AC POWER QUALITY
Secrets to clean and reliable power

A LOOK AT COMPRESSION
Serial compression could destroy your digital quality

OLYMPIC PREVIEW
Inside the '98 Olympics broadcast center

FIRST INSIDE LOOK:
KITV, first on-air DTV station
How they did it!
The New **TV-1000** Audio Console

**LIVE TV – The Way It Has to Be**

315-452-5000

Wheatstone® Corporation

Circle (1) on Free Info Card

www.americanradiohistory.com
When Allbritton Communications wanted to reach two television markets from a single location, Harris incorporated a centrally located all-digital studio with microwave links to three transmitters over 100 miles apart, two remote news bureaus and 3 additional microwave repeater sites. This solution enables Alabama's ABC 33/40 to blanket the state with city-grade signals.  

"Harris' digital solution gives us multichannel capabilities which allow us to offer four distinct channels to advertisers," Robert Allbritton notes. "Not only do we now have twice the product to sell; we have the ability to broadcast DTV as soon as we're ready. What's more, Harris designed and implemented our digital solution faster than we ever thought possible - and at a cost only 10-15% greater than analog."

From an all-digital studio and C-/Ku-band teleport facility...to a fleet of Harris ENG and SNG vehicles that proudly bear the ABC 33/40 logo, Harris met Allbritton's unique challenge with state-of-the-future technology. Whether your needs call for digital-ready analog, or digital right now, call Harris today. We'll show you how digital is more of a practical reality than you may think.
The moment of concentration before the gate slams open. The turn of a ski that determines the race. The spin. The soar. The gasp.

With Panasonic DVCPRO cameras covering every game at Nagano, there’s not much drama our lenses will miss.

But it’s more than just the coverage that will make you feel like you’re right in the middle of it. DVCPRO digital cameras are so lightweight, they allow broadcasters to keep pace with the athletes, even at 140 kilometers per hour, even at 138 meters above ground. And that’s important when the difference between a national hero and a silver medalist is measured in .001 second increments.

There are over 30,000 DVCPRO units in use at broadcast facilities around the world, offering super-sharp digital images, pin-drop sound quality and minimal dubbing degradation. DVCPRO won’t just bring the action to your home, it will bring you to Nagano. Panasonic will offer state-of-the-art broadcasting systems, such as DVCPRO in our role as the Official Supplier and prime contractor for the International Broadcast Center (IBC) and all the venues.

As an Official Worldwide Olympic Partner participating with superior digital technology, we believe it’s also important to cover the true spirit of sport. Something we do with our hearts, not just our cameras.

See you in Nagano for the snow.
4x Non-Linear Editor AJ-DE77

Official Worldwide Olympic Partner

South Africa  Tel. 27-11-312-1400  U.K.  Tel. 44-118-920-9010
Sweden  Tel. 46-8-425-9300  U.S.A.  Tel. 1-800-528-6868
Switzerland  Tel. 41-1-259-9000  Venezuela  Tel. 58-2-285-6440
Taiwan, R.O.C.  Tel. 886-2-725-9100
Thailand  Tel. 66-2-929-9292
Turkey  Tel. 90-216-416-0350
U.A.E.  Tel. 971-4-719000

Official Worldwide Olympic Partner

T-103 36 USC 380 (m) Official Mark of the Canadian Olympic Association
http://www.panasonic.co.jp

www.americanradiohistory.com
Features

86 Power quality and grounding
By Warren H. Lewis
Many of the older methods of grounding, bonding and shielding must be abandoned for reliable operation of today’s digital equipment.

100 MPEG compression issues
By Keith Dunford
Concatenation, digital turnaround and interoperability are the keys to MPEG transportability.

Beyond the Headlines

NEWS
14 TCI has “different” HDTV
18 Is lip sync in HDTV going to be a problem?
20 A new chip for cameras
22 Show me the graphics
22 CEMA unveils new logo
22 Blazing trails in DTV
27 Harris and Lucent form DTV alliance

FCC UPDATE
28 Reallocating TV Channels 60-69

DTV UPDATE
30 DTV: Broadcasting or datacasting?

EXPERT’S CORNER/VENDOR VIEWS
34 What speed — a digital infrastructure?

Digital Handbook

TRANSITION TO DIGITAL
50 Testing CCIR-601 serial digital distribution

COMPUTERS AND NETWORKS
54 Networking basics, Part 2: Faster is better

ASK DR. DIGITAL
58 Bringing a scope back to life
60 Doing the dishes

Special report
106 Winter Olympics: Putting on the Games in Japan

(Continued on page 8)
Is the uncertainty of HDTV keeping you from buying the digital audio equipment you need today? Are you afraid that what you buy today will be obsolete tomorrow? With NVISION you can buy now and buy with confidence, because these products are 100% HDTV compatible. Each one is designed to perform in today's demanding environment as well as tomorrow's.
In a world dominated by deadlines and ratings, the ability to create great news graphics fast, is vital. The united forces of Paintbox®, Picturebox® and Picturenets® Plus gives you all the creative power, assured stills handling performance and efficient networking you need. It's the team you can count on.

Call our 24 hour Graphics Hotline now: 1 800 218 0051 Ext.481
Quantel Inc., 28 Thorndal Circle, Darien, CT 06820 Tel: (203) 656 3100 Fax: (203) 656 3459 http://www.quantel.com
Marching to the DTV drummer

Ever heard the line “If you build it, they will come” from the movie Field of Dreams? Recently it’s been uttered by a variety of pundits from Wall Street to Sesame Street when referring to HDTV, but they have added a new twist, “If you build it, will they come?” Trouble is, after it’s asked, few seem willing to answer the question. Well, I think the question has been answered.

I recently spent several days at the January Winter Consumer Electronics Show (CES). I attend the show infrequently, but when I heard that Harris Broadcast was going to host a special DTV event, I decided it was time once again to check it out.

What I learned was more than a little surprising. Although it’s no secret that TV set makers need something new to sell, I didn’t expect as much excitement and visible support for HDTV from them as I saw. From the set makers to DirecTV, to broadcasters, everyone’s onboard the HDTV train, and this baby is ready to roll.

The show had plenty of set makers showing off their new TV sets. In the past, we mostly saw recorded clips of flowers or fish, much of which wasn’t even real HDTV. However, this time, the images were live, off-air HDTV feeds from two Las Vegas stations, KLAS and KLVW. There was lots of material, some designed to stress the receivers, but all of it looking great. There were plenty of flat-panel displays, new projection systems and lower predicted prices. Sets will be available by the third quarter of this year. And, if you think all this won’t matter because there won’t be any images to view on these sets at your local Radio Shack or Best Buy, think again. DirecTV announced that it will soon begin delivering two channels of HDTV programming.

Before concluding, I want to give a “Well done,” to the folks at Harris. I’ve been to a lot of press events (most could have been neglected without missing anything), but this one was different.

The company hosted a session the day before CES opened to highlight its research supporting the conversion to DTV. Although you might question the research the company conducted, Harris also had independent sources there presenting their own data on the subject. Company officials promoted HDTV and the technology; they did not promote their products.

Later that evening, Harris hosted what had to be the most upbeat, no-holds-barred, rousing kick-off for DTV (or any other broadcast technology) ever. While I expected a typical snoozer, complete with company talking heads spouting the advantages of “their” solutions, what I, and more than 200 others, got was a fantastic evening’s entertainment, in addition to some great facts and demonstrations of HDTV and DTV.

Congratulations to Harris for supporting DTV at CES. It helps not only broadcasters, but also our partners in this endeavor, the consumer electronics industry.

So to the question I first posed: Will they come? Well, I’ve seen it and when you build it — they will come.

Brad Dick, editor

direct: brad_dick@compuserve.com
website: www.broadcastengineering.com

www.americanradiohistory.com
The Golden Age of Television is Back

The One Box That Changes Everything

It took eight years to create. It's driven by 22 radically advanced custom chips and one million lines of hand-coded software. It's the stunning new technology everyone's whispering about. There's never been anything like it: all real-time, all D1 digital, all perfect network-level broadcast quality. A lot of people didn't think it was possible. They were wrong.

Made in U.S.A.
Rancho Cordova, California

Experience Trinity Now
at your
Local Dealer

800-306-PLAY www.play.com

Play Incorporated

8 Input Live Production Switcher
Real-Time 3D Digital Video Warp Effects
On-Line Non-Linear/Linear Editor
Live 4ns Character Generator
Dual Channel D1 Still Store
Two Time Base Correctors
Real-Time Animated Paint and Compositing
re: the October 1997 “Digital Basics”

Dear Paul,

Yes, the 2.4GHz digital wireless sender really works! I just bought the Wavecom Jr. brand (it cost $95) from one of our distributors for video products (Pettra) and frankly, I was skeptical. I am surprised to report that the quality is satisfactory and better than expected!

I needed to transmit a PrimeStar signal to another part of the house, approximately 40 feet away and downstairs. Yes, the receiving antenna must be pointed in the general direction of the transmitter, but the transmitter did not need to be pointed at the receiver. I have not noticed any interference due to other equipment operation, nor does walking between the units cause any signal degradation.

You might want to purchase one to experiment with and see for yourself all of its possible uses. I also plan to use it with my camcorder for times when I want the signal to transmit to a monitor or recorder at a close distance where wire would be impractical. It also transmits quality stereo sound and can be used for audio applications, as well.

I have also been trying some wireless speakers around my house with excellent results, solving some wiring problems with a simple solution.

Yes, it truly is a TV station for $150.

Donald D. Flint
President/CEO
DF&A Wireless
Corpus Christie, TX

Another roadblock for DTV?

Brad Dick wrote in his December 1997 Editorial: “In November, I again reminded readers how stupid rules seem to be the normal course of action by elected officials (and bureaucrats).” Here is yet another example:

Dear Brad,

I know most Broadcast Engineering readers are more concerned, understandably, about having to implement advanced TV and how to finance advanced television, however . . .

The Copyright Royalty Tribunal recommended increasing direct-to-home (DTH) network copyright fees by 900%, more than cable’s fees for the same network signals. When the Library of Congress approved that raise, I realized that whether intentional or not, another roadblock had been put in place to block the road leading to smooth growth, development and implementation of ATV-DTV in the one area of program distribution that can most easily embrace network ATV-DTV technology, the DTH industry!

Can anyone provide a detailed explanation of either the Copyright Royalty Tribunal’s or the Library of Congress’ logic and reasoning for the disparity between past and new DTH copyright liability vs. cable’s copyright liability?

Cable advertisements compare (promote) their service vs. DTH. The advertisement cable’s ability to carry multiple channels (multiplexed) on one coaxial cable. Each TV connected to cable in one dwelling, can display any of 20 to 45+ channels all at the same time—while DTH receivers can only tune and output one channel at a time. So, without multiple DTH receivers (and modulators), off-air broadcast reception, cable, or other signals (modulated onto channels other than 3 or 4) DTH owners must watch the same channel on any/all TV sets in the dwelling that are connected to the DTH receiver.

To date, no one in Congress or the broadcast or cable industries can explain the logic. If you can, I’d like to hear it.

Robin Adair, CET
The Video Ladies
DULCA Scenes
2471 Montpelier Rd.
Columbia, KY 42728
dulca@duo-county.com

re: the November 1997 Editorial “Stupid Rules”

If you want to know about DTV or HDTV ask your Congressman or Senator! (Particularly those on the Communications Committee, i.e., former Senator Hank Brown from Colorado — “I can’t answer that question, but I will certainly ask my office advisor about that issue.” My answer was — Wait a minute, I didn’t ask about an issue, I just asked a simple question.

Jack E. McKain
ITLCO
Denver, CO
You can buy a discontinued 2465B for more or a new IWATSU for less.

Decisions, decisions.

How often does it turn out that your only choice is your best choice?

While you can still buy a used Tek 2465B 400 MHz oscilloscope for as much as $8,300, our new $8,000 470 MHz not only costs you less but you get a whole lot more.

Besides the extra 70 MHz of bandwidth and all of the functionality that you've come to expect from a superior analog oscilloscope, you'll also enjoy...

• Our auto calibration feature that cuts your calibration time down to 30 minutes or less.
• Our 'ghost-free' IWATSU 6" meshless CRT display that assures bright and sharp traces.
• Our full TV triggering function that is a standard feature and not a costly option.

Each of our 100, 200, 400 and 470 MHz analog oscilloscopes comes with a three year warranty and IWATSU's 43 year history of analog oscilloscope experience.

For more information, product literature or to arrange a demonstration call us toll free at 888-637-4513 or visit our web site at http://www.iwatsu.com.
TCI has “different” HDTV
BY LARRY BLOOMFIELD

"TCI May Deny HDTV to its Subscribers" and "TCI Cable Service May Provide Only Low-Resolution Digital Television" were headlines that blazed across the wire services recently.

Last month, while speaking to the National Association of Television Production Executives (NATPE) in New Orleans, Consumer Electronics Manufacturers Association (CEMA) president Gary Shapiro said, "Manufacturers and broadcasters have committed to bringing Americans the astounding picture resolution of HDTV, but now TCI's 14 million customers may never have the chance to see it. This is a huge tragedy for the American consumer."

TCI plans to downconvert broadcaster transmission of 1,080 interlace (1,080-I) HDTV and then pass it on to its subscribers in a lower resolution, 480 progressive (480-P) format. Under these circumstances, TCI's subscribers may suffer a loss of more than 80% of their spatial resolution when compared to the 1,080-I signal were they to receive it directly.

"This highlights the importance of the FCC's upcoming must-carry proceeding," continued Shapiro. "The FCC must ensure that if broadcasters transmit programming in high-definition, cable companies are required to pass the programming through to the consumer in the same manner. Otherwise, cable subscribers will be involuntarily downconverted to a picture resolution no better than today's TV."

Although the next generation of TV receivers will be able to receive and decode the lower-resolution 480-P as one of the 18 formats available, the lower-resolution 480-P, just isn't HDTV. "Any effort to label 480-P as true HDTV is an attempt to fool American consumers, who want the highest level of resolution they can get. HDTV could have a wonderful future, but it won't if Americans aren't allowed to see it," Shapiro concluded.

The cable industry has always had the charter to pass along what they received from their various sources. Case-by-case exceptions have been made when it has been impractical to pass on some program material in stereo.

To present the other side of the story, Leo J. Hindery, Jr., president of TCI, said, "CEMA's information is incorrect and it was extremely irresponsible of them to mislead the public. The truth is, TCI has provided for additional choices and flexibility for all involved. The technology in TCI's advanced digital set-top devices allows a TV signal in any HDTV format to be transmitted to a customer's high-definition TV set. Second, customers who do not own a high-definition TV set can receive 480-P HDTV signals, translated into a standard-definition format, with the set-top device as currently configured. As the market for HDTV evolves, TCI will continue to respond to the needs of its customers. Any accusation that we are impeding this process is dead wrong."

Hindery continued, "We believe strongly that the marketplace will drive this business and determine which HDTV format will be used. The dialogue continues in the broadcast indus-
And every dollar, franc, pound, or peso too! That's why you need a company that offers more than just shrink-wrapped software and board sets. One that has an ongoing history of customer satisfaction and field-proven system solutions. A company like Odetics Broadcast. We understand your station automation needs and have systems to meet those requirements. Like SpotBank, a complete on-air automation system that provides smart management of video server storage.

SpotBank is a flexible system that supports multiple on-air channels. And SpotBank uses RAID servers for maximum data protection, so you can count on every spot.

To assure a smooth transition, Odetics includes system installation, training and round-the-clock customer support. Clearly, the SpotBank family makes every second count.
Contrary to popular belief, engineers and physicists are quite capable of celebration.
Engineers and physicists don't celebrate like the rest of us. They wait for a truly special occasion. Like developing the finest 12-bit digital camera on the market. And then they really cut loose.

Our engineers designed an advanced 12-bit Digital Signal Processor. Our physicists developed a revolutionary 16:9 CCD imager. Working together, they figured out how these innovations could give you the best picture available.

And if that weren't enough to cheer about, they made our camera SDTV-ready, with the flexibility and reliability you've come to expect from Sony. After you see what our new camera can do, you'll understand what all the celebration is about.

www.sony.com/professional and 800-635-SONY ext. ADSP
try surrounding HDTV formats and digital multiplexing. The outcome of this dialogue will help determine the HDTV product ultimately available in the consumer marketplace."

A few days after CEMA's Gary Shapiro addressed NATPE, TCI countered by saying, "TCI unequivocally affirms that its advanced digital set-top devices will indeed have the capability to pass through, to high-definition TV sets, HDTV signals in the 1,080-I format or any other proposed HDTV format that may be selected by broadcasters and the consumer marketplace. Furthermore, since the introduction of high-definition TV sets into consumers' homes will happen over time, TCI has taken the extra step of incorporating the ability to translate 480-P HDTV signals into the standard NTSC format for display on consumers' standard-definition TV sets."

It is my understanding that only the 720-P and the 1,080-I have ever been referred to as high-definition television." TCI also stated, "Based upon the demands of the marketplace, translating other HDTV formats into standard-definition TV signals remains possible with additional processing speed and memory in the advanced digital set-top devices. In no way is TCI planning to "downconvert" any higher-format HDTV signal to a lower HDTV format."

Is lip sync in HDTV going to be a problem?

Much space has been given to the 18 different video formats that are part of the new DTV standards, but not much has been said about audio. You need to look at what you'll be working with, because there may be potential problems, if you are not aware of what's going on.

Dolby Digital AC-3 is Dolby's third and next generation of surround sound and is the audio system adopted for HDTV. AC-3 is also the digital film format and is used on the audio tracks of the latest-generation digital video disc (DVD). That's not all. With the recent changes to the PAL DVD specification, the AC-3 encoders are used in most parts of the world, including Europe, making it, for the most part, the worldwide format on audio tracks. This makes the techniques for encoding/decoding the same for DTV, DVD and HDTV.

AC-3 provides five full-bandwidth channels and a 120Hz bandwidth low-frequency effects channel (hence the 5.1 channel term) that provide extra headroom for special effects. The full-frequency range channels consist of right-front, center-front, left-front, right-surrround (rear) and left-surrround (rear).

The trick comes in carrying 5.1 channels of audio information, which would normally require close to 5Mb/s of data in a 384kb/s stream. Perceptual coding methods that take advantage of the human ear's tendency to respond to only the loudest of several closely spaced components of a sound are used to do this trick.

AC-3 also includes provisions for sending information about the audio in multiple auxiliary datastreams, such as language identifiers, copyright protection, time stamps and control information.

According to Louis D. Fielder of Dolby Laboratories in San Francisco, in a technical paper published by the Audio Engineering Society entitled Collected Papers on Digital Audio Bit-Rate Reduction: "A distinguishing feature of the AC-3 is that it processes multiple channels as an ensemble. It uses an oddly stacked TDAC transform and is designed primarily for single-point to multi-point consumer applications."

