sequence of patterns for surveillance applications as well.

- Accept and routes virtually any one-volt NTSC or PAL video signal input to any or all video outputs.
- Accept and route two-volt mono or stereo unbalanced audio inputs to any or all audio outputs.
- Video and audio inputs can be routed independently, they don't need to have the same destination.
- Can store and recall preset cross-point patterns. (Not available on RS12x2.)
- Front panel key-pad operation for easy manual operation.
- Can also be controlled via RS-232 interface with optional RS Remote Controller or Remote Keypad.
- Front panel LED indicators display the present routing patterns at all times.
- An internal battery remembers and restores the current pattern in case of power failure.
- Internal vertical interval switching firmware allows on-air switching.
- Housed in a thin profile rackmount 1" chassis.
- Also except the RS12x2 are available in S-Video versions with/without audio.
- Models RS16x8 and RS16x16 are also available in RGB/component version.
- With optional Remote Video Readout, the RS16x8 and RS16x16 can display active routes on a monitor at remote locations, via a composite signal from a BNC connector on the rear panel.
- The RS4x4, RS8x8 and RS16x16 are also available with balanced stereo audio. They operate at 660 ohms and handle the full range of balanced audio up to +4 dB with professional quick-connect, self-locking, bare-wire connectors.

LEADER

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5860C WAVEFORM MONITOR

A two-input waveform monitor, the 5860C features 1H, 1V, 2H, 2V, 1 s/div and 2V mag time bases as well as vertical amplifier response choices of flat, IRE (low pass), chroma and DIF-STEP. The latter facilitates easy checks of luminance linearity using the staircase signal. A PIX MON output jack feeds observed (A or B) signals to a picture monitor, and the unit accepts an external sync reference. Built-in calibrator and on-off control of the DC restorer is also provided.

5850C VECTORSCOPE

The ideal companion for the 5860C, the 5850C adds simultaneous side-by-side waveform and vector monitoring. Featured is an electronically-generated vector scale that precludes the need for fussy centering adjustments and eases phase adjustments from relatively long viewing distances. Provision is made for selecting the phase reference from either A or B inputs or a separate external timing reference.

5100 4-Channel Component / Composite WAVEFORM

The 5100 handles three channels of component signals, plus a fourth channel for composite signals, in mixed component / composite facilities. Features are overlaid and parade waveform displays, component vector displays, and automatic bow-tie or "shark fin" displays for timing checks. Menu-driven options select format (525/60, 625/50, and 1125/60 HDTV), full line-select, vector calibration, preset front-panel setups and more. On-screen readout of scan rates, line-select, preset numbers, trigger source, cursor time and volts.

5100D Digital Waveform/Vectorscope

The 5100D can work in component digital as well as component analog facilities (and mixed operations). It provides comprehensive waveform, vector, timing and picture monitoring capabilities. Menu driven control functions extend familiar waveform observations into highly specialized areas and include local calibration control, the ability to show or blank SAV/EAV signals in both the waveform and picture, the ability to monitor digital signals in GBR or YCbCr form, line select (with an adjustable window), memory storage of test setups with the ability to provide on-screen labels, flexible cursor measurements, automatic 525/60 and 625/50 operation and much much more.

5870 Waveform/Vectorscope w/SCH and Line Select

A two-channel Waveform/Vector monitor, the microprocessor-run 5870 permits overlaid waveform and vector displays, as well as overlaid A and B inputs for precision amplitude and timing/phase matching. Use of decoded R-Y allows relatively high-resolution DG and DP measurements. The 5870 adds a precision SCH measurement with on-screen numerical readout of error with an analog display of SCH error over field and line times. Full-raster line select is also featured with on-screen readout of selected lines, a strobe on the PIX MON output signal to highlight the selected line, and presets for up to nine lines for routine checks.

5872A Combination Waveform/Vectorscope

All the operating advantages of the 5870, except SCH is deleted (line select retained), making it ideal for satellite work.

5864A Waveform Monitor

A two-input waveform monitor that offers full monitoring facilities for cameras, VCRs and video transmission links. The 5864A offers front panel selection of A or B inputs, the choice of 2H or 2V display with sweep magnification, and flat frequency response or the insertion of an IRE filter. In addition, a switchable gain boost of X4 magnifies setup to 30 IRE units, and a dashed graticule line at 30 units on screen facilitates easy setting of master pedestal. Intensity and focus are fixed and automatic for optimum display. Supplied with an instruction manual and DC power cable.

5854 Vectorscope

A dual channel compact vectorscope, the 5854 provides precision checkout of camera encoders and camera balance, as well as the means for precise genlock adjustments for two or more video sources. Front panel controls choose between A and B inputs for display and between A and B for decoder reference. Gain is fixed or variable, with front panel controls for gain and phase adjustments. A gain boost of 5X facilitates precise camera balance adjustments in the field. Supplied with a DC power cable.