With that in mind, what do we do with AC-3 when it gets to our station? There could be some potentially undesirable side effects lurking in the corners ready to bite you when you're not looking.

It will help to understand the impending quagmire if we approach this from the standpoint of a station getting a feed in HDTV. The station will receive encoded AC-3 along with normal network HDTV video feeds. Dolby addressed this issue and said, "Most of the networks, except for PBS, are planning to distribute a mezzanine level rate-reduced datastream to their affiliates. The audio and video will run at a high enough data rate to allow several decode-re-encode processes to happen without losing any significant amount of quality. The final rate-reduction process that produces the 384kb AC-3 datastream and the video data that will be combined to make up the 19.39Mb/s ATSC transport stream, will happen at the transmitter." Now that should put some minds to rest.

But what about the network or other feeds that may be distributed, like PBS will be doing. According to Dolby, "PBS will distribute the 19.39Mb/s per ATSC transport stream to all affiliates just to get a system-wide HDTV presence from day one. The company realizes that for the HD programming, it won't have the freedom to brand its programs, but is willing to forego this to get the service started. I'm guessing that it will also go to the intermediate level of compression that will allow them the operational freedom it now has in the future."

There is some concern that decoding delays in AC-3 may raise their ugly heads. Dolby reassured me that "normally, the video is processed, when it goes through master control and has to be decoded and re-encoded in the same manner as the audio would have to be to add a voice-over." The saving factor here is that the video decoding, processing and re-encoding takes longer for the video than it does for the audio. The result is that we will still have to delay the audio to match the video, as we do today."

It appears that any station, especially the PBS affiliates, will have to decode the AC-3 back into all six channels, add what it needs to and then re-encode all six channels back to AC-3. According to Dolby, AC-3 decoders will have the ability to decode and reproduce any of a number of different configurations "from one to 5.1 channels from a com-
The Short/cut™ Editor is your next tape recorder, edit block and digital delivery system.

It's Un-Reel. So is our free test drive offer.

Discover for yourself why the Short/cut Personal Audio Editor is the perfect replacement for generations of reel-to-reel tape recorders.

It delivers massive hard disk storage, provides true cut and paste waveform editing, and makes low-cost copies to the popular Zip™ drive. It even has built-in speakers.

Short/cut is powerful enough for production, yet easy enough for fast on-air editing. All this in one compact, portable and sexy unit.

If you've got a lot to do, and not enough time to do it in, it's time for a Short/cut.

So here's our offer. Take it out for a test drive on our nickel. We're that sure that after you test drive it, you'll want to park it at your place.

Attention call letter stations.** You're only a phone call away from a free 10-day Test Drive. So try it out. We'll understand if you don't give it back.

(818) 991-0360

For more information call (818) 991-0360 / Fax (818) 991-1360 / e-mail: info@360systems.com / Website: www.360systems.com

Circle (6) on Free Info Card

*Optional accessory **Offer good in U.S. and Canada only. © 1997-360 Systems

www.americanradiohistory.com
mon 5.1 channel bitstream." The channel playback configuration is the X/Y mode, X being the number of front channels and Y the number of surround channels. Thus, the AC-3 coding algorithm supports 3/2, 3/1, 3/0, 2/2, 2/1, 2/0 and 1/0 playback modes.

Also keep in mind that it takes time to decode and encode digital signals.

Fielder said, "AC-3 is a single algorithm with a high degree of flexibility with regard to data rate and other operational details."

In speaking with Brink's Intasys's Peter Burinskas who was involved with the audio codec concept and associated compression issues said, "Where the Grand Alliance's selection of the AC-3 scheme gets dicey is in live feeds that need to be VO'd. The problem, even when sending the original 5.1 signal out as 2/0, is the encoder delay. If you are feeding a digital transmitter with an uninterrupted compressed digital signal, and all of the boxes along the way "speak" AC-3, all is wonderful in TV land. The moment the signal is decoded for enhancement of any kind, it must be fed to the transmitter as uncompressed or recompressed using AC-3. The encoder/decoder chain total processing delay averages 100ms. Most of this is in the encoder, with only 5ms to 27ms delay resulting from the decoding process. This means that at best, 'walking up to the post' is gonna be tough.

Two questions. Is there a simpler way of doing it? How can we do our local audio business, such as inserts without screwing up the incoming signal? If you think about it, we're sure you can think of several more concerns.

### A new chip for cameras

Looking to buy new cameras in the not too distant future? Well hold on to your hat and those budget dollars too. It looks like you could get much more for your money and better pictures to boot from a new generation of cameras, if they use a recently developed chip from the Sarnoff Corporation. Sarnoff, the former RCA Laboratories, has developed an image sensor based on complementary metal oxide semiconductor (CMOS) technology. The new CMOS active pixel sensor (APS) has a dynamic range that is nearly 100 times that of standard charged-coupled device (CCD) sensors, at comparable resolutions. This means better shadow and highlight detail. What's more, the APS-CMOS can control exposure without the need for a mechanical iris. The onboard electronics also eliminate the need for external analog-to-digital converters and other circuitry normally required in CCD-based cameras.

The chip is designed to give full TV resolution with video output in analog and 12-bit digital form. The temporal noise is as low as 10 elec./pixel for demanding applications, with a dynamic range better than state-of-the-art CCDS (more than 110dB), to preserve image detail in highlights and shadows. APS-CMOS chips have lower power consumption than CCDs, making it attractive for battery-power applications. The chip is also compatible with color filter technology. The design incorporates breakthrough technology that virtually eliminates the performance limitations associated with previous CMOS-based image sensors. The design of the internal circuitry reduces fixed pattern noise to <0.01% of full signal, below the threshold of visibility.

Michael Ettenberg, senior vice president of Sarnoff’s solid-state division said, “The CMOS APS is virtually a ‘camera on a chip,’ and we believe it will revolutionize the way cameras are made and used. Not only can it replace CCDS in many current camera applications — it will help create new applications. Its low cost allows engineers to add vision capability to products where it would once have been too expensive. Complete cameras based on the CMOS imagers will be cheaper right from the start, because they'll need fewer electronic parts and consume less power.”

It came as no surprise when Ettenberg commented, “We expect the quality of the resolution to eventually overtake what you can do with film. As we move forward and improve the technology, we'll be able to have the same quality as pictures from high-definition TV sets and beyond.”

The cost of the chip is low enough to make the digital camera as inexpensive as a computer mouse and just as common. Ettenberg predicts that the CMOS APS chips will start at prices comparable to those of equivalent CCDS and then drop as volume increases. Unit costs for the chips could be in the $6 to $10 range.

The company will license the technology to camera makers and provide engineering support to modify the sensor’s design to fit specific cameras and applications. The company has already approved two foundries to fabricate the chip, and will supply design tapes for manufacturers who wish to produce it in other foundries.

For additional information, check out www.sarnoff.com.
In more innocent times, we discovered the joy of sharing an experience. We found out that accomplishment and creativity flourished more fully when we cooperated and worked in teams. It’s time to get back to basics.

The CentraVision™ Fibre Channel Network and Storage System is founded on the fundamental lesson of sharing. Now, multiple workstations in your facility can all access the same pool of source material, even work on the same projects at the same time. And the CentraVision VDR lets you bridge the world of the on-line suite with the non-linear, easily transferring source material between the two. It’s also the only VDR that grows up with you, providing expandable storage that’s shared on the CentraVision network.

It’s a whole new way of working together. Just like it used to be.

Call 800-556-0222 or 702-851-9393 and visit our website at www.mountaingate.com.

Shared Media Solutions

© 1996 Mountaingate Data Systems, Inc. CentraVision and CentraVision VDR are trademarks of Mountaingate Data Systems, Inc. This fantasy was taken during the making of this ad.
Show me the graphics

If you weren't one of the estimated 130 million plus who watched Super Bowl XXXII, you missed some of the hottest graphics seen on television. To make spectacular graphics happen, NBC Sports enlisted the help of Silicon Graphics (SGI) to provide game analysis using SGI's Onyx2 Infinite-Reality graphics computers to render and deliver live, real-time, 3-D graphics.

The goal of NBC and SGI was to present complex statistics in a way never before seen on network television, while providing an informative, entertaining interpretation with a new look.

As the football game progressed, several on-site engineers used SGI's O2, desktop workstations to input data, play by play, so it could render the results live on the Onyx2 systems when needed. An NBC spokesperson said, "There was a separate machine for every category or separate graphic they built. This SGI equipment and software and a live set where the commentator made his presentation were all housed in a separate trailer near the remote truck.

At the conclusion of each quarter, Randy Cross, NBC Sports commentator used statistical charts created by the Silicon Graphics Onyx2 systems to provide viewers with a live, 3-D animations of key game elements from the graphics trailer. "Statistics are a necessary part of football, but numbers are boring. Pictures excite people. The capabilities of real-time live, instead of a pre-made packaged piece made my job as a commentator much easier."

The 3-D model of the stadium was created by MultiGen, Inc., using its real-time, 3-D modeling tool, MultiGen II Pro. Also working with Silicon Graphics was Boston Dynamics who had developed Football-Guy, a special version of its DI-Guy (software which was created to visualize football defense formations).

The equipment was, for the most part, off-the-shelf SGI gear, but the software was a joint effort custom modified or designed specifically for this particular event.

The current price tag for this "solution," including the custom software and hardware, is pretty stiff. The approximate cost for everything in this particular solution was about $250,000. However, like everything else, the price should come down for these packages as they come into more common use.

For more information, check out www.sgi.com.

Blazing trails in DTV

When you want to do a job right the first time, you start by getting the best people you can. That is what Hughes did when it put together its subsidiary, DirecTV. To lead the team, the company nabbed Dave Baylor, NBC's Skypath wizard.

Because DirecTV delivers TV programming digitally, it might give us some insight as to what terrestrial broadcasters will be getting into. My first step was to get a direct broadcast satellite (DBS) receiver. If there were any faults, I'd see them on my 50-inch TV set. The difference in picture quality over any of the cable services or off-the-air signals exceeded my expectations.

Step two was to give the engineers at DirecTV a call. I asked Jeffrey Crosby, senior vice president in charge of engineering, what DirecTV had planned. He said, "There are 18 different formats all separate from NTSC. Given the large established market, we will continue to transmit NTSC for many years to come. DirecTV will most certainly want to offer digital TV formats to the consumer that will be consistent with these (other) new formats."

DirecTV broadcasts from satellites some 22,300 miles out in space. "We currently have three satellites flying in close formation. Each satellite has 16 transponders. DirecTV uses 11 transponders on DBS-1 and USSB uses the remaining five transponders. DirecTV operates all of the transponders on each of the other two satellites." DirecTV's uplink site is in Castle Rock, CO, and a second site is being built in southern California.

To get the number of channels to the viewer's receiver, I was curious about

CEMA unveils new logo

At the International Consumer Electronics Show in Las Vegas last month, the Consumer Electronics Manufacturers Association (CEMA) and the Advanced Television Systems Committee (ATSC) unveiled a new logo for the DTV Receiver Certification program.

This new logo will be displayed on TV sets, computers and other consumer devices to signify to consumers that the product they are about to purchase will be capable of receiving and presenting for display all ATSC video formats.

The CEMA/ATSC certification program, which will be administered by CEMA, will allow manufacturers to assess their products for conformance to the ATSC standard. ATSC will establish the conformance standards and compliance testing procedures.

For more information, contact CEMA at www.cemacity.org or ATSC at www.atsc.org.

February 1998
DTV. ADAPT OR DIE?

Circle (12) on Free Info Card

www.americanradiohistory.com
YOUR SURVIVAL


How easily can you adapt to the digital television future? Snell & Wilcox has many of the answers you need. Especially on the question of HDTV. After all, we’ve been developing High Definition technology for the past ten years.

Can I use my existing facility for production and then upconvert to HDTV for transmission and still adhere to the FCC requirements?

Yes. FCC regulations only require the transmission of a digital signal, but don’t specify the digital transmission or production format. Standard Definition (SD) formats such as 480i can be upconverted to higher quality formats, and component digital signals from clean sources upconvert fairly well to HDTV. NTSC is not so good because of its limited bandwidth. D-2 and D-3 digital signals are better than analog because of the reduced noise. The ideal pictures for this purpose are those downconverted from HD. So the best solution of all is to use HDTV cameras for acquisition and downconvert to SDTV for post production prior to up-converting. This also means you get continuing value out of your existing SDTV hardware investment.

How do I deal with all Easy. Compared with clean 601 digital signals, archive material typically suffers from problems such as tape noise, film grain, poor quality transfer, motion weave and sometimes the degradation of old age.

Can I downconvert a signal so that I can do local production?

Yes. Studio quality baseband HD feeds just require a suitable downconverter set to the required aspect ratio. If the source is an ATSC MPEG bitstream, it’s got to be decoded back to baseband video with the highest possible quality before downconversion.
GUIDE TO HDTV

Is it time to transfer my facility to a 601 type production at the very least?

Maybe. 601 isn’t HD and will still require upconversion, but the output quality will be much better than upconversion from other sources. If your NTSC quality is good, you could use a high grade decoder and an upconverter to output HDTV in the short term. If it isn’t, you should fix it because upconversion reveals poor quality and MPEG encoders don’t like noise.

Can I pass through an HDTV signal if I’m not doing any local HD production?

Yes. The HDTV signal you pass through will be MPEG encoded and provided you don’t modify it in any way, it’s a cinch.

What kind of quality can I expect when I upconvert my local production for transmission in HD?

Best results are from a 601 digital source. Then analog component is the next best, finally the least good results come from a composite NTSC source. When you have no choice but to use composite, you will need the best decoder. With less than excellent decoding, residual NTSC color subcarrier can remain in the decoded video signal. This is then treated as video by the MPEG encoder, wasting valuable bandwidth.

Careful noise reduction and pre-processing of these SD signals prior to upconversion will tackle each of these problems and enable you to maximise the value of your archives.
THE DEFINITIVE HD RANGE FROM SNELL & WILCOX

Up and downconversion allows existing equipment to complete its life cycle into the HD era.

**HD5100: HDTV Upconverter**
Fully featured provider of high quality upconversion from SD to all current HD formats.
- 10 bit Transmission/Production

**HD3100: HDTV Cross/Downconverter**
With PhC motion compensation option for total conversion transparency across field rates. Perfect for international syndication of sports etc.
- 10 bit Transmission/Production

**HD2100: HDTV Downconverter**
Excellent quality pictures, particularly suitable for dual SD/HD production.
- 10 bit Transmission/Production

**HD200: Compact HDTV Downconverter**
Economical solution for dual format studios.
- 8 bit General Purpose

**HD50: HDTV Upconverter**
Economical analog upconversion. Ideal for monitoring.
- 8 bit General Purpose

**HD6000: HDTV Field Rate Converter**
Converts both ways between previous 1125 HD formats and US 1080 standard. Enables incorporation of legacy hardware and archive programming.
- 10 bit Transmission/Production

For more information and product details call us on 408 260 1000 or fax us on 408 260 2800. e-mail: info@snellusa.com. www: snellwilcox.com.

And to see DTV solutions in action visit our booth #9876(LVCC) at NAB '98

Circle (14) on Free Info Card

SNELL & WILCOX
what kind of compression it used. When pressed, Crosby said, “We’re using MPEG-2. The world of digital video compression is similar for everyone right now. We’re dealing with the same issues trading off the number of channels vs. the image quality for those channels.”

Crosby went on to indicate that when it comes to formats, the consumer will not decide. It will be up to the broadcasters. Ultimately, Crosby felt that if the broadcast industry narrows down to just a few of the 18 formats, they would become de-facto formats.

Harris and Lucent form DTV alliance

On Jan. 21, Harris Corporation and Lucent Technologies announced the formation of a strategic alliance to provide digital TV encoding equipment for broadcasters. The Harris FlexiCoder (tm) will use MPEG-2 encoding technology developed by Bell Labs, the R&D arm of Lucent Technologies.

The FlexiCoder is an expandable, modular, ATSC-compliant digital video and audio compression system. It will allow flexible, transparent switching between multiple channels of standard-definition video or a single channel of high-definition video, each with Dolby stereo digital audio. A data input module will accept EIA708 captioning data and will support an external Dolby Digital encoder. All video modes and formats in the original ATSC Table 3 will be supported, subject to ongoing standard-setting issues.

Four SD channels in a single ATSC transport stream (one TV channel) were demonstrated, with a target of six HD programs or one HD program to be available by NAB ‘98. For the target HD operation, six encoding engines are combined for increased horsepower. Of the six encoder engines used in the HD mode, four are required and two are configured as redundant standbys. For additional reliability, multiple modules of the same type can be installed as redundant pairs, with automatic change-over. The modules are hot-swappable, although redundant units must already be installed to allow seamless replacement of a failed unit.

ATSC transport stream outputs are available in a variety of formats, including ATM and SMPTE 310M. (310M is the new SMPTE standard for the link between the ATSC encoder and the 8VSB exciter. It is in the final stages of standardization.) A unique feature of the FlexiCoder and 8VSB exciter combination is a transport stream frame synchronizer. This decouples the timing reference of the transmitter from the transport stream clock rate, allowing the transmitter frequency stability to be determined by an external frequency reference (GPS, WWV, etc.) if desired.

Larry Bloomfield is a former chief engineer, industry consultant and author, located in Bend, OR.

Who has the best wireless microphone systems?

Systems Wireless is proud to offer and support the NEW Lectrosonics 200 Series wireless microphone systems for demanding field production needs. This is the most advanced wireless in the world, with the most frequencies available to the user, period. When wireless microphones are a part of your life’s work, don’t take a risk. Depend on the folks who have made wireless their life’s work.

- SALES
- RENTALS
- SERVICE
In a year-end action, TV Channels 60-69 (the 746-806 MHz band) were reallocated to other services. Specifically, 24 MHz at 764-776 MHz and 794-806 MHz were allocated to the fixed and mobile services for public safety use. The remaining 36 MHz at 746-764 MHz and 776-794 MHz were allocated to the fixed, mobile and over-the-air DTV broadcasting services.

A proposal has been issued to develop rules for the public safety services that will operate in the Channel 60-69 spectrum and includes criteria for protecting analog TV and future DTV stations against interference.

Channel assignment update

In December, broadcasters responded to filings by the Association for Maximum Service Television (MSTV) and the Association of Local TV Stations (ALTV), which asked the FCC to revise the DTV table of channel allotments. MSTV requested 357 changes to the table saying they were designed to reduce projected adjacent-channel interference among stations operating on the DTV channels and alleviate interference to existing NTSC service and new DTV service. MSTV changes included 32 additional allotments on Channels 60-69. ALTV addressed the disparity in authorized power between UHF DTV channels assigned to stations operating on UHF channels and UHF DTV channels assigned to stations operating on VHF channels. ALTV suggested allowing DTV stations to increase power to 1,000 kW if they use beam-tilt antennas or other technologies to prevent additional interference.

Fees for ancillary DTV signals

The FCC plans to impose fees on stations that use digital spectrum for non-broadcast services and other uses that are supplemental to stations’ over-the-air DTV signals. In an NPR, the FCC asked what methodology should be used to determine the fees. The rationale for imposing fees on ancillary use of DTV spectrum is that the commission does not wish to provide a competitive advantage to broadcasters over wireless licensees who purchased their spectrum at auctions.

The FCC proposed three alternatives to calculate the fees: 1) a percentage of gross revenues, 2) a percentage of net revenues or 3) a combination of both.

Harry Martin is an attorney with Fletcher, Heald & Hildreth, PLC., Rosslyn, VA.
You've got 15 minutes. With a StrataSphere™ nonlinear editing system you can do 33 layers, 19 Diveous™ effects with drop shadows, 26 wives, 17 alpha keys, 44 dissolves, 3 title rolls, composite it all, mix your audio, finish 4 different versions, and still have time to change your mind. Imagine what you can do with 20 minutes.

StrataSphere™

The Ultimate Drive Machine™

The key to unleashing your creative potential is within reach. Experience realtime creativity in the fast lane.

Call us now to set up a test drive. Toll free [ 888-846-7017 ]
DTV Update

DTV: Broadcasting or datacasting?

BY LOUIS LIBIN

There are now more opportunities for broadcasting data and it is the new catch phrase for those who want to take advantage of the digital capacity of the new DTV channel. According to some estimates, the potential revenue from datacasting will ultimately run a close second to broadcasting revenue. In the beginning of the DTV era, however, datacasting has an even higher potential for stations to earn money than even broadcasting premier HDTV programming. To date, there is no conclusive research or evidence to prove the business model of the various datacasting schemes and plans that broadcasters are currently evaluating.

The new digital transmission technology will allow broadcasters to deliver high-definition pictures, CD-quality audio and additionally, data transmissions. The FCC adopted the standard, leaving open the video formats. This means that full flexibility is available to broadcasters for different video formats, all the way from high-definition pictures to low-resolution images. The digital broadcaster will be transmitting only data through its network, leaving it to make the choice of services to occupy the almost 20Mb/s. The use of data broadcasting will allow broadcasters and others to apply part of the 6MHz channel for other services, and these uses may prove to be a significant revenue stream, even at the beginning of the DTV service.

The DTV system owes much of its power and flexibility to the packetized transport technology employed for the broadcast delivery of the multimedia service.

Along with packetization, the transport technology provides two other important functions: multiplexing and synchronization of the services that comprise a program. The transport technology creates a stream of fixed-length information packets from a variety of elementary bitstreams. Each packet contains only one type of data: video, audio or ancillary. Because there is no fixed mix of packet types, the transport mechanism can dynamically allocate the available channel bandwidth for complete flexibility. Each transport packet consists of a four-byte packet header followed by 184 bytes of payload. The header includes means for synchronizing packets and identify-
Introducing the largest scaleable routing switcher...with the smallest footprint.

- A Digital/Analog Routing Switcher scaleable from 8 x 16 to 144 x 144. Low cost expansion to 288 x 288, or beyond.
- Compact 12RU video chassis handles both 60MHz analog and SMPTE 259M digital cards in the same frame. The audio chassis provides two analog, or two AES/EBU digital levels in 8RU. Both frames include redundant power supplies.
- Two outputs/bus with equalization.
- WIN3500 System Controller with Tieline Management supports a wide selection of control panels. Single or dual controllers can be installed inside the video chassis.

Grab hold of a Tiger...

a smart investment for the DTV transition.

You can do it!
Call...1-800-328-1008
Circle (8) on Free Info Card

Corporate Sales • Melville, NY 11747
www.pesa.com
NAB Booth 12970
LVCC—South Hall

www.americanradiohistory.com
Now you can turn a single lightning bolt into a hundred different stories. In a broadcast second. Fact is, "Tektronix" News Solutions can help you produce more news, better news, in less time — with more control.

As integrated video solutions, they can help you automate all the news gathering, editing and organizing. At the same time, they can streamline your entire news production — from assignments to on-air scheduling. But before you start to feel any gigavolt jolts, know this. Tektronix News Solutions can be integrated with tape systems as easily as disk. So you can set your own migration pace on the way to disk. They're scalable. So you can grow from newsrooms of 20 people all the way to 200. And, of course, you can rely on Tektronix' long-running support of these "mission critical" applications. Just so you know, you'll get maximum impact for every broadcast watt — without the risk of natural disaster. See, if you can dream it up, we've got a way to get you there.

For the whole story, call 1-888-TEK-VIDEO, dept. 606 or visit us at www.tek.com/VND
ing payload service. The sync byte, always the first byte of the packet header, contains a fixed, pre-assigned value. A 13-bit field called the packet identifier, also found in the packet header, affords a way of multiplexing various elementary bitstreams. Because the location of the packet identifier field is fixed, packets corresponding to a particular elementary bitstream are simple to extract once packet synchronization has been established. The simplicity of this approach is extremely significant.

An example of a solution for the multiplexing/datcasting problem can be seen with the Philips 4.0+1 DTV compression system. This is a modular system, capable of flexible designs. A station may choose to transmit four SDTV signals in one ATSC datastream. HDTV programming may be added by using an HDTV encoder. External data sources can be inserted, even replacing an SDTV source. One of the primary purposes for this device is an STL replacement, to allow the NTSC and the DTV or multiple DTV channels to be multiplexed together for transmission on a single channel. This is but an example of the types of equipment we will see in the coming months and years.

Louis Libin is a broadcast consultant in New York and Washington.

**Expert's Corner/Vendor Views**

**Planning for DTV**

Within any facility, there are infrastructure issues that once implemented are difficult to change. As stations move toward DTV broadcasts, these infrastructure issues must be revisited. BE contacted two readers and two vendors and posed the following questions:

1) What type of infrastructure would you recommend stations build if they have to convert within the next two years? Is a mezzanine approach adequate today, how about for tomorrow?
2) What if stations don't have to convert until five years from now? Would the answer be different?

---

**EXPERT**

**Group perspective:**

All of our stations are in the 30+ tier and do not need to convert until the end of the FCCs timetable. Therefore, we will be doing only minimal conversion over the next two years. Our facilities consist of a composite analog infrastructure, however, within that infrastructure are other formats, made necessary by color-under and component tape equipment and RGB-based graphics systems. These signals are converted to the house format (analog composite) as needed, and we expect conversion to the house format to remain a staple of our operations. What will change will be the house format.

Facility upgrades and purchases are made with an eye toward a serial digital infrastructure. For example, we are no longer installing 8281 cabling. Wiring is being done with true 75Ω connectors and cabling that supports data rates in excess of 270Mb/s. Fiber is not used unless it is required. Routing switcher frames compatible with serial digital are used, but are being configured with analog crosspoints. As our complement of serial digital equipment grows, so too will the router crosspoints to support it. As our existing cameras are replaced, we are providing them with switchable aspect ratio cameras. In this manner, we hope to preserve our current investment and extend the equipment's useful lifetime.

The concept of local pass-through of network signals is unworkable. Local branding, EAS and local commercial insertion are all required in our current and future operations. A mezzanine level of some type might be supportable, but our anticipation is that incoming and locally produced signals will be converted to a serial digital house format and handled accordingly. We do not expect to support a high-definition infrastructure, but rather to upconvert standard-definition as needed. It does not make economic sense to invest $4 or $5 million in a station that is only worth $4 or $5 million.

Charlie Goode, vice president of engineering, Smith Broadcasting, St. Petersburg, FL.

---

**EXPERT**

**System integrator perspective:**

The choice of infrastructure needed to support DTV programming is primarily a business decision. It is based more on a station's market competition, network affiliations, fiscal capacity and programming content than on a subjectively chosen transmission or production standard. The mezzanine approach of a 270Mb/s routing and distribution scheme, with upconversion and "mole"-aided bitstream splicing for network insertion, is the most cost-effective approach for most stations that need to convert within two years. Once transmitting in DTV, a close monitoring of the competition, and an assessment of the actual financial impact of the new technology will lend clarity to a prudent next step, whether it be further technological upgrade or expanded programming.

Scott G. Griffin, principal and director of engineering, The Systems Group, Hoboken, NJ.

---

www.americanradiohistory.com
Technical Brief:
Studio Camera Technologies and Systems for the DTV Era

By Laurence J. Thorpe
Vice President, Acquisition Systems, Business & Professional Group
Sony Electronics, Inc.
The era of DTV has arrived. A gigantic private sector undertaking has finally forged its way through a long and sometimes difficult process to shape the new American broadcasting landscape. Television is about to change dramatically, and it will change for the better.

All facets of the gigantic television "food chain" are already being touched. From program origination through post-production, distribution, and traversal of the broadcast network infrastructure, to the local station's final program preparation and—finally—transmission to the home, the new DTV agenda is affecting every element of the television system. And, it is affecting the system in ways we would not have dreamed of only a short five years ago.

The DTV agenda of the United States encompasses a new freedom never before known through all of the decades of analog NTSC transmission. DTV can be a digital HDTV (high-definition television) service, or it can be a digital SDTV (standard-definition television) multichannel service. Perhaps most important, it can be any combination of these two. In other words, broadcasters have been assigned a new and separate 6 MHz RF channel through which they can transmit a single channel of HDTV, or multiple channels of SDTV, or any combination of these two services—throughout different portions of a given day or night. The "payload" carried by the mandated digital transmission standard has been effectively deregulated.

It is probably true to say that the new freedom broadcasters now have, in terms of the DTV service that they might ultimately offer, is presently a cause for some confusion and anxiety. The difficult decision of how to start the service, and then how to evolve it to a successful new broadcast business, confronts every broadcaster.

The leading edge of this total television system, namely, the camera or camcorder that originates the DTV pictures and sound, will play a major role in the system that follows. Just the decision of whether to start with digital HDTV, or one, two, three or more widescreen or 4:3 digital SDTV services, poses a basic question as to the appropriate camcorders for the news crews, the cameras for the news studio, and cameras for a production studio or mobile outside broadcast (OB) truck.

In this Technical Brief, Sony will examine the central technical issues confronting the producer and broadcaster when acquiring the program origination equipment that will support their first venture into an embryonic DTV service, while facilitating further flexible migration. What is unique about this DTV era is that different broadcasters may elect to pursue quite different migration strategies to their final service. This poses special challenges to the studio/OB camera manufacturer. Sony's design strategies underlying the new BVP-900/950 digital SDTV studio/OB cameras and the new HDC-700/750 high-definition cameras will be outlined as contemporary solutions to these challenges.

**DTV Requirements in Studio Camera Systems**

What are the key requisites for acquisition systems supporting program origination in this looming era of DTV? What are the essential technical imperatives, in contrast with those of the former analog-only NTSC period? There are four such requirements, given below:

- **Aspect ratio management.** The need to service both the standard 4:3 aspect ratio and the new 16:9 widescreen image format introduces the most difficult challenge of all for the program originator. Aspect ratio conversion entails difficult choices in terms of preserving or discarding precious picture content.

- **Highest picture quality.** In anticipation of DTV, an entirely new yardstick of picture quality will soon be appearing in the living room. This will be propelled by a plethora of new digital delivery media that bring MPEG-2 digital component video directly into the home.

- **Highest signal/noise performance.** There is now an entirely new industry need for the very lowest in picture source noise. Noise is the enemy of compression. Television program masters will henceforth 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.

- **System flexibility.** The diversity of services that any given broadcaster may ultimately deliver, coupled with the still unclear migration to a full widescreen DTV operation (while still maintaining an ongoing standard 4:3 analog NTSC service for some years), augur for particular care in the choice of program origination equipment that is suitably flexible.

The implications of each of these issues are complex, and need to be carefully evaluated against the contemporary technologies available to camera equipment manufacturers. In particular, the ability to deliver full HDTV and a choice of either the 480I or 480P SDTV formats will become more important.
Section I: Camera Technology for SDTV

HDTV and SDTV are both usually distinguished from current analog NTSC by their aspect ratio. 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 be largely 16:9 widescreen, can also be standard 4:3.

As shown in Figure 1, 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 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 anticipated competitive and innovative DTV marketplace.

The management of aspect ratio is a significant new production issue, dealing in a world that will encompass two quite different image formats: the widescreen 16:9 format and the standard 4:3 format. Here we are dealing with the very troublesome issue of picture content, as illustrated in Figure 2. The 16:9 image has 33 percent more horizontal picture content than the 4:3 image.

There is no good way of moving program material in a bidirectional manner between two such formats. Simply put, you can derive an often-times 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.

Figure 3 summarizes a novel Sony approach to the entire issue of implementation of dual 16:9 and 4:3 aspect ratios in a studio/OB camera (the BVP-900/950). The essential point the illustration conveys is Sony’s recognition that this implementation would vary considerably between customers. No one implementation would meet all the needs of a broadcast and production industry that will see different approaches to both the initial start-up and the ultimate migration of DTV services. There are a number of primary variables, including:

- The timetable of the end-user. Being able to upgrade to 16:9, in their time frame, can be very important.

- Some innovative users will start immediate production in 16:9, but would still like to have the ability to also produce in 4:3 if the need arises.

---

Figure 1. The flow of program material between the existing analog NTSC service and the new DTV service.

Figure 2. Exchanging program material between two different image formats is not symmetrical in terms of protecting picture content.

Figure 3. The Integrated Imaging Capsule allows rapid configuration of a camera with a 16:9 or a 4:3 CCD imaging system.
At first glance, it would seem that the switchable 16:9/4:3 camera would meet all requirements. That is not, however, the case in the real world.

Widescreen is fully expected by the marketplace to produce a picture that can be clearly distinguished from traditional 4:3 images, and for that reason alone there can be no short-changing the initial 16:9 image capture. It is for this reason that Sony always employs a full-format, true widescreen 16:9 CCD imager, whenever it images for widescreen.

The suggested approach of using a basic 4:3 imager and electronically altering the vertical spatial sampling structure to implement 16:9—in Sony’s view—is, unfortunately, badly flawed. Sony disagrees with the concept of attempting to synthesize any form of credible widescreen image from switching a 4:3 imager into a 16:9 mode, for the following reason.

Spatial sampling can only be optimized for one format or the other. The all-important optical low-pass filter is a fixed entity that cannot be optimized for two different vertical spatial sampling formats. Vertical aliasing is inherently troublesome in the 525-line SDTV domain, and this is worsened by such an approach. Sony strongly favors the use of a true 16:9 imager and the employment of DSP signal processing to derive a quality 4:3 video format from the widescreen original.

For a television station today, three approaches to dual 16:9 and 4:3 camera operation are useful:

- Configurable
- Simultaneous
- Switchable

We will look at each in turn.

**Configurable**

This approach exploits the innovative Sony concept of the plug-in *Integrated Imaging Capsule*. It uses two optimized CCD Integrated Imaging Capsules—one being a full-diagonal 2/3-inch standard 4:3 format, and the other a full-diagonal widescreen 2/3-inch 16:9 format.

This approach works exceedingly well for those customers who, by the very nature of their business, are regularly reconfiguring studio/OB and companion portable cameras. Mobile truck operators, who alternate between different sports coverage and high-visibility entertainment events, are a classic example of this type of user.

They also fully expect to be reconfiguring their cameras for different events that will be defined by widescreen or standard 4:3. Having an appropriate pool of 16:9 Integrated Imaging Capsules will readily facilitate the transformation of the appropriate mix of studio/OB and portable cameras to 16:9 operation.

**Simultaneous**

This is a very important operational situation. Figure 4 depicts a macro-view of the evolving broadcast station (or production facility) of the near future. Depending upon the agenda of the customer, they will ramp-up some form of DTV while continuing to broadcast 4:3 NTSC. It is expected that these agendas will be widely variable. HDTV may or may not figure into the agenda in the early years. Widescreen 525-line SDTV surely will play a role for most.

Within the dual simulcast NTSC/DTV operation, there will constantly arise the need to service both channels from a single live source. Broadcast news is a prime example. Here, a widescreen camera will directly originate the live 16:9 pictures for the new DTV service, but those same images may also be required for the analog 4:3 NTSC news program.

Sony’s novel (and still unique) ARU-701 aspect ratio converter can take an analog component video output, or the serial digital component video output, from the widescreen 16:9 camera CCU and simultaneously deliver the two required live feeds—each via serial digital interfaces. (See Figure 5.) A switchable camera alone cannot do this.

**Switchable**

As DTV broadcasting becomes more routine, the need to deploy cameras between 4:3 and 16:9 operation will, for many customers, become almost a daily event during the simulcast years (at least until NTSC goes away, many years from now). Now, the switchable camera becomes more attractive.
Figure 5. Use of the ARU-701 digital processor produces simultaneous 16:9 and 4:3 outputs.

The switchable camera will require a DSP camera head and a true 16:9 Integrated Imaging Capsule. This provides the high-performance true widescreen image origination, delivered via a serial digital interface of 16:9 at the output of the CCU. Alternatively, via a remote control switch at the master setup unit, a 4:3 derivative can be digitally created from the widescreen capture and provided as a serial digital stream at the CCU output.

Highest Picture Quality

The overall performance of a television 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).

- Those separate artifacts of the camera system that collectively detract from the overall picture quality.

The name of the game in high-end television camera design is to optimize all of the picture quality factors while minimizing all of the picture artifacts.

The New Importance of Picture Quality

As the transition begins to digital component video origination and post-production—and all-digital transmission to the home—it is very important to take stock of how we specify the true overall performance of picture sources. Widescreen MPEG-2 digital 4:2:0 component 525-line video that is virtually artifact and noise-free will look dramatically different from analog NTSC when viewed in the living room. As a consequence, new criteria for source picture quality will invariably emerge.

In describing the overall aesthetics of the DTV picture, it is essential to re-examine the multidimensional aspect of image quality and to reassign some priorities to the contribution of each of those picture dimensions.

Quantifying the Separate Dimensions of Picture Quality

There are four core attributes of picture quality, as illustrated in Figure 6. 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 gray scale.

- **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 four core attributes, earlier defined, of a television picture. The image quality must be fully retained and—where possible—en-
enhanced within the complex RGB video processing system that follows the imaging system.

Thus, the operational picture performance of a camera is totally determined by the combination of the CCD optics, the imaging system and the RGB video processing system. Table 1 shows the relationship between the CCD imaging parameters and the associated video processing that together contribute to each of the four primary dimensions of picture quality.

### Achieving the Highest Picture Quality: The Pivotal Technological Linkage of a New CCD and ADSP

What is different about the Sony approach to Advanced DSP (ADSP) is that it was not born of an isolated technological advance in RGB video signal processing. Rather, Sony's ADSP was part of a larger advanced imaging strategy that carefully coordinated two important, but separate, development programs. It comprised no less than a strategic mobilization of the separate technologies of CCD imaging and DSP processing to enhance the multidimensional aspects of a number of important imaging parameters.