Designed for EFP and ENG (electronic field production and electronic news gathering) operations, they feature compact size, light weight and 12 V DC power operation. Thus full monitoring facilities can be carried into the field and powered from NP-1 batteries, battery belts and vehicle power. Careful thought has been given to the reduction of operating controls to facilitate the maximum in monitoring options with the operating simplicity demanded in field work.

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TV ENGINEER

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Interested candidates must have a Bachelor's Degree in Electrical Engineering with specialized courses in television maintenance. Five years' experience in troubleshooting and repairing broadcast television equipment including Ampex, Sony and Chyron is required. The qualified candidate will also have experience in graphic arts for television and be able to communicate effectively, both orally and in writing. Previous Middle East experience preferred.

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Applicants must have strong background in digital technology and TV station design and construction, as well as computers, LAN's and Generic CAD. Experience operating an SNG/ENG vehicle, FCC General Radiotelephone License and or SBE Certification is preferred.

Successful applicants must be self-motivated team player, able to set priorities as well as plan and execute projects independently under deadlines.

Please send resume and salary history to Suzanne Council, Director of Human Resources, WLVI-TV, Dept. BE56, 75 Morrissey Blvd., Boston, MA 02125.

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EOM

Quality and the future

BY PAUL MCGOLDRICK

I love the current story of the sales team for a major consumer equipment manufacturer that is advising video store salespeople not to open the box for that expensive new TV when it is delivered to the customer. Instead, they should first ensure that terrestrial DTV signals are receivable at the site. Once the signals are verified, then the box can be opened. This will supposedly prevent the creation of a large amount of "B" stock.

This scenario is similar to that surrounding the introduction of color in Europe. Color followed quickly on the heels of the move to UHF channels. Luckily, the naysayers at that time were basically off the mark. The new frequencies were easy to do business on and gave solidly repeatable performance — something that could not be said of VHF channels, especially during warm summers when signals skipped all over the place, including way over national borders.

We were paranoid at transmitters in those days. On the rare occasions when everything went correctly for the entire shift, the transmitter site was an extremely boring place to be. More often something went wrong. There is nothing like the adrenaline kick when the alarms start screaming and you take off, maybe for a quarter-mile run, to get to the source. If you were on the monitoring desk, the first thing you would do is log the time — to the second — and then take all the external telephone lines off the hook. That way, the managers, who seemed to sit at home with a phone on their lap waiting for an emergency, couldn't call in to tell you what you already knew.

Even when the transmission equipment was working, we still had to log every program, every break, and every error. We assessed the video and audio quality of every incoming feed, including noting things such as visible tape dropouts.

That was still better than a period I spent in the studios of a classical music radio service. Some shifts were spent in a darkened monitoring room focused on listening to the transmission quality and logging everything. Sometimes the hardest part was staying awake. However, there were benefits: we got free concert tickets — to keep our ears tuned to the real acoustics rather than the recorded thing. On some of the more formal occasions, tux rentals were included in our expense reports.

The responsibility for transmission quality has been moved from the engineers to the operators.

Today and DTV

Concern for quality has decayed to the point that it sometimes seems a "Quality? What quality?" attitude is pervasive. Monitoring that compares favorably to my experience has not been done for a long time. The responsibility for transmission quality has been moved from the engineers to the operators. Unfortunately, one sometimes has to assume that acceptable performance levels are simply when the colored picture is moving and making noise.

In multichannel control rooms, it is obvious that the staffing level does not allow reasonable monitoring of even a small portion of the channels being processed. I think it's time for engineers to take back the responsibility for a program's transmission quality. If we expect Mr. and Mrs. Consumer to dig into their wallets for DTV dollars, then we had better provide them with quality. It is a sermon that I have given before and will probably repeat several more times; *Technology does not sell.* We can be the cleverest individuals on Earth, we can do extraordinary things with compression and the aura of presentation, but if the content is not there, the consumer will not buy.

As engineers, we cannot generally be held responsible for, or have much effect on, the quality of program content. But we certainly can — and should — be held responsible for ensuring that the very best pictures and the very best audio experience reach those who have paid for it. That means keeping your facility in top condition. Haven't you always? The engineering group must be pulling in the same direction over the issues of the day. It should also mean that we are willing to go out on a limb, and that could be really tough.

At the extreme, we should hold fast in preventing non-DTV material, except in emergencies, from going to air. Have you yet seen a VHS tape upconverted to 720p? It is unbelievably awful. Regardless, I'm told that a number of second-tier stations are talking about using it as a source for some local programming. That should be unacceptable. This and similar scenarios should be prevented by the engineers responsible.

Fear for your job? You shouldn't. Good broadcast engineers are in demand. For that matter, do you really want to work for a management/programming operation that doesn't serve the audience fairly? Quality really does matter. ■

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


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