The specific goal was to advance digital video imaging simultaneously, on two fronts, with the intent to produce the highest performance SDTV camera in the industry. These two development programs included:

- The introduction of an advanced new CCD imager that would simultaneously improve dynamic range and S/N.
- The move to the long-sought 12-bit DSP, which would simultaneously facilitate a better match with the high dynamic range of contemporary CCDs, and higher S/N.

![Figure 7. The three core performance attributes of the CCD imager that combine to expand the exposure latitude of the studio camera.](image-url)

### The New CCD Imager

We unceasingly refine the core technologies of CCD imaging. These refinements are not merely isolated advances in semiconductor physics. Rather, they constitute carefully planned development programs targeted at improving specific picture attributes that have been clearly identified by Sony's camera design teams. These engineers are a formal part of design reviews for any new CCD development programs.

The award-winning Hyper-HAD™ technology was spawned from this synergistic coordination of a focused program to make a significant breakthrough in television camera dynamic range, actually thrusting its imaging capability—in this respect—beyond the legendary capabilities of motion-picture film. Sony did not stop there.

The company, some time ago, elevated the priority of sensitivity, S/N, and dynamic range as a system "imaging troika" that Sony would optimize in concert. This imaging troika is illustrated in Figure 7. Equally important, when Sony attempts to optimally reproduce the superb CCD imaging capability at the lower end—toward optical black—as well as the overexposed signal ability, it speaks of a total imaging dynamic range in excess of 70 dB! As much priority needs to be assigned to this crucial lower region of the exposed signal as to the higher signal level region. Clearly then, care must be exercised in the priorities assigned to the A/D amplitude scaling applied to this unprecedented level of video signal [1]. This is the very essence of the Sony strategy to significantly improve overall picture quality.

![Table 1. System linkage between the CCD imager characteristics and the video DSP processing in determining overall camera performance.](table-image-url)
Sony's Approach to 12-bit ADSP

The analog-to-digital (A/D) quantizing levels have a direct bearing on the S/N performance of the DSP processing circuits in a camera system. Over the linear video A/D output range from black to nominally exposed reference white level, the video S/N is given by the well-known formula,

\[ S/N = 10.8 + 6 \cdot N \ (dB) \]

Where \( N \) = the number of bits assigned to that range.

Table 2 summarizes the quantization S/N ratios of various levels of DSP amplitude sampling.

The significance of this DSP S/N quickly emerges when the concatenation of this S/N with that of the CCD itself is examined. Sony set as a central design target, for the new BVP-900/950 cameras, that the amplitude sampling of the video representation of a nominally exposed signal (capped black to nominal 100% exposed reference white) must be at least 10 bits. The remaining bits would be delegated to handling the overexposed signal.

To ensure the highest S/N camera for the era of SDTV, it is essential that the CCD imager be the defining element of that noise level. This demands that the DSP quantization noise be of a far lower level than the CCD imager noise. In this respect, a rule of thumb is that the DSP quantization noise will have less than a 1 dB effect on overall camera S/N if the DSP S/N is about 6 dB higher than that of the CCD. Figure 8 illustrates this critical issue by examining two cases: one where the CCD and the DSP have the same S/N, and a second where the DSP has an S/N approximately 10 dB higher than that of the CCD.

### The 12-bit DSP Camera: The New BVP-900/950

It is in recognition of this major S/N system optimization that Sony's design approach to 12-bit digital video processing is markedly different from that of some competitive 12-bit DSP cameras. This difference is significant. Figure 9 shows the contemporary approach used for the assignment of the 12 bits to the full CCD linear output signal. Here, priority has been given to a linear quantization, based upon a plausible argument that handling the compression of the overexposed signals entirely in the digital domain constitutes the achievement of a goal of the true digital processing camera [2].

The resulting 9.2-bit amplitude scaling applied to the nominally exposed signal produces a DSP quantization noise in the vicinity of 65 dB, which, if concatenated with a 62 dB CCD, would produce an operational S/N of about 60.5 dB.
10 bits to the nominally exposed (reference white chip of gray scale chart at 100% video level) signal.

Accordingly, Sony uses an analog pre-knee processing technique before the 12-bit A/D converter. This is a careful compromise—a fixed and accurate analog compression of highlight information—one that facilitates unique and sophisticated downstream digital processing of the important overexposed highlight information. The results of this approach are shown in Figure 10.

This scheme produces an effective operational S/N performance for the camera of 65 dB, a number that sets a new yardstick for the industry and assures the requisite ultra-low noise source that will be important in the era of compressed SDTV transmission. Table 3 shows how this S/N is produced, being a concatenation of the 66 dB of the new CCD and the 10.3-bit allocation to the quantization of the nominally exposed video.

The issue of S/N, however, is only the first key performance issue. The second is the effective dynamic range of the CCD/DSP combination, which—in turn—will determine the operational exposure latitude of the camera itself.

It must be emphasized that 12 bits are still not sufficient to properly quantize the extraordinarily high linear dynamic range signal that a contemporary CCD can produce. Today, Sony typically talks in terms of overexposed CCD linear signal output capabilities in the vicinity of 600 percent! At least 16-bit linear quantization is required to do justice to such an extraordinary signal range if it is to be handled entirely in the digital domain, as shown in Table 4.

Unfortunately, 16-bit high-speed A/D and video processing is beyond today’s technology. Various techniques for pre-processing the linear analog output from the CCD imaging system have, therefore, been utilized to optimally match this extraordinarily wide video signal dynamic range to the capabilities of a given A/D converter. Given this limitation, Sony carefully deploys the 12 bits to optimize both S/N and dynamic range. True optimization of exposure latitude (this is bound up in issues of CCD sensitivity, dynamic range, and noise floor) is the primary goal.
Section II: Camera Technology for HDTV

The nature of the U.S. DTV agenda suggests that the majority of broadcasters will inevitably become involved in providing both digital HDTV and digital SDTV services. This duality poses a serious dilemma to the broadcaster and program producer in terms of planning their capital outlays over the early years of DTV. In recognition of this fact, and of the quite unpredictable nature of the overall migration from 4:3 analog NTSC to widescreen DTV, Sony has adopted a core strategy to make HDTV program origination equipment as multipurpose as possible. Multipurpose, meaning the flexibility for one studio/OB camera system to deliver both HDTV and SDTV outputs. The latter one available as a choice of the ubiquitous ITU R601 4:2:2 480I standard, or the new 480P version of that basic format.

A flanking strategy was to design that camera to be as cost-effective as possible, so that the HDTV premium paid above the typical cost of a present-day, high-end, 525-line equivalent camera system would be well-justified by this dual format capability. The center of the strategy was to firmly embed the new HDVS (High-Definition Video System—the logo used by Sony for its line of products to support HDTV program production) cameras within the existing BVP series of SDTV/NTSC studio and portable systems. Maximum system compatibility would be maintained; lens interfaces (optical, mechanical and electrical) would be maintained; and—to the degree possible—all physical components would be common between the two camera families.

The HDC-700 is a full-featured studio/outside broadcast camera utilizing Sony’s two million pixel Hyper-HAD frame-interline transfer (FIT) CCD imager. The HDC-750 is a companion portable HDVS camera that perfectly matches the performance and operational features of the HDC-700. It can, however, be used in a stand-alone portable configuration for highly mobile field acquisition. It can also be configured for full studio operation with the same CCU and control panels as the HDC-700. Figure 11 illustrates the integrated camera HDTV/SDTV system.

The cameras utilize the same housings and chassis as the contemporary BVP-900/950 and BVP-500/550 SDTV camera families. The unique high-speed digital control sys-

---

**Figure 11.** The master design strategy to integrate SDTV and HDTV studio and portable camera systems.
The benefits of this master design plan are twofold:

- Migration from the present analog 4:3 525-line world to widescreen digital SDTV or full HDTV is made easier with a variety of transition paths.
- Important manufacturing economies of scale were gained that dramatically lowered the price of the new HDTV camera systems.

Having set the stage for the transition to HDTV, the HDC-700 studio camera and its portable companion HDC-750 will next be outlined in terms of the four key criteria earlier defined for DTV.

### Management of Aspect Ratio

The HDC-700/750 cameras originate in 16:9 widescreen HDTV. Both of the cameras also provide a simultaneous feed of downconverted 525-line SDTV. The cameras are, thus, multipurpose in that they simultaneously deliver serial digital outputs of both HDTV and SDTV. This “two for one” capability offers broad operational flexibility in that it enables the servicing of both forms of DTV (for those who will offer both HDTV and SDTV), or it allows a paced migration from an initial SDTV program service to full HDTV at a later time.

The troubling conversion of widescreen SDTV to a standard 4:3 format can be a creative decision requiring some production flexibility. The HDC-700/750 provide remote control (from the MSU or the RCP video panels) of a variety of aspect ratio conversion choices. These include:

- **Widescreen 16:9 525-line SDTV.**
- **Standard 4:3** derived from the 16:9 downconversion, with remote variable control of pan-and-scan.
- **Letterbox** version of the full widescreen image within the standard 4:3 format.

### Picture Quality

Just as with the SDTV camera, the front-end CCD imager goes a long way toward the ultimate determination of the HDTV camera picture quality. And again, the criteria of picture sharpness is directly related to the pixel sampling structure, while the remaining key criteria of tonal reproduction, color reproduction and exposure latitude are all largely bound up in the quality of the individual CCD sensor.

Sony expended enormous resources in perfecting the HDTV CCD imager. It first introduced the 1920 x 1035 pixel CCD to the U.S. market in 1992 with the HDC-500 camera [3]. Refinement of the HD CCD technology has been ongoing since that time. At NAB in 1997, Sony introduced the 2/3-inch, two million sensor CCD using Hyper-HAD and FIT technologies.

A distinct advantage of such a multipurpose camera is that the downconverted SDTV video is of a highly technical quality. The original HDTV imaging effectively constitutes a “super-sampling” system in both the horizontal and vertical domain (with a 1920 x 1080 sampling lattice), both of which are subsequently interpolated down to the 4:2:2 SDTV structure of 720 x 480 samples using very sophisticated digital techniques. In the vertical direction, this means a higher overall modulation transfer function (MTF) and much less aliasing than that created by a 525-line camera. In the horizontal direction, it also allows a higher MTF and less aliasing for the downconverted SDTV signal.

As illustrated in Figure 12, the CCU delivers three outputs of serial digital HDTV and two outputs of serial digital 525-line SDTV. In the case of the progressive scan SDTV output, each 540-line Field of HDTV is digitally converted to a high-quality 480-line Frame.

### Signal to Noise

The HDC-700/750 cameras employ a new 2/3-inch, two million pixel CCD for each of the RGB video channels. These Sony-developed CCD imagers (FIT technology) are the culmination of a decade of technical development. They utilize the latest in Hyper-HAD techniques in the sensor design, which yields a high luminance S/N performance of 54 dB (measured unweighted over a 30 MHz bandwidth). While it is difficult to directly relate this specification to contempo-
System Flexibility

The HDC-700/750 cameras were designed to meet all needs for outside broadcast in HDTV. In particular, long cable connections between the camera heads and their CCUs are the key to system flexibility for large sports and entertainment event coverage. Both cameras utilize two-way, all-digital transmission of video, audio, intercom, control and status signaling. These are 1.5 Gbits/s serial digital transmissions (both directions), according to the SMPTE 292M standard. Such transmission data rates negate the possibility of multicore or triax cable. Accordingly, a new fiber-optic interface has been developed to facilitate this transmission over a 3,000-meter (>9,000 feet) length, as shown in Figure 13. This camera fiber interface is presently in the final stages of standardization by SMPTE.

The technical advantage of this approach is enormous, providing a digital link of high signal integrity, which ensures that the full quality of the HDTV image created in the camera head is made available at the CCU output interface. Perennial problems associated with triax transmission on long cable lengths are a thing of the past in HDTV: no more electromagnetic or RF interference, no timing skewing, and minimal equalization problems.

A New Era for Camera Technology

The dawn of DTV, and especially HDTV, promises to reshape the television industry in short order. New digital devices and systems are rapidly replacing important elements of the NTSC-based analog past. Cameras are, of course, a crucial element in the chain that will bring crystal-clear images to consumers. New advances in imaging and digital signal processing developed by Sony have given broadcasters, content producers and production houses the tools they need to succeed in the DTV revolution.

References


A MASTER PLAN FOR DTV

For more information, contact your Sony Account Manager:

NORTHEAST REGION
123 West Tryon Avenue, Teaneck, New Jersey 07666 (201) 833-5200

MID-ATLANTIC BRANCH
9901 Business Parkway, Lanham, Maryland 20706 (301) 577-4850

SOUTHEAST REGION
3175A Northwoods Parkway, Norcross, Georgia 30071 (770) 263-9888

MIDWEST REGION
1200 N. Arlington Heights Road, Itasca, Illinois 60143 (630) 773-6000

SOUTHWEST REGION
8400 Esters Boulevard, Suite 500, Irving, Texas 75063-2214 (972) 915-3100

WEST REGION
10833 Valley View Street, Cypress, California 90630 (714) 220-9100

SAN JOSE HEADQUARTERS
3300 Zanker Road, San Jose, California 95134 (408) 432-1600

www.sony.com/professional
BC-00645
Copyright 1998 Sony Electronics©. All rights reserved. Specifications subject to change without notice.

12 Sony Technical Brief
The same two questions were posed to vendors familiar with infrastructure issues.

VENDOR

One of the most basic questions a broadcaster faces in planning for DTV is whether to go single-program high-definition or multiprogram standard-definition. Many broadcast stations still have analog NTSC facilities. If broadcasters elect to jump all the way from NTSC to HDTV, but consumers don’t buy into HDTV, they could find themselves sitting on a high-tech elephant. If, on the other hand, broadcasters bet on multichannel SDTV and convert their NTSC facility to component digital 601, they might be at a competitive disadvantage if HDTV is a hit. What’s needed is a strategy for converting an analog NTSC facility to digital, while preserving the flexibility to later use the facility for either HDTV or SDTV.

Proper application of compression in a DTV facility can provide this flexibility. If we use 270Mb/s or 360Mb/s serial digital routing and distribution within a facility, we can support lightly compressed HDTV or non-compressed SDTV. Broadcasters can safely convert to digital now, implement 16:9 widescreen operation at the appropriate resolution for their market and know that the basic infrastructure is future-proofed to handle SDTV or HDTV.

But what if a broadcaster doesn’t have to convert to digital until five years from now? Because 16:9 widescreen is a key part of DTV, the sooner broadcasters convert to 16:9 digital, the sooner they can start building their library. By choosing the right balance of 16:9 SDTV, lightly compressed HDTV and full 1.5Gb/s HDTV, broadcasters can be sure that their investment in digital television has immediate and long-term value regardless of whether DTV means SDTV, HDTV or both.

VENDOR

The DTV infrastructure will inevitably encompass the duality of routing/distributing and networking. This duality includes routing and distributing uncompressed baseband SDTV and HDTV video and multichannel audio, in addition to networking digitally compressed SDTV/HDTV/ audio signals. For high-definition production, the baseband network will encompass digital “islands” largely using the SMPTE 292M HD SDI interface.

Sony has embraced the international MPEG4:2:2 P@ML compression standard as the basis for production, transmission and distribution (via the new SMPTE SDTI transport interface standard) of SDTV. An extended family of MPEG levels will serve the HDTV applications.

Four imperatives form the underpinnings of the approach being taken by Sony: 1) highest possible picture quality based upon the 4:2:2 digital component set for all broadcast applications — adequate data; 2) highest possible storage efficiency on disk (realize cost-effective DTV servers) — minimum data rate; 3) utilization of the installed base of digital routers — attempt to maintain the maximum DTV data rate below 270Mb/s; 4) utilization of existing digital VTRs for tape streaming — data rates commensurate with those VTRs.

An 18Mb/s implementation of such a system has already been brought to the marketplace.
The new Origin video computing platform.
It's about time.
It's about
Introducing the Origin™ video computing platform from Silicon Graphics. It’s time you had everything you wanted, everything you needed and everything your competitors didn’t want you to have in one, rack-mountable, digital broadcast platform.

Time will tell which digital video formats become the standards of our industry, so the Origin platform supports them all. From the biggest uncompressed formats to the most multi-channel playout streams, from HDTV to low bit-rate MPEG, run them all today.

Time also changes everything, so we’ve given the Origin platform more scalability and flexibility than any dedicated box. Store months of on-line video, fast-network to any local desktop, run world-class applications, support standard automation systems and StudioCentral™ asset management environment. Want advanced graphics? Origin will let you add it. That’s power and flexibility.

When you’re ready to see what the best system in the industry can do, visit us on the Web. But don’t wait too long. Time is money and of the two, we can only make you more of the latter.
Testing CCIR-601 serial digital distribution

BY MICHAEL ROBIN

The need to satisfy the complex signal distribution patterns typical of large teleproduction centers led to the development of the bit-serial distribution concept. For this type of distributing signal can then be transmitted on a single coaxial cable. This signal has a high bit rate (270Mb/s) and an associated spectrum on the order of 1GHz. When properly installed, this system on the cable loss equalization capability of the receiver, are typical.

Figure 1 shows a block diagram of a bit-serial digital signal distribution model. The source encoder is a conventional group of three A/D converters whose outputs are multiplexed into a 27Mword/s bit-parallel datastream. The channel encoder transforms the bit-parallel datastream into a bit-serial digital signal suitable for transmission through the chosen medium (e.g., coaxial cable). The receiver channel decoder deserializes the received bit-serial signal and recovers the bit-parallel digital video signal, which can be converted back to analog, if necessary, by a set of three D/A converters. Problems can arise due to excessive cable losses, that result in a low signal-to-noise ratio (SNR) and a high bit error rate (BER). Additionally, interference caused by thermal noise contributed by the receiver input stage, can corrupt the signal.

Standard interface characteristics and performance

SMPTE 259M describes the bit-serial interface for 525/59.94 and 625/50 equipment. It has applications in video facilities using coaxial cable. Cable lengths must not exceed the amount specified by the equipment manufac-
urer (typically 300 meters). A signal loss of 30dB at the clock frequency is normally acceptable. The interface characteristics are summarized in Table 1. The typical eye diagram of the bit-serial digital signal and some significant characteristics are shown in Figure 2.

Figure 3 shows a classification of bit-serial performance indicative of parameters related to the transmitter, distribution medium and the receiver of the bit-serial signal. Three areas of performance-related engineering concerns are as follows:
1. evaluation of equipment and technology;
2. post-installation acceptance tests; and
3. maintenance tests.

**Measuring signal parameters**

For SDI, measuring signal characteristics requires accuracy, speed and reproducibility. It is advantageous to use a digitizing oscilloscope with a bandwidth on the order of 2GHz, which can be programmed to measure a set of parameters and display the results. Parameters to be measured include amplitude, rise time and fall time, jitter, overshoot and undershoot.

Jitter measurements require a suitable reference. The reference can be external to the equipment to be tested, resulting in absolute jitter measurements, or derived from the signal to be measured, resulting in relative measurements. The bandwidth of the relative jitter measurement depends on the clock recovery method used, because the recovered clock signal will contain some of the signal characteristics. A jitter measurement bandwidth of 10Hz to 27MHz yields timing jitter values, whereas a measurement bandwidth of 1kHz to 27MHz yields alignment jitter values. When measuring jitter, it is important to mention the reference clock source.

Waveform monitors belonging to the Tektronix WFM601 family can be used to carry out signal characteristics measurements. However, many of these instruments have a measurement bandwidth on the order of 300MHz, which affects the rise time/fall time and overshoot/undershoot measurements. This requires the use of a correction formula (check with the

**Figure 2. Eye diagram measurement dimensions.**

"LOOK WILCOX, THE DIGITAL COMMUNICATIONS TREND IS CATCHING ON EVERYWHERE," WHISPERED SNELL.
(manufacturer) to obtain credible results. Some waveform monitors offer a choice of derived reference clock bandpass allowing the user to determine the dominant frequency of jitter.

Transmitter output return loss is an important performance indicative parameter, especially for relatively short cable runs. Measuring this parameter, however, requires special network analyzers.

Bit-serial digital video equipment, especially large-capacity routing switches, may generate high levels of EMR. Equipment design and safe installation practices can help reduce EMR to acceptable levels. EMR levels of equipment and installations can be measured using a calibrated antenna and a spectrum analyzer.

For receivers, in addition to the input return loss, several other characteristics should be measured. These have to do with the receiver's ability to extract the original data from a noisy and jittery input signal. Two special test signals have been developed to meet

"CLEARLY THE RESULT OF AN EARLY EXPERIMENT IN COMPRESSION..." MUSED WILCOX.
EXPLORE THE DIGITAL FUTURE WITH SNELL & WILCOX

MARVEL AT THE STUNNING WIDE-SCREEN PICTURES!

SNELL & WILCOX
Engineering with Vision

Circle (27) on Free Info Card

www.americanradiohistory.com
Networking basics, Part 2: Faster is better

BY BRAD GILMER

If you are building a network from scratch, you might be asking yourself, “Should I be looking into something faster than 10Mb/s?” “How much more will it cost to install a faster network?”

The cabling, connectors, patch panels and wall plates will cost you exactly the same for 100BaseT as for 10BaseT. The labor cost associated with installing these components is the same too — about $125 per desktop. The pieces at the ends of the cable — the network interface card (NIC) and the hub — are the only price difference. The NIC plugs into your PC. The hub is at the center of the star and serves as a central connecting point. (See Part 1 in January.) Even the NIC and hub costs are similar between 10BaseT and 100BaseT. A six-pack of 10BaseT NICs can be purchased for about $200 — about $34 per card. A totally dumb

Table 1. Characteristics of bit-serial interfaces.

<table>
<thead>
<tr>
<th>CHANNEL CODING</th>
<th>SCRAMBLED 4RZI</th>
<th>INPUT SIGNAL POLARITY: POSITIVE LOGIC</th>
<th>DATA WORD LENGTH: 16 bits</th>
<th>TRANSMISSION ORDER: LSB OF ANY DATA WORD TRANSMITTED FIRST</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSMITTER CHARACTERISTICS</td>
<td>UNBALANCED OUTPUT</td>
<td>SOURCE IMPEDANCE: 50Ω NOMINAL</td>
<td>RETURN LOSS: &lt;15dB (50Hz TO CLOCK FREQUENCY OF SIGNAL)</td>
<td>OUTPUT SIGNAL AMPLITUDE: 300mV p-p ±10%</td>
</tr>
<tr>
<td></td>
<td>DC OFFSET: 0.0 V ±0.5 V WITH REFERENCE TO MID-AMPLITUDE OF SIGNAL</td>
<td></td>
<td>RISE AND FALL TIME: 0-4ns TO 10-9s BETWEEN 20% AND 80% OF SIGNAL</td>
<td>AMPLITUDE POINTS: DIFFERENCES NOT TO EXCEED 0.5nS</td>
</tr>
<tr>
<td></td>
<td>OVERSHOOT OF RISING AND FALLING SIGNAL EDGES: &lt;5% OF SIGNAL AMPLITUDE</td>
<td></td>
<td>JITTER: 0.2 µs (8.74ns) BETWEEN 10Hz AND 27MHz</td>
<td></td>
</tr>
</tbody>
</table>

| RECEIVER CHARACTERISTICS | UNBALANCED INPUT | INPUT IMPEDANCE: 75Ω NOMINAL | RETURN LOSS: <15dB (50MHz TO CLOCK FREQUENCY OF SIGNAL) | OPTIONAL CABLE-LOSS EQUALIZATION: 30dB AT CLOCK FREQUENCY OF SIGNAL |

Note: The pathological test signal (SDI checkfield) is defined in SMPTE RP 178. It is used to test the performance of bit-serial equipment. The signal is generated by a digital interface card (SDI) connected to the digital input of a receiver.

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

Tests both active video and auxiliary data portions of SDI signal and displays embedded audio stream numerically or as a waveform for easy recognition of proper test tones. 'Stop on Error' trigger catches auxiliary data embedding errors and embedded audio errors.

Jitter injection, amplitude attenuation, and error injection tell you if interconnections have enough headroom.

Edge diagram of digital waveform. Clearly displays waveform shape and jitter. Fast, automatic eye-diagram waveform measurements are readable from remote control port.

Long-term digital error logging can grab 400 complete errored frames for unattended burn-in and overnight testing.

Built-in test pattern generator provides stimulus and analyzes results conveniently. You get 32 test patterns and the ability to grab, create and store up to 400.

Advanced jitter features include FFT analysis with automatic measurements, output BNC connectors for demodulated jitter and reference clock to identify 'fingerprints' of jitter sources.

The DVA184C

It's all here. Complete digital SDTV and widescreen testing at 270 and 360 Mbps, all in one very serious instrument that's also easy to use. The DVA184C is so accurate, fast and conclusive, you can bring systems up in much less time, ship product on schedule, and nail equipment incompatibilities before they nail you. Plus, the DVA184C has been well-proven, with demanding folks like HBO, ABC and SGI. Give us a call at 650-364-1853, or hit our web site today.

SYNTHESYS RESEARCH, INC
www.synthesysresearch.com
Circle (28) on Free Info Card

See us at NAB April 6-9 in the Sands Convention Center, Booth S4920
10BaseT hub will cost about $100. A six-pack of 10/100 cards that will run either 10BaseT or 100BaseT costs $350, and a dumb 100Mb hub costs approximately $400.

**Dumb hubs or smart hubs?**

Hub prices vary greatly, ranging from $400 to $2,500 for a 10/100 Ethernet hub. So, why is there such a big difference in price? Quality of components may have something to do with it, but the larger reason is differences in functionality.

**How can I go even faster?**

One way to go faster is to purchase faster cable. There are cable technologies on the horizon that promise connectivity over wire at rates up into the gigabit range. Standards for some of these technologies have not been set, and equipment availability is constantly changing. One thing is certain — faster wire-based technology will be available soon. The best thing is to speak with someone knowledgeable about networking when you are ready to begin work, and purchase the fastest wiring available at that time. Once the cost of installation, NICs and a hub are considered, cable cost becomes much less significant.
LIKE OTHER TOP PERFORMERS, THE LONGEST LASTING BATTERY USES A STAGE NAME.

Around the house, DURACELL® batteries go by the name The Copper Top®. But on the job, the longest lasting batteries answer to PROCELL® PROFESSIONAL™ BATTERIES. PROCELL batteries are DURACELL® batteries. The longest lasting professional alkaline batteries you can buy. You get the same DURACELL performance. The same DURACELL dependability. The same DURACELL value, and more, because PROCELL Professional Batteries are specially priced and packaged for professional use. Now that’s one act that’s hard to follow. For more information or a distributor near you, call 1-800-4PROCELL. Ext. 33.

Circle (30) on Free Info Card
What about fiber?

What about running fiber to the desktop for the ultimate in speed? Fiber connectivity provides the greatest potential for high-speed networking to the desktop. But, fiber has found its true niche in connecting hubs together behind the scenes. Here are some of the reasons. The first is installed cost. It costs about $2.50 per line for fiber line, terminations, wall plates and jumpers. A fiber hub costs anywhere between $1,500 and $3,000, depending on the features. Fiber NICs are also more expensive — a six-pack of FX fiber NICs is about $2,000. Second, fiber media can be easily damaged. The cables are better than they used to be, but it is difficult to protect a fiber cable in an office environment. The big killer of fiber cables is not crushing, it is bending the fiber too tightly. Third, fiber terminations are sensitive to dirt. If you leave a fiber termination uncovered and reconnect the cable before you clean both surfaces, you may end up with a connection that is noisy at best. On the positive side, gone are the days of the old biconic fiber connectors where alignment was a real problem. The new FC connectors always mate correctly with little problem. Once you connect the fiber, dirt is no longer a problem. Taken together, these three issues have relegated fiber to the back room where it is a better fit in the computer network environment.

Fiber has a big advantage over wire in areas of high electromagnetic interference, impulse noise and lightning. If you continually have a problem with lightning destroying the NICs, you might try switching to fiber. Another advantage is distance. Fiber can be used in runs up to 412 meters. 10BaseT and 100BaseT are limited to 100 meters.

If you have ever tried terminating fiber cables in the past, you probably still have nightmares about sanding little figure eights. All that has changed. 3M, Secor and others now make crimp connectors and splices for fiber that allow you to terminate fiber easier and cheaper. (See Figure 1.) If you were not all that great at making splices in the past, you can probably do better with these. Losses will be in the one-half to one decibel per connector range. A connector kit costs about $350 and connectors are about $6 each.

Although it is difficult to make a single recommendation that is right for everyone, here are some thoughts. Let’s assume that you are going to install a small network with 10 workstations. Given that the cost of 10BaseT and 100BaseT is about the same, and given that you can purchase equipment that runs at 10Mb and 100Mb, then you should probably purchase 10/100 cards and wire your facility with the fastest wiring system available. Minimize your initial hub investment and plan on replacing it in a few years as your network grows.

Brad Gilmer is president of Gilmer & Associates, Inc., a technology and management firm.

FURTHER READING

The following sites on the web contain more information on 100BaseT and fiber:

* "Data Communications Cabling FAQ" compiled by readers of the comp.com cabling newsgroup.
  * www.hcstots.utexas.edu/ethernet/descript-100quickref.html
  * www.cis.ohio-state.edu/hype-test/faq/usenet/lans/cabling-faq/faq.html

Brad Gilmer left a 14-year stint at Turner Broadcasting Systems, Inc. to start Gilmer & Associates, Inc. Brad’s consulting company specializes in designing and implementing multi-channel and DTV broadcast facilities — especially those facilities that employ high-speed video networking. You can reach Brad at 770-414-9952 or on the Internet at bgilmer@atlnet.com.

Ask Dr. Digital

Bringing a scope back to life

BY STEVE EPSTEIN

As promised last month, we’re here to help. Along those lines, one of my assistants recently received a plea for help from Brian Hoover, chief engineer at WNIT, the PBS affiliate in Elkhart, IN. It seems Brian was in the middle of rebuilding a Tek 529 and needed some information that ran many years back in Broadcast Engineering magazine.

Well, we dug deep in the archives and it turns out that the article Brian was looking for was written by Ken Dixon and ran in our December 1978 issue. It discussed modifying the 529 to replace the 7788 tubes (yes, tubes) used for vertical output with 2N3439 transistors. Now, I’ve repaired a few 529s in my time, and most of them had already been modified. Why anyone would want to keep one of those beasts alive is beyond me, but hey, I just spent my entire weekend rebuilding/restoring a 50-year-old micrometer (ACE Hardware sells them for $29.95, but it was my wife’s grandfather’s). So, who am I to say? Regardless, we sent Brian the information he needed.

Shortly thereafter...

Received your fax with the magazine article and schematic diagrams. Repaired the scope and it works great. Please have lunch on us grateful WNIT engineers!

Brian L. Hoover, Chief Engineer
WNIT-TV, Elkhart, IN

Enclosed in the letter were some fast food lunch coupons (hint, hint).

Thanks, Brian.
Now with Special Pricing on Betacam SP,
guess what the SP stands for?

Now's the time to take advantage of Sony's highest quality Betacam SP format. BVW series list prices have been lowered by 15%. Key part prices have been lowered by 30% on average. And there is a new, extended warranty. The BVW series recorders and players deliver robust, solid performance under critical conditions, using either metal or low-cost oxide media.

Expand and enhance your production capabilities with Betacam SP. There's never been a more affordable time to own Betacam SP. For more information on these special prices, call 1-800-635-SONY, ext. SP.

www.sony.com/professional
Well, I don’t think that Tektronix has to worry too much about a warranty claim on that scope. We’re here to help you. So, if you’ve got a technical problem, complaint or question, send it to dr_digital@intertec.com. Include as many pertinent details as possible, such as what you’ve done already and who you have talked to at the manufacturer and I’ll see what I can do.

Steve Epstein

Several years ago I was hired as the chief engineer at a station in southern Illinois. Included in the station’s equipment complement was a 10-foot satellite dish that was used daily for a variety of feeds. Apparently, it was designed for use at a cable head-end because it was not motorized. Two hand-operated jacks allowed it to be aimed at the desired bird. Sometime before I arrived, one of the hand jacks was replaced with a motorized unit. After I was on board several weeks, I found out the dish could only be aimed at the birds in the center of the arc. It seems that once the dish was moved too far east or west, the motor (which was basically designed for a six-foot mesh dish) was not strong enough to lift the dish back up.

After doing a little research, it became apparent why a larger (stronger) jack wasn’t used; it simply wasn’t available in the necessary size for a reasonable amount of money. For the most part, there were consumer units and models for five-meter and larger dishes — but nothing that was in between. Another solution was needed. Because I couldn’t use a bigger jack, maybe I could lighten the dish. Counterweights are fairly common in many applications, I figured one could help here as well.

A series of calculations led me to believe that 150 or so pounds of counterweight on about a five-foot lever arm would offset the weight of the dish. Luckily, the metal and fiber-glass dish assembly had a metal frame that provided support for the rather massive counterweight. Using mostly two-inch pipe, a local machine shop fabricated the “iron cross” and the necessary mounting hardware. The end of the long pipe was threaded to accept a standard pipe cap. Removing the cap allowed the counterweights to be added as necessary.

The counterweights (two large and one small) were made from six-inch steel sleeves large enough to fit around the two-inch pipe. Four “spikes” (three-inch carriage bolts) were welded to the outside of the sleeve to provide some additional grip for the concrete. The spiked sleeves were placed in the center of a wooden form and the concrete was poured around them and allowed to harden.

When everything was assembled (except the jack) and the counterweights adjusted, the dish could be moved from horizon to horizon with little more than finger pressure. The jack was then remounted and with some adjustment, provided full coverage of the arc. At that point, the dish could be aimed at any satellite. However, one small problem became obvious over the next few weeks. It seemed that when the dish was pointed nearly due south, the signal strength would bounce around a bit. Looking at the dish, I noticed it was being blown around by the wind! The problem was mechanical “slop” in the jack. Re-adjusting the counterweights added some load (25 to 50 pounds) to the jack, eliminating the dish blowing in the wind.

Manufacturing the “iron cross” ran about $300, but it eliminated the majority of the wear and tear on the motor/jack assembly. It also improved the functionality of the dish by more than 300%. Other than an occasional tune-up, that dish required no additional maintenance the rest of the three years I was there.
Maximize your footprint and get the impact you need with the cleanliness you deserve!

Years of research and experience in digital compression and limiting techniques for CD mastering have led TC Electronic to the development of the five-band DBMAX processor.

The DBMAX was brought to life in close cooperation with chief engineers at broadcast facilities world-wide, resulting in a powerful broadcasting tool, that easily interfaces with all analog and digital audio broadcast formats.

Used as a Transmission Processor, the DBMAX ensures a louder and more consistent signal, thereby enhancing the signal within the actual coverage area.

Better coverage means you get better ratings, which in turn makes the DBMAX a sound investment!

The DBMAX doubles as a great Production Tool at all resolutions and sample rates, offering optimized program material without the sacrifice of sound quality.

Radio, TV & Film Post Optimizer:
- Ultimate mastering processing: Louder, crisper, warmer, punchier, more subtle, more spectrally-balanced production
- 5-band Eq, Dynamic filtering of spot/trouble frequencies, 0 or 90 degree mono summing, MS-decoder etc
- AES/EBU I/O and sync-input as well as 24 bit AD and DA-converters
- Full 24 kHz audio bandwidth at 48 kHz sampling frequency

Transmission Processor:
- Transparent 5-band on-air dynamics processing
- Presets available for DAB, FM and AM transmission
- all pre-programmed and easy to set up
- Simultaneous AGC, Compressor, Limiter and Soft Clipper
- Enhanced signal within the broadcast coverage area
- Various versatile OB-tools (for unattended operation etc)

The DBMAX allows transmission-settings to be copied to the production suites, enabling engineers with a DBMAX to listen to the final transmitted signal during the production phase. For easy transfer and back-up of these transmission settings we’ve equipped the DBMAX with a PCMCIA-slot.

Finally you can be confident your listeners receive the signal you intended them to!

Put Yourself in the Place of Your Listener

TV or Radio Production & Transmission Emulation
Example of production for DAB, Digital TV and FM
1) Production: DBMAX inserted pre-master to optimize production.
2) TX Emulation: DBMAX inserted post-master for transmission emulation
Predicting DTV coverage

BY DON MARKLEY

Some months ago, this column touched on filing requirements for DTV. In part, the procedure described was correct, but more needs to be added to fully cover the filing requirements and the ability to predict the DTV service area. The problem comes about as the result of the commission’s determination of a new antenna pattern that is meant to duplicate the NTSC Grade B service area.

The table of allotments that was contained in Appendix B of the FCC’s sixth Report and Order identifies a maximum ERP and HAAT for each DTV allocation. What isn’t clear from that document is that the ERP is the maximum allowable using the directional pattern determined by the commission. In preparing a DTV application for a construction permit, it is necessary to refer to that directional pattern and to propose an antenna that will not exceed the limits of that pattern at any azimuth value. This is discussed further in documents that can be found on the web page for the Association of Federal Communications Consulting Engineers (AFCCE) at www.afcce.org.

In particular, the comments filed by AFCCE concerning petitions for reconsideration in that docket are of interest as is an excellent paper by Oded Bendov concerning the construction permit process.

More on directional patterns

Of particular concern are the new directional patterns. The patterns are available from the FCC web page at www.fcc.gov. An easier way is to use the link through the author’s web page at www.dlmarkley.com. That page also includes a link to the AFCCE. The actual file is “dadb” and contains all of the notified patterns for all manufacturers, the directional antenna patterns as filed by all existing or proposed stations and the calculated DTV patterns. The DTV patterns are at the end and are identified by the city, state and channel number. Here is where the first of the problems lies.

For many stations, the DTV patterns are near non-directional. Many are sufficiently close to non-directional that a standard “omni” antenna will fit by simply checking the actual pattern for the antenna and rotating it.

A standard “omni” antenna will fit by simply checking the actual pattern for the antenna and rotating it.

---

**FRAME GRAB**

A look at the consumer side of DTV.

So what’s a set gonna cost?

This chart shows that in today’s dollars, the first color TV sets were very expensive. However, as quantities shipped increased and technology improved, prices dropped dramatically. Experts believe that a similar, but far more rapid, price drop will be evident with HDTV sets.

---

Source: Consumer Electronics Manufacturers Association market research department. www.cesweb.org

---

62 Broadcast Engineering February 1998

www.americanradiohistory.com
COMPARE

Why risk your future with any other DTV transmitter company?

Date: 12-10-97  Time: 12:32 PM
IF (44 MHz): AM
Calibrations:
TRACE A: F2 SORT/SPEC1'S A Marker
Range: 5 dBm; RBW: 400 KHz

Date: 12-10-97  Time: 12:14 PM
B'CAST (CH 36): AM
Calibrations:
TRACE A: F2 SORT/SPEC1'S A Marker
Range: 5 dBm; RBW: 100 KHz

The numbers PROVE the difference between occupying one channel or three!

We always knew that the Diacorde™ and Advanced Tetrode were good! We just didn’t know how good. The answer to the out-of-band problem is obvious. Just look at the wave forms. It’s too late to ask for an ACRODYNE transmitter after you’ve interfered with your neighbor.

Making the right decision in the first place is in your best interest. Can you afford to risk your DTV future with anything less than ACRODYNE performance?

Suddenly, the UHF TV band just got a lot less crowded! Visit us. See for yourself.

ACRODYNE
Leading Edge Television Transmitter Technology!

Acrodyne Industries, Inc.  516 Township Line Road  Blue Bell, Pennsylvania 19422
Phone: 800-523-2596  (215) 542-7000  Fax: (215) 540-5837  E-Mail: acrodyne@pond.com  www.acrodyne.com

© 1998 Acrodyne Industries, Inc. All rights reserved.

Circle (22) on Free Info Card

www.americanradiohistory.com
Looking for a way to test

There's only one

HP ESA-L1500A Portable Spectrum Analyzer:
Low cost, high dynamic range spectrum analyzer for return path and ingress maintenance.

HP 8591Q QAM Analyzer:
Transition smoothly to digital RF testing with comprehensive RF, modulation and data quality measurements.

HP E6277A MPEGscope DVBplus:
Real-time measurements and monitoring of MPEG streams.

HP 8591C Cable TV Analyzer:
The industry's only one-box tester for all non-interfering RF and video measurements.

Your subscribers depend on you—you can depend on Hewlett-Packard. HP has dedicated itself to keeping your broadband system at peak performance by providing a complete range of test solutions for:
- R & D
- Manufacturing
- Headend
- Field

Be Prepared for the Interactive Technology of the Future.

To stay competitive, you have to be prepared for new digital technologies—including interactive services. And you have to know that the products you buy

www.americanradiohistory.com
today will meet your needs well into the future. HP gives you a unique range of products to make sure your cable system always delivers quality service to your subscribers.

Performance from End to End.
There's only one way to go for broadband test products: HP. No one offers a more complete range of test equipment to keep your entire broadband system up and running today—and down the road.

**For more information, call:** 1-800-452-4844, Ext. 5663

www.hp.com/go/catv
for directional antennas limit the ratio of the maximum to minimum value of the pattern to 15dB for UHF stations and as little as 10dB for VHF stations. Although waivers of those limits have been granted on a case by case basis in the past, it seems unusual for the commission to specify patterns that do not meet their own rules. A brief study of the patterns reveals max to min ratios of as much as 32dB. Get serious. That ratio is difficult to achieve with a dish, let alone a TV transmitting antenna. That really means that the maximum ERP shown on the table is a joke. Even if a ratio of 20dB could be achieved, the maximum ERP would have to be reduced by as much as 12dB to have an application that would be acceptable by the FCC.

Let’s look at some real numbers. WGBO-TV is licensed to Joliet, IL, on Channel 66. The station is located on the John Hancock Building in downtown Chicago and operates with a directional antenna and an ERP of 5,000kW. The null on its DTV pattern is 128.7kW. Let it be assumed that an antenna with nulls 20dB down could be reasonably built and further assumed that the commission would grant a waiver for that antenna. That would limit the station’s maximum DTV ERP to 9.89kW to avoid exceeding the commission’s pattern at any azimuth. The commission’s tables indicate that the station’s DTV/NTSC coverage match is 100%. Let’s see now. That would mean that 9.89kW for DTV will provide the same service area as 5,000kW for NTSC at the same height. Those pigs must be flying again.

In addition, the lobe shapes themselves are a little bit strange. Rates of change on the side of lobes of as much as 10dB over a 10° azimuth change are shown for some stations. That can’t be realistically done in the real world. Therefore, it won’t be possible for some stations to duplicate their existing NTSC Grade B contours. In some cases, they can’t even come close. You wonder if anyone actually looked at the DTV patterns before they were published or if the output of the computer was treated as the mouthing of some great deity as untouchable and absolute.

Now, on to the height above average terrain. The value shown in the allotment table is a maximum HAAT. Unless the DTV operation is to be on the same antenna as the NTSC station, which should be possible for some stations, the two stations cannot operate with the same HAAT unless a candelabra structure is used. There is no provision in the DTV rules for reducing the HAAT for the DTV system unless an improved propagation model, such as Longley-Rice, can be used to obtain a more accurate evaluation of the service area based on actual terrain. With luck, this will change. Numerous petitions have requested the commission to revisit this process and to correct some of the obvious problems. It is felt by many that the problem results, at least in part, from using one model to calculate the location of the NTSC contour, a different model to determine the location of the DTV contour and a third method to determine interference. This is not comparing apples and oranges — it is comparing apples and cows. The commission’s staff has indicated that changes are

calculo and the maximum ERP and HAAT can be obtained from the table contained in the sixth Report and Order. Then, the transmitting antenna must be designed to provide the best match to the commission’s directional antenna for that station without exceeding the directional pattern at any azimuth. Then, the distance to the noise-limited contour can be determined from the $F(50, 50)$ curves modified to $F(50, 90)$. Even better, an improved propagation model, such as Longley-Rice, can be used to obtain a more accurate evaluation of the service area based on actual terrain.

With luck, this will change. Numerous petitions have requested the commission to revisit this process and to correct some of the obvious problems. It is felt by many that the problem results, at least in part, from using one model to calculate the location of the NTSC contour, a different model to determine the location of the DTV contour and a third method to determine interference. This is not comparing apples and oranges — it is comparing apples and cows. The commission’s staff has indicated that changes are needed.

### It won’t be possible for some stations to duplicate their existing NTSC Grade B contours.

- They would have to reduce the maximum ERP to 9.89kW to avoid exceeding the commission’s pattern at any azimuth.
- The commission’s tables indicate that the station’s DTV/NTSC coverage match is 100%.
- That would mean that 9.89kW for DTV will provide the same service area as 5,000kW for NTSC at the same height.

### In the meantime, to answer the question of what your DTV coverage will be — who the hell knows.

### Revisiting the contours

So, what will the DTV service area look like for a given station? To start the calculation, the maximum ERP and HAAT can be obtained from the table contained in the sixth Report and Order. Then, the transmitting antenna must be designed to provide the best match to the commission’s directional antenna for that station without exceeding the directional pattern at any azimuth. Then, the distance to the noise-limited contour can be determined from the $F(50, 50)$ curves modified to $F(50, 90)$. Even better, an improved propagation model, such as Longley-Rice, can be used to obtain a more accurate evaluation of the service area based on actual terrain.

With luck, this will change. Numerous petitions have requested the commission to revisit this process and to correct some of the obvious problems. It is felt by many that the problem results, at least in part, from using one model to calculate the location of the NTSC contour, a different model to determine the location of the DTV contour and a third method to determine interference. This is not comparing apples and oranges — it is comparing apples and cows. The commission’s staff has indicated that changes are needed.

### WEB SITES

- [www.afcc.org](http://www.afcc.org) (Association of Federal Communications Consulting Engineers)
- [www.fcc.gov](http://www.fcc.gov) (Federal Communications Commission)
- [www.dlmarkley.com](http://www.dlmarkley.com) (Don Markley web page with links to the above)

---

Don Markley is the president of D. L. Markley and Associates, Peoria, IL.
think of us as your crack pit crew.

Broadcast technology is on the fast track as stations across the country begin converting their technology to digital. If you’re not on track for this important transition, the time to begin is now. And Professional Communications Systems is here with the tools to help.

*Professional Communications Systems* is a reliable, cost efficient source in the design and integration of today’s digital technology. From turn-key studios for new television and cable operations, to up-grades for existing broadcast facilities.

Technology can be the difference between winning and losing. *Professional Communications Systems* will help you stay in front.

Technology Evolves. We Take You There.
Field accessories

BY BENNETT LILES

When a shooter grabs a camera bag and heads for the field, he or she can always count on one thing. That is, that you can't count on anything. A camera, a microphone and a batt light will equip you for home movies, but today's field shoots demand a toolbox full of widgets to instantly convert a number of tasks from impossible to easy. When selecting gear for a field package — accessorize!

There is a virtually endless array of small tools that are forgettable until the moment you need them. Clamps and C-stands can hold lights, masks, gobo, reflectors and shades. These are best kept in good condition with all three pads on the stand legs. One missing pad can cause the clamped equipment to sway back and forth in the wind like an annoying restaurant table with one short leg. Before the equipment goes out, always check the tripod for loose legs. One that slowly lets go can cost you a camera and a lens. A frequent question asked as the smoke clears and the damage is cleaned up is — "Why weren't those light stands sandbagged?"

Lighting gear can fill a large truck, but if you carry a batt light, at least have a barn door, some scrims, diffusion material and a solid stand and a sandbag for it. Still on the mechanical side, one item that no shooter should ever walk out the door without is gaffer's tape. It is used everywhere for everything. Take plenty.

If you get lucky and AC power is available, extension cables with adapters will be needed. The adapters should include stage/Edison and pigtail/Edison. Although they are heavy and cumbersome, AC power隔离s can cure headaches for you and others using common power on the shoot; especially when that mysterious audio hum gets into everything like sand on a beach trip. Although Nickel/Cadmium (NiCad) batteries still rule the roost, the newer Nickel Metal Hydride (NiMH) batteries are the heir apparent, with greater capacity per size and without the memory effect commonly found in older NiCads not allowed to fully discharge before recharging.

That brings us to the fleet of audio adapters. Isolation transformers with ground lifters can help cure hum situations when you can't select another power source. Splitters of every kind are also a must. RCA, XLR, quarter-inch, mini and even submini splitters are good to have. There are still occa

have mini or RCA connectors while 150Ω to 600Ω sources will be XLR. Even binding posts for banana connectors are sometimes found at the rear of a PA mixer or pre-amp. One frequently home-made item is a phase reverser housed in an XLR audio turnaround. Just make sure that these are clearly labeled "phase reverse."

Extremely long audio cables can attenuate the sound signal until it is far below the originally advertised level. One little black box that's worth its weight in gold is a battery-powered pre-amplifier. Many of these have a selectable amplification level calibrated in power decibels and sport a range of 3dB to 64dB of amplification. Among other places, these have been used in cramped skyboxes at political conventions to boost individual mic lines to much higher levels so that they can be sent downstairs and across the street to the production truck in the press area and mixed there. The closer to the microphone that these preamps are located, the cleaner the amplified signal will be. A stereo field mixer is worth the extra money. The post people may want three mics on three separate tracks and a mix on the fourth. If you are mixing mics onto a common track in the field, a stereo mixer can allow you to easily mix any combination of sources to any combination of sound tracks. This is valuable because producers may not consider these options until things are hooked up and tape is about to roll. The stereo field mixer gives you maximum flexibility at a moment's notice.

Live from anywhere

In recent years there has been a new remote shoot animal added to the zoo — the ENG satellite uplink live shot. When your video and audio signal is
Meet the **new** company with **decades** of experience.

Once broadcasters looked to DMV (formerly the Advanced Products Division of NTL) for compression, and News Datacom for conditional access. Now DMV and NDC have come together to create NDS. Your one clear choice for digital broadcast solutions. Whether you're involved in contribution, distribution, digital terrestrial, satellite, private networks, or cable, NDS has everything you need to be successful.

NDS has already provided systems to leading broadcasters worldwide such as: DIRECTV, EEU, Fox, Galaxy Latin America, NBC, PanAmSat, Reuters, CBC, and others.

Call NDS today. Because with NDS, the future of digital broadcasting never looked clearer.

NDS Americas Inc
3501 Jamboree Road Suite 200
Newport Beach, CA 92660
714.725.2554

www.ndsworld.com

©1998 NDS America Inc. NDS, DMV, and NDC are trademarks of NDS. All other trademarks are the property of their respective holders. All rights reserved.

Circle (32) on Free Info Card

www.americanradiohistory.com
We'll never leave you alone in the dark.
Sometimes the only thing that can turn a crisis into a creative opportunity is the company you keep.

At Sony, your performance is our priority. Whether you’re on-air or on-line, Sony has the features you want and the critical support you need to beat the clock. The Sony DVS-7000 series of digital video switchers can help you handle anything from a large studio production to a small mobile application. Choose from four models with 18 panel styles–or custom configure your switcher with drop-in panels. We’ll do whatever it takes to get you through the night. Extensive training, on-going SUPPORTNET services, SOFTWAREplus upgrades, and on-call technical support 24 hours-a-day, every day, just for starters. To arrange a demonstration, contact your Sony Account Manager, call 1-800-635-SONY, ext. DVS, or visit our website at www.sony.com/professional.

Sony

DVS-7200 System

DVS-7300 System

Features and specifications are subject to change without notice.
being uplinked as part of a program originating elsewhere, several new tools are needed in the field kit. These items interface the telephone line with the IFB earpiece and the shooter’s communication headset.

Typically, one side of these telephone couplers will have an RJ-11 jack and a loop-through RJ-11 for connection of a standard handset. The other side will have an XLR and/or quarter-inch jack to connect the IFB earpiece or the camera op’s high-impedance headset connector. Many now sport diaier pads and some even have an auto-answer feature. Of course, there have been telephone sets around for years that have parallel headset outputs incorporated into the case, but these are generally too bulky for a field kit.

Here again, the stereo field mixer can be used to mix mics on one channel and monitor mix-minus program sound on the other, by way of a pair of stereo headphones so that the camera op can hear both sides of the conversation.

One channel carrying the mic mix is fed to the uplink, while the other channel carrying the mix-minus is fed into the talent's IFB earpiece by way of the second output channel on the mixer. Some of these telco interface units are powered by the wet phone line, but some use 9V batteries or external power in the range of 15-24VDC at around 50mA. Lately, cell phones have begun to augment telco interfaces for connecting to remote intercom and IFB.

**Check that cable**

Bad cables are a fact of life on field shoots and the task is to diagnose and replace them quickly. Many new tools have surfaced to help spot sick lines. Some consist of nothing more than small, mic-to-headphone amplifiers that can be clipped to a belt and worn for instant line monitoring. Others tell a more complete story, with LEDs that light to show which if any conductors are carrying DC. This will identify phantom-powered mic lines and IFB cables.

The nicer boxes have built-in microphones, speakers and tone oscillators with selectable output levels at -50dB, -20dB and +4dB. With one at each end of an audio cable, an instant intercom is created and powered on a 9V battery in each unit. Microphones can be handyly checked at the mic end of the line. On the video side, new hand-held multifunction monitors have made field video measurements and monitoring easier than ever. Some of these units enable adjustments to video, sync and blanking levels anywhere along the signal path while displaying a vectorscope or waveform in the corner of the picture. All vital video and audio parameters can be checked at any location along the line, allowing the field operator to quickly isolate a trouble spot and make corrections. As field accessories have gotten smaller and smarter, jobs that used to take an hour or more can now be done in seconds. Using these tools more, the modern field shooter may use his running shoes and antacids less.

Bennett Liles is audio engineer at Georgia Public Broadcasting, Atlanta.
Technically speaking there's no better broadcast video server than ASC's VR300™. With 1 Gb/sec bandwidth, it serves up to 24 simultaneous channels and 96 hours of online digital storage.

**FIBREDRIVE. ALL THE DIFFERENCE IN THE WORLD.**

The VR300 is the only on-air server with FibreDrive™. ASC's exclusive Fibre Channel technology. FibreDrive is the only server architecture that gives all users true simultaneous random access to Fibre Channel RAID storage.

**SERVE UP FASTER, BETTER LOOKING NEWS.**

For a completely tapeless newsroom, integrate the VR300 with ASC's NEWSFlash™, a powerful full-featured news editing solution. Record satellite feeds, edit news stories, and play directly to air — all at the same time with the same media. No tapes. No local buffers. No file transfers.

**THE WORLD'S MOST ADVANCED VIDEO SERVER IS NOW PART OF THE LEITCH FAMILY.**

Recently, ASC's innovative server technologies became part of the Leitch family of digital broadcast solutions. Now the leader in video servers is backed up by Leitch's global support network and world-class customer service.

KITV: First on-air DTV station

BY JT DUGGIN

When Argyle Television did its due diligence inspection visit at KITV in Honolulu in December 1994, Tom Mann, then Argyle's vice president for engineering and new technologies, discovered that upon purchase, the company would have to begin a fast-track plan to find and equip new studio facilities for Channel 4. The present building was an owned building on leasehold land, with the lease expiring in three years. The old facility was extremely crowded, contained in just 15,000 square feet. Preliminary space planning studies by the previous owner revealed the need for double the space. A 35,000-square-foot commercial space at the One Archer Lane condominium complex was selected to be the site of KITV's new facility.

The technical facility was straight out of the early 1970s with poor growth planning and insufficient technical capital. Almost no equipment would be valuable enough to move and the rest was in questionable repair. A facility would need to be designed from the ground up. Although no regulations were on the books to require ATV and no technical standards existed for ATV, it was to be a reality within the next several years. An analog design, whether component or composite, would be a poor choice for new construction.
ROSS

SYNERGY SERIES
DIGITAL PRODUCTION SWITCHERS

POWERFUL

Ross has combined the latest digital technology with a firm understanding of video production and over 20 years of switcher design experience to develop a series of production switchers which will be the standard that all digital switchers will be compared to for years to come.

Synergy Series Digital Production Switchers by Ross.

Add MLEs and a larger control panel as your needs grow.

Squeeze & Tease Freeze, Zoom Reposition & Push Keys: 2 per MLE

Full function keyers have dedicated push buttons, fixing borders for every key, a squeeze and three key over transitions, quick preview & take, and bi-color on all status.

Chroma Keyers with chroma suppression, hue rejection, natural & simulated shadows and transparencies.

Direct control of VTR transport with timecode.

32 Custom Control Hot Buttons recall any combination of switcher memories, built-in pushes and external double control.

All MLEs have full effects capabilities, their own memory system, keypads, "no pattern generator", live compossition, matte generators and dual chroma keyers.

Preview, Monitor Overlay Display including VTR Timecode, count up/down timer, source ID, safe titles area.

DVE Effects from all popular DVEs are seamlessly integrated as switcher transitions.

11 RU frame Redundant power 500 W, 1/4 line delay

Excellent price 3 year transferable warranty

And all the Terminal Gear to go with them

■ Conversion Gear A-D & D-A Converters
■ Distribution Gear Audio, Video, and Digital Video
■ Video Keying Gear Analog and Digital Keyers
■ Master Control Gear Mini Master Control Switchers
■ Telecine Gear Telecine Switchers

As well as the complete line of Ross Analog Video Production Switchers

NAB Booth 9635

Tel: (613)652-4886 Fax: (613)652-4425 Web: www.rossvideo.com eMail: solutions@rossvideo.com

www.americanradiohistory.com
We’re bringing tomorrow together.

At Philips Digital Video Systems we’re focused on the future and ready with the solutions that will get you there fast. From camera to reception in the home, our technology covers every link in the digital chain. And we back it with the kind of knowledge you only get by spending 70 years pushing the boundaries in broadcasting technology. No one is in a stronger position to help you migrate to DTV.
Our multi-format approach frees you to move ahead in the most cost-effective way at the pace that suits you best, while respecting your existing investments. Visit us at NAB '98 and we'll show you a host of innovations. We'll be delighted to welcome you—and to demonstrate how Philips Digital Video Systems can put the power of digital to work for you. To learn more, call us toll free at 1-800-962-4287.

Circle (25) on Free Info Card

www.americanradiohistory.com
Putting the system together: Invention

KITV did not have a large engineering staff. The goal was to efficiently construct a new station without adding to the station's engineering staff. John Duggin Sr. and Digital System Technology, Inc. (DST) presented a unique solution. We had supplied routing switchers, master control and machine control systems packaged pre-wired to Argyle Television for other stations in the past. Duggin and Mann had coined the term palletization several years prior, to describe a process that wasn't stick-built and wasn't turnkey.

Digital System Technology, Inc. assembled multirack modules pre-wired to patch panels, configured and tested. The racks were bolted together on a shipping pallet so that the installation team could drop it in place, connect the inputs and outputs and let it fly. The station gets a finished, tested system, ready for implementation into its existing technical fabric. Digital System Technology, Inc. extended this modular design and packaging of palletization to larger more complete systems, including the entire technical facility at KITV. Because of its modularity, the palletization process is particularly suited to the ATV conversion of TV stations. Many stations will not need a complete redesign of their facility, just a conversion in key areas.

Working closely with Mann and KITV station chief, Greg Johnson, Dwight Crumb engineer at Digital System Technology, Inc. began the task of designing KITV's new digital facility. Once the technical design was completed DST's president John Duggin Sr. oversaw the procurement of the specified equipment for the project. Simultaneously, DST began pre-building the core of the station at its facility in Irwindale, CA. The

The master control room with a Philips Media Pool that is used for spot playout.
Meet The Digital Detectives


Whether you are testing SDI transport path, verifying digital video protocol or performing quality assurance checks on program material, Leader’s new “Digital Detectives” are a dynamic solution for meeting SDI testing needs. Designed to operate in today’s “transition” environment where analog and digital are present, these advanced design instruments provide superior flexibility and ease of use for quick, painless transition from analog to digital. Yes, each “Digital Detective” is a stand-alone product, but...the sum is greater than the parts!

For example, the LT 5910 SDI Analyzer delivers every capability for routing path and protocol analysis. What’s more, it acts as a signal source to permit deliberate introduction of digital video errors into the data stream in order to test your system’s ability to identify and deal with errors. Error capture and an extensive set of alarms facilitate 24 hour monitoring. Simultaneously, error capture permits detailed troubleshooting of intermittent faults.

Monitoring actual video signals is the job of the versatile LV 5100D. It has 2 serial and one analog (3-wire) inputs and works well in multi-format environments. Extensive cursors and data readouts facilitate quick, error-free analysis using familiar analog displays to ease the transition to digital. The LT 425D generates all the signals and test patterns needed to become a precise master source for digital component reference and signal testing. Multiple SDI and analog black outputs simplify use with multi-formats. Compression test patterns include provisions for future test needs, while the built-in AES/EBU (separate and embedded) satisfies audio test requirements.

For a close-up look at the “Digital Detectives,” or for further details, call Leader’s system integration specialists...

1-800-645-5104 / www.leaderusa.com

See us at NAB Booth #6415
equipment was pre-wired in five rack modules, powered up and tested prior to shipment. Taking into consideration the high cost of on-site labor, everything that could be completed prior to shipment was addressed. On Sept. 10, 1997, 3.2 million dollars of crated and palletized equipment was sent via air cargo to Honolulu. Digital System Technology, Inc. remained on site for 14 weeks with its installation crew. The entire install took place at KITV's new home, One Archer Lane, while the building was under construction. This alone presented some interesting challenges. In order to meet the specified deadlines for transmission we began the install under temporary lighting with no air conditioning or windows in the middle of a construction zone. Painstaking efforts were taken to protect the equipment from dust and damage.

The master control room with an Itelco transmitter remote control shown in the background.

2. production system; and
3. news gathering and editing.

The Philips Venus digital routing switcher, Jupiter router and machine control, Saturn digital master control and Diamond digital production switcher system were chosen as key core technical equipment, principally because the components all work together as a system. KITV's master control was specifically designed to do HDTV and SDTV multicasting. It is designed to originate up to eight program streams simultaneously, and is presently equipped to output two SDTV streams. Additional SDTV streams are largely a matter of plugging in cards. Insofar as possible, HDTV is also a plug-in. Although KITV is not automating as part of the move, automation is part of the design and will be implemented as soon as it is necessary to originate additional program streams.

Hawaiian TV stations have a unique problem in that the network (ABC in KITV's case) has to delay two or three hours (depending on the season; Hawaii does not have daylight savings time). KITV was a pioneer adopter of Philips Media Pool disk-based storage system for this net delay back in 1994. A second Media Pool has been added for spot playback in the new technical facility. The great advantage of Media
At Best Power, everything points up, because our 
uninterruptible power systems keep you up and running.

Best Power products are reliable, with a field-proven mean time between failure up to 300,000 hours. That's why Best Power was voted #1 in product quality. If uptime matters, demand the most reliable UPS solution.

Demand Best Power.

When it comes to reliability, Best Power never stops.

1.800.356.5794 • www.bestpower.com

*VARBusiness 1997 APEX Study conducted by Charles River Strategies.
Circle (37) on Free Info Card
The newsroom area under construction.

Pool over competing products for spot applications is that it inherently has variable compression as part of its original design. Figuratively, a K-Mart spot could be compressed 10:1 or even 22:1 if there was no motion, but a Rolls Royce spot could be stored in uncompressed form. The Media Pool is the short-form storage engine for the station. There is planning for the addition of near-line storage to the Media Pool this year.

The long-form storage engine for KITV is JVC Digital S tape. This format was chosen after evaluation of Digital S and DVC PRO, both of which got high marks for quality in subjective tests. The following factors carried the most weight in the decision-making process:

- Digital S is 4:2:2 with a 50MB/s data rate from inception.
- The half-inch tape in the Digital S format was thought to be more physically stable than the 8mm tape in DVC PRO in the high humidity environment of Honolulu, because tape is hydro-
Philips TV Test Equipment is today owned by PANTA Electronics from the Netherlands, a company in which Advent International holds the majority of the shares.

Philips TV Test Equipment's new name is ProTeleVision Technologies - PTV, delivering to our customers the same high quality products and services they have come to expect.

PTV is poised to meet the challenge of tomorrow's digital innovation. In close co-operation with our customers, we will expand our expertise within digital technology. Your wish is our command.

Our goal? To make things even better!

Circle (43) on Free Info Card

PROTELEVISION TECHNOLOGIES, 85 McKee Drive, Mahwah, New Jersey 07430. Tel. 201-529-2188 or 1-800-421-0888. Fax 201-529-2109
E-mail: ptvna@compuserve.com, Website: http://www.ptv.dk

www.americanradiohistory.com
scopic and there had been reports of problems with hi-8 tape in humid environments. This was circumstantial, but Hawaii is a unique, tropical environment.

The station had been using JVC SVHS for news gathering, had a good maintenance and support history with JVC and could retain the KY-27 cameras for a couple more years of use in the news department field service.

The production studio system was designed to be SDTV component digital 16x9/4x3 aspect ratio switchable, based on Philips LDK-10 cameras, the Philips DD-30 production switcher and a Neve 55S analog audio console. This straightforward control room/studio pair provides daily service for the production of news shows, as well as special production for the unique identity of the station's trademark, Island Television.

Post-production editing is accomplished on three Avid Media Composer 8000 systems, one of which is exclusively dedicated to station promotion production to keep KITV's image and programs fresh in the Hawaiian public's eye.

News footage is shot on Digital S with JVC KY-27 cameras, then transmitted or carried back to the station and spooled into six Avid News Cutters. Ninety percent of the station's news product is non-linearly edited. The edited product is streamed to an Avid Air Play, which also stores interstitial components of the news and serves the station's affiliation on local cable with CNN 24/54 news. News stories are played out of Air Play into the 5:00 newscast from the production control room. Long-form news programs (specials, series pieces, etc.) often start out in News Cutter and migrate to the Media Composers via Avid's Media Dock docking hard drives.
Transmitting advanced television

On April 2, 1997, the FCC authorized the commencement of digital TV broadcasting and assigned channels for that purpose. In June 1997, Argyle Television made a strategic decision to be first in the Hawaiian market to actually transmit ATV signals. Thus, began a fast-track project to license, provision and construct KITV-DT, KHVO-DT and KMAU-DT (Honolulu, Hilo and Maui, respectively). They became the first commercial TV stations to receive an FCC construction permit to build digital TV transmitters.

The DTV transmitters were the longest lead item in the RF group. After discussions with most of the major transmitter manufacturers, Itelco S.p.A., was selected because it was the only manufacturer who could deliver a solid-state design before the third quarter of 1998. Itelco-USA was able to deliver two 800W DTV transmitters and one 7.5kW transmitter in late November 1997. The transmitters are, at least one aspect, unusual for a solid-state design, because the power amplifiers are liquid cooled. The liquid is distilled water, although other liquids could easily be used. This cooling method allows the transistors to operate 20°C cooler than air-cooled designs. Thus, allowing much greater linearity and stability in conventional bipolar transistor designs, without having to resort to bleeding-edge technology before it may be ready.

The Honolulu transmitter began transmitting on Nov. 28 at 3:34 p.m. Honolulu time. Hilo followed several days later on Dec. 3 at 8:00 p.m. As far as is known, this was the first commercial digital TV transmission in the United States.

JT Daggin is the vice president of Digital System Technology, Inc., Irwindale, CA.
Power quality and grounding

Times change, and so does equipment. Analog power supplies and electronic circuitry have been steadily giving way to digital switching and logic-based designs. Although most of us have noticed this progress, are we aware of what this change means regarding the reliable operation of digital-based equipment? Also, what happens when newer equipment is connected into the typical AC power and signal wiring systems used for the old analog equipment?

To begin with, most analog audio mixers used potentiometers to directly vary the input signal level. The potentiometers could be rotary or slide types, and either type could get noisy over time. Newer digital-based circuits use the same types of controls, but with a difference. Channel gain is step-variable in accordance with the binary value of the number produced via A-to-D conversion of the potentiometer's resistance. Noise is filtered out prior to and during the A-to-D conversion process.

Some controls for mixing and gain are no longer even potentiometer-based. Optically or magnetically coupled digital encoders are used. Shaft rotation or slide position is directly converted to digital pulses and hence, binary numbers. Then, of course, there are systems such as audio and video mixers controlled via a digital link to a laptop or desktop personal computer. Links are often of the RS-232 or RS-422 type, although fiber-optic links with even better performance are coming on strong. Wireless systems also exist, and they may also use control and signal links involving infrared (IR) or radio frequency (RF) for the wireless portion of the path, but still wind up using wiring to get the signal into and out of the equipment to which these links are connected. The wired portion of these devices may use these types of digital-format signal protocols or other proprietary types.

Once we get to the actual control, audio and video signals that newer equipment deals with, we find the signals are fully digital. They are no longer neatly phase-shifted or amplitude-varied AC waveforms or DC-referenced sine or analog-shaped waves. Rather, they are streams of square-wave-shaped, pulse-width-modulated (PWM) signals or packets of encoded binary numbers representing a fully digitized control, sound or video signal. Even looking into AC-to-DC power supplies, there are typically only two places where DC exists (the input filter capacitor and the logic or utilization voltage output buses); the rest of the circuit handles square waves of one sort or another. Frequencies into the tens of kHz and PWM schemes are now encountered inside power supplies. In contrast, analog power supplies had only 50Hz or 60Hz AC on the line input to the rectifier and everywhere else was either pulsating 120Hz DC or some “pure” level of DC — stable or changing, but nevertheless DC.
Power quality and grounding

Ground rules

In the analog equipment world, we typically listed after the much-discussed single-point ground (SPG) system and quiet earth-grounding electrode, usually of a mystical 1Ω character and not connected to anything except our equipment. This practice has been and remains a serious NEC violation per Article 250 — Grounding. All earth-grounding electrodes on the premises are required for fire, shock and lightning safety purposes to be made by means of bonding conductors, electrically common to all other electrodes and to the building's electrical systems equipment (safety) grounding conductor (EGC) system. The system consists of metal conduit raceway, metal equipment enclosures and the famous greenwire on the power cords.

This situation has changed completely. The modern recommended practice for grounding analog and digital-based equipment is to use a multipoint grounding (MPG) design, accept connection to the AC power system's equipment grounding greenwires and ignore special connections to earth of all types.

For example, where we have rooms full of equipment in racks and where this equipment is interconnected by signal-level cables, a signal reference grid (SRG) is used to ensure that broadband grounding capability is achieved and common-mode noise is attenuated among interconnected units. A diagram of an SRG and related equipment is shown in Figure 1. We will cover the SRG in detail later in this article.

Digital equipment is different and also immune to some of the problems associated with analog equipment. However, new problems have emerged relative to digital equipment. Some old rules of installation used with analog equipment must be thrown out and new rules applied. Luckily, these rules generally apply to analog equipment as well. For example, some equipment grounding rules have undergone significant revision. Some cable shield rules have been similarly affected. Lightning and electrical surge-protection requirements have also emerged as being poorly understood and more important than ever when using electronic load equipment and, in particular, digital-based equipment.

Power quality and performance problems

No practical difference exists between a logic circuit used in a computer system to represent a numerical bit value (0 or 1) and that used in digital circuit-based sound and video equipment. Therefore, a lot of information that has been successfully developed for use in the computer world is directly applicable to digital audio and video equipment. Don't forget this also involves computer equipment. Nowhere is this more true than when considering the CBEMA curve.

CBEMA (pronounced See-B-Mah) stands for an old mainframe computer manufacturer's organization called the Computer Business Equipment Association. The curve developed by CBEMA's Power Interface Subcommittee No. 3 (SC-3) can be used to characterize the general relationship between AC power quality and the reliable performance of most digital logic-based equipment. (See Figure 2.)

The x-axis is constructed in terms of time and the related number of cycles per second of the standard U.S. 60Hz power-line frequency. The y-axis is constructed as a plus-and-minus reference for voltage. The reference point on the y-axis is set to equal 100% of the chosen nominal rms voltage of the AC line being considered. For example, 120VAC is at the 100% line, when the voltage increases, go up on the curve's y-axis (marked by double, triple and so on increments of the AC line's nominal voltage as set to 100%). When the line...
voltage goes down, go down the y-axis all the way to zero, as in a complete power loss. The logarithmic x-axis determines the duration of the event being tracked. For example, if the AC power line went to zero voltage for one minute (in addition, the y-axis line on its way to the next half cycle and a polarity reversal. We all hope that our equipment will continue to work while the AC line does this; otherwise, we will have to provide for a DC power distribution system.

To the left of the 8.33ms or half-cycle point is the subcycle, impulse or transient-surge voltage realm. To the right, is the longer-term or rms voltage event realm. For example, voltage swells or voltage sags are found here if these events last only a few cycles. After that, we might be discussing problems such as a long-term, high or low nominal rms line voltage or loss of voltage. In general, impulses are to the left and high or low rms voltages are to the right of the 8.33ms mark. The former lasts for less than one-half cycle; the latter lasts for more than one-half cycle and can continue indefinitely.

Sags
One of the most commonly encountered power-quality problems is called a sag. The sag has been variously described as being a dip, dive or something similar, but sag is the official term, according to the IEEE’s Emerald Book (Std. 1100-1992). An idealized view of a sag is shown in Figure 3, where a nominal voltage exists before and after the sag event. A sag event results in a noticeable decrease in rms voltage for more than one and over a period of several cycles.

The typical sag event is often caused by the sudden application of loads that have a high momentary starting or inrush current. Such loads are typically represented by whole panel boards, motors, large rectifiers and AC-DC power supplies that have an internal large-value input capacitor. The capacitor is charged directly across the line via a rectifier. With a big, empty capacitor, a large charging current can exist on the first half cycle, with progressively lessening currents on subsequent half cycles until the capacitor is charged to near the peak line voltage.

Swells
As might be expected, the swell is the exact opposite of the sag condition. The swell has also been called a surge voltage, but this phrase is not correct. The term surge is more properly applied to shorter-duration events involving momentary high voltages, such as those produced by lightning. The term swell is the IEEE’s official description of the described event. An idealized view of a swell is shown in Figure 4, where a nominal voltage exists before and after the swell event, which resulted in a noticeable increase in rms voltage for more than one and over a period of several cycles.

The typical swell event is often caused by the removal on an electrical system or circuit of large loads that have a high running current. Such loads are typically represented by panel boards, motors, rectifiers and large groups of AC-DC power supplies that can be disconnected at the same time by a single power-off control.

The impulse voltage condition
The typical impulse event has many names, such as glitch, spike, notch, whis-kker, zot, transient and, of course, impulse. These events are characterized as being subcyclic events of either polarity and any amplitude. They are
Power quality and grounding

Generally of a singular nature, but can occur in trains or strings of impulses that may or may not all be related to a single cause. The impulse may be synchronous or asynchronous with the amplitude of the AC line's voltage or current with which it is being compared. The impulse will typically appear in that portion of the CBEMA curve to the left of the 8.33ms point and in the subcyclic area. The impulse may remain fully above or below the 100% line or part of it might be above and part below that line. It may also be of a decaying oscillatory nature.

A fast transition time is also typically associated with an impulse event, but the term fast is not always clear except in comparison to the rate of change for the AC power system's fundamental frequency. Generally, impulses have a transition time expressed in terms of less than a millisecond or several microseconds. Faster transition times are typically seen only when the source of the impulse is close to the point at which the measurement is being undertaken. This is because at high frequency, AC power circuits are lossy transmission lines and tend to attenuate signals rapidly with distance. An idealized impulse is shown in Figure 5.

Decaying oscillatory voltages

The impulse event may also involve a decaying oscillatory current or voltage waveform, depending upon how it was generated and transmitted through the AC power system. AC systems contain reactances and are LC circuits resonant at a fundamental frequency and harmonically related ones. Therefore, oscillatory events are common. The degree of damping of these oscillations is variable, but in general, only a few decaying repetitions of the higher-frequency impulse will be seen. Lower-frequency events may take longer to damp out and can be propagated over longer wiring paths. The typical decaying oscillatory event is found to the left of the 8.33ms point on the CBEMA curve and in the subcyclic disturbance area. However, sometimes the 8.33ms line is crossed by the oscillatory waveform's tail.

An example of this type of event is when banks of power factor capacitors are switched in (and sometimes out). These events have some energy behind them and contain a lot of low-frequency content. Together, these things allow the resulting disturbance to be propagated without much attenuation up to several miles. Generally, the closer the capacitor bank is to the affected electronic equipment, the worse the potential disturbance will be and vice-versa. Most power factor correction capacitor banks are installed on three-phase distribution circuits for the electrical supply system itself, within a facility on its main feeder system or at both locations. In either case, their unwanted effects reach down the building's secondary feeder and branch circuit system to electronic load equipment.

The commutation notch

Voltage waveforms on the AC line are also sometimes seen to exist with what is best described as one or more notches having been taken out of the waveform. (See Figure 6.) These notches may appear anywhere along the time base and may move around in starting time and duration. They are called commutation notches and are generally caused by the momentary short circuit placed across the AC line during the time that one controlled rectifier is turning off and another is turning on. With SCR's that are phase-shift fired, it is easy to see the notches move around on the x-axis. Notches generally stay on the left side of the 8.33 ms line on the CBEMA curve and in the subcyclic area.

Multiple zero crossings on the voltage waveform

In the extreme case of a capacitor's decaying oscillatory event, the zero-voltage line may be crossed multiple times.

Figure 5. Impulse waveform (as impressed onto AC voltage waveform).

Figure 6. Waveform notching (typical commutation notches caused by rectifiers).

Figure 7. Voltage waveform distortion from rectifier-type load on an alternator.
any equipment that depends upon the 60Hz line voltage's zero-crossing point for timing, SCR commutating or both. Some SCR-based lighting control systems are seriously affected by this kind of problem. Also, some digital clocks and timers that count zero crossings on the voltage waveform can really speed up if they get more than one voltage zero crossing every 180° on the 60Hz circuit.

Harmonic voltage waveform distortion

With non-linear loads, such as rectifier power supplies of all types (linear and SMPS), current is taken from the power line at frequencies harmonically related to the 60Hz fundamental. In general, all current is taken in the form of an impulse near 90° and 270° as opposed to being linearly taken all along the applied voltage waveform. A typical input current waveform for a switched-mode power supply (SMPS) is shown in Figure 8. This waveform can involve a high peak current on the affected circuit with a concurrently large voltage drop occurring across the AC supply circuit’s impedances. These impedances include the wiring, the impedance of the supply transformer and an alternator's windings or any other AC power source's internal impedance.

Of special note and interest, the above impedance can be largely provided by the flexible power cord sets used with temporary AC power distribution systems. Long branch circuits are another contributor, and if they are used in conjunction with an extension cord, good luck! Also, placing a power-conditioning device, such as a line voltage regulator, between the non-linear load and the AC supply can sometimes make things worse. This is because the typical power-conditioning device has considerable internal impedance, adding directly to the voltage waveform distortion problem.

The typical non-linear load, such as an SMPS connected to a 120VAC line, requires fundamental frequency current and harmonic currents up to about the 19th order (19x60Hz or 1,140Hz). Mostly, the currents are drawn from odd-ordered harmonics (3, 5, 7, 9 . . .) and from the lower orders (particularly the third, fifth and seventh harmonics). Once a harmonic current is demanded by the non-linear load, it produces voltage drops across any of the impedances in the series path. Thus, if a third-harmonic current of a given amount produces a 10V drop in the upstream circuit, this condition will be seen as 10V at 180Hz algebraically added to the 120V, 60Hz fundamental voltage. (See Figure 9.) It is important to understand that because of the total amount of inductive reactance XL=πfL in the current's path, 1A at 180Hz (third harmonic) produces three times the voltage drop that would be produced per amp at the current's fundamental frequency of 60Hz. This relationship also holds true for each higher order of harmonic current because the inductive reactance increases proportionally with frequency.

Harmonically distorted voltage waveforms typically have less total area under the curve than an undistorted sine wave and the peak voltage may also be lower. This spells more trouble for a connected linear power supply than for an SMPS design. The former loses regulation headroom and runs hotter. It sees what it interprets as a low-voltage condition on its input and reacts accordingly. The SMPS has more headroom available and compensates by drawing a higher peak-charging current for its main energy storage capacitor at 90° and 270°. With enough distortion, both supplies will eventually lose regulation, but the linear supply will almost always go first and by quite a bit.

Here's an important bit of advice. If you are attempting to make an accurate voltage or current measurement on an AC power conductor that is not carrying a sinusoidal waveform, you cannot use anything other than a true rms instrument. The typical analog or digital current or voltmeter is not true rms, but is an average-actuated, rms-calibrated device. In other words, it is a full-wave-rectified DC instrument that...

Figure 8. Typical high-peak current waveform for switch-mode power supply input on 120VAC circuit.

Figure 9. Multiple zero crossings of a 60Hz voltage waveform distorted by third-harmonic voltage (180Hz).
Power quality and grounding

has its scale fudge-factored to make it agree with the rms value of 0.707 on a pure sine wave. On a typically harmonically distorted waveform, the area under the curve is insufficient to allow this kind of instrument to give accurate readings. The result is typically a reading that may be off as much as 50%, making a 20A rms current read around 10A. This could mislead the user into believing that the circuit is not heavily loaded. Similar problems occur on the voltage waveform, where the user is mislead into thinking the AC line voltage is too low and needs to be raised. Computations involving voltage and current are, of course, really fooled up by this situation.

Mitigating problems
Choosing the AC power source: Proper AC power for electronic equipment definitely involves more than just plugging it into the nearest available wall outlet. It also involves avoiding the common mistakes made when attempting to get special or dedicated AC power. The task of obtaining truly proper AC power, therefore, starts with the AC source itself.

Go upstream: The best advice to follow is to originate the AC power from a point on or as close upstream to the service equipment (SEQ) for the building as is practical. This means a dedicated feeder into the SEQ that is routed to the electronic equipment room, where it can be interfaced to one or more panel boards via an isolation transformer (IT) or another suitable power-conditioning device.

The rationale for this advice is simple. No matter where you get the AC power in the building, whatever affects the SEQ will similarly affect all.

Switch mode vs. linear power supplies

Another perspective on the CBEMA curve is to view the area below the 100% line on the y-axis and to the left of the 8.33ms point as being the area where the lack of good energy storage in the typical SMPS' input filter capacitor comes into play. In well-designed SMPS units, this relatively large-valued capacitor is fed from a full-wave bridge rectifier connected directly across the input AC line, and can be charged to nearly the AC line's peak line voltage (169VDC on a 120VAC line). It can store a lot of charge (Q=CE), which can then be drawn off by the supply's inverter prior to use in the logic voltage regulation circuits.

SAG EVENTS

A poorly made SMPS or a good one that is overloaded, could be susceptible to a lack of stored energy in its main input capacitor once during a sag event. In an SMPS, this occurs anytime the peak AC line voltage out of the full-wave rectifier is equal to or less than the voltage level on the capacitor for that half cycle. In linear AC-DC supplies, the filter capacitors are operated at a low voltage obtained from an input step-down transformer. Not much voltage difference exists between what the capacitor is charged to and what the linear voltage regulators constantly work against. This difference is called head room, and there is no comparison between the two designs — the SMPS wins this contest hands down.

Because Q=CE, it can be seen that for the same size capacitor, the amount of available energy stored at 170 peak volts from a 120VAC line is a lot more than what might be stored at 40 peak volts from a 25VAC transformer secondary. Also, just think about the additional energy that could be stored in an SMPS that is operated at 240VAC input. In a linear design, there is no difference. The secondary voltage from the step-down transformer doesn't change, only the primary voltage does; hence no change in headroom results either.

The idealized effect of a typical line voltage sag on the DC output of an analog supply and SMPS of similar output rating is compared in Figure 1. (See page 96.) A line voltage sag does little to the connected SMPS when compared to an equivalent linear AC-DC power supply. The digital difference provides better performance in a less-expensive, smaller volume and lighter weight supply. Not surprisingly, most AC power-quality studies (IBM, Bell, et al.) have identified the AC line voltage sag event as being the most commonly experienced power-quality problem by most electronic and computer equipment users. Even though the SMPS-based digital equipment type is better than analog equipment at ignoring AC line power-quality problems, there is still some point at which the sag can produce performance problems.

SWELL EFFECTS

When a swell arrives at the input to a typical SMPS, the result is predictable. It tries to charge the input energy storage capacitor after the full-wave rectifier as quickly as possible. The capacitance in the typical SMPS is fairly large, making the task difficult. Adding to the difficulty is the RLC time constant based on the input capacitor and the reactances and resistance of the whole upstream wiring system. It is hard to get the capacitor filled up; instead it just absorbs what is available and stores it for use. If it results in a voltage higher than the AC line's peak, the capacitor will not accept any new charge until after the SMPS' inverter load has depleted the capacitor's voltage to below the AC line's peak voltage.

SMPS inverters are high-frequency (usually in the tens of kilohertz) switched circuits involving alternately cut-off and saturated devices supplied from the main input energy storage capacitor. The inverter transformer's secondary is then full-wave rectified and used to charge a secondary energy storage capacitor at a voltage (with headroom) near that used by the connected loads. By pulse-width modulating the inverter (controlling its duty cycle), the capacitor's charge level can be precisely controlled.

The final result is a stable voltage on the inverter-serve secondary energy storage capacitor, even though the main input energy storage capacitor may have considerable voltage variation across its terminals. The inverter may even be temporarily held off by the pulse-width modulation circuit if too much voltage begins to appear across the secondary energy storage capacitor. This automatically resetting protective action works quite well, keeping input line overvoltages from reaching the load.

In linear power supplies, swells often cause the main energy storage capacitor (on the transformer's low-voltage secondary) to become overcharged. Ultimately, the

Continued on page 96
levels of power distribution in the building. For example, a momentary low voltage (sag) at the SEQ will also be seen at all electrical outlets in the building. However, if you are obtaining power from an outlet far downstream in the distribution system, then anything affecting the feeders or panel boards between the selected outlet and the SEQ can affect the power quality at the selected outlet. Statistically, power quality is best at the SEQ and becomes progressively worse as you move down through the distribution system, where the building's own loads can create problems.

Get a low-impedance power source: All power sources have an internal impedance. This is what limits the short-circuit current available across the terminals of a battery or a transformer, for example. Internal impedance is, therefore, unavoidable and beneficial unless you fail to account for it and get in trouble from its predictable effects.

Typical electronic load equipment power supplies involve rectifier inputs. These kinds of inputs require non-sinusoidal and high peak currents on each half cycle and cause a significant voltage drop across the internal impedance of a power source. This then causes a harmonic distortion of the available voltage waveform from the source. Harmonically distorted voltage waveforms thus created cause numerous problems with the basic operation of normal and electronic types of load equipment.

Harmonics on power circuits can be strong and, therefore, can usually get into telephone and electronic equipment's signal level circuits and cause a lot of mischief. For example, simple voltage waveform harmonics on the AC power system are serious because they also cause the involved AC power wiring to propagate wideband audio-frequency interference into nearby control or signal cables. For example, the interference from simple AC-DC power supplies may range from 60Hz to around 2kHz. Where higher-frequency notching is present on the voltage waveform, the available harmonics can extend upward into the tens and hundreds of kilohertz, potentially affecting video or digital switching processes.

Harmonic voltages are reduced to reasonable levels by ensuring that the chosen AC power source is of sufficiently low internal impedance. For the typical service transformer (ST), this correction is not a problem. But it can easily become a problem where dry-type transformers or other types of power-conditioning equipment are subsequently installed within a building, and from which equipment is being powered. Recommended practice is to employ building AC power sources of larger kilovoltampere capability than the load requires and with internal impedances in the range of 2.5% to 5% to avoid most of these problems.

Note that most voltage regulators and UPS types of power sources cannot meet the foregoing internal impedance recommendations. This compromise is sometimes still acceptable. The trick is to make certain that the chosen regulator or UPS has an internal output voltage feedback circuit that looks at the output voltage waveform and sends an error-correction signal back into the control circuit. This signal will keep the output waveform distortion and rms voltage level under simultaneous control. Thus, an active method can be used to compensate for the high internal impedance.

If the power-conditioning equipment does not have good output voltage waveform control, then it is common for the distortion of the output voltage waveform to be significantly worse than when it is being supplied directly from the building's power system. Sometimes, this problem gets so bad that the electronic load equipment won't even work properly when connected to a power-conditioning unit, but will work when connected directly to building power. In the trade, this is known as an expensive lesson.

NEC wiring methods for electronic loads

Historically, the NEC did not allow much flexibility when wiring the AC power branch circuit supplying electronic load equipment. Only two ways were allowed: solid grounding (5G) and isolated or insulated grounding (IG). The AC system supplying the equipment typically could only be a solidly grounded system. (This means bonding the supply transformer's neutral to the equipment grounding conductor system and to the nearest NEC-acceptable earth-grounding electrode to the transformer for AC systems of 150VAC to ground. See Sections 250-5 and 250-26.) Anything else was not permitted on the branch circuit, even if it might be a good idea from an equipment performance standpoint, such as decreasing hum and other noise problems.

Because the product safety testing and listing services (such as UL) were completely aware of this point, it should be apparent that all of the equipment that they tested and the standard for safety to which it was tested had to meet the NEC's requirements as they were written, not as someone would like them to have been written. Together, the NEC and UL made it impossible to try anything else until the NEC was changed. This was done for the 1996 edition of the NEC.

AC system and branch circuit grounding

The two traditional ways of grounding an AC system and its branch circuits used to support typical installed electronic load equipment that is subject to noise and hum problems are shown in Figure 10 for the 5G design and in Figure 11 for the IG design. Until the NEC's 1996 edition, these were the only two permitted designs.

There are two important points to be aware of relative to these grounding methods. First, on a typical 120Vrms branch circuit, the hot wire is at a...
Power quality and grounding

potential of nearly 170 peak volts to anything grounded or to ground itself. Second, because of common-mode noise current flow in the grounding conductor system, an unequal common-mode (CM) noise current can occur on the neutral and hot conductors of the branch circuit. This unequal current subsequently gets partially converted to normal-mode current on the AC power wires to the load (the hot and neutral conductors).

The first situation means the electric field (e-field) is quite high nearest to the hot conductors and in relation to anything grounded, such as a shield on an audio cable installed near power wires. This high e-field maximizes the electrostatic coupling between the AC wires and the grounded shield, which then introduces hum and other noise into the audio cable. This point is important for high-impedance circuits because they are voltage driven. If the voltage to ground on the AC wiring was lowered, so would the amount of coupled interference from the e-field into nearby signal-level conductors. This is important because the e-field is a near-field phenomenon that is proportional to the voltage and tends to fall off rapidly with increasing distance between the involved conductors.

The second situation means that the normal-mode converted common-mode (CM) noise current becomes algebraically additive to the expected power current on the circuit and, after interaction with the circuit's impedances, becomes a normal-mode noise voltage impressed upon the AC voltage waveform. Thus, the load equipment must have an AC input circuit immunity to noise voltage across the entire audio frequency range and above, not just at 60Hz and 120Hz. This implies special considerations for the filtering system following the rectification process. These might include the use of low series-resistance leakage value capacitors and low-leakage inductors.

For example, a linear power supply might pass this noise voltage onto its DC output, where it could affect the regulation circuit's performance. The noise voltage might even pass through or around the regulation circuits and gain access to the final DC bus structure directly connected to the electronic circuits. This is especially vexing when these are low-level mixers or amplifiers that are analog in nature and have a bandpass that ranges across the audio range.

However, with the typical SMPS, this is not much of a problem because the inverter transformer provides a sufficient amount of attenuation between stages and keeps the noise out of circuits, such as the regulator circuits.

The new way

The newest way to provide AC power system wiring and grounding is to use a 120VAC center-tapped AC system for a single-phase AC power source and to establish the branch circuit system with all of the conductors symmetrically arranged to ground. The nominal AC voltage to ground must be one-half of what it was before, for example, 60Vrms instead of 120Vrms. This type of AC system and the subsequent wiring and grounding requirements are called out in NEC Article 530 — Motion Picture and Television Studios and Similar Locations, Part G; Separately Derived Systems with 60V to Ground. A typical wiring design using the solid grounding (SG) method with the new AC system grounding method is shown in Figure 12; the design for the insulated-isolated grounding (IG) method is shown in Figure 13.

The operative section within the NEC for a 60VAC to ground system is

Figure 10. Solidly grounded (SG) AC system and branch circuits.

Figure 11. Solidly grounded AC system and isolated or insulated grounding (IG) of the served branch circuit.
530-70, General, where it states that the “use of a separately derived 120V, single-phase, three-wire system with 60V on each of two ungrounded conductors to a grounded neutral conductor shall be permitted for the purpose of reducing objectionable noise in A-V production or other similar sensitive electronic equipment locations provided that its use is restricted to electronic equipment only and that all of the requirements in Sections 530-71 through 530-73 are met. The new requirements call for the addition of a ground-fault interrupt (GFI) on either the receptacle or the branch circuit breaker used on the new type of AC system grounding.

Three important changes occur when the new 120/60VAC system is used. First, the voltage to ground on the hot conductors is one-half of what it would be if it were a standard form of circuit. This drops the e-field to ground level proportionally. Second, the grounding system is fully symmetrical, limiting the ability of a common-mode noise current in the grounding system to be converted to normal-mode current and hence normal-mode noise voltage on the circuit. This change reduces the ability of the noise to get through the equipment’s power supply and to the subsequent circuits. Finally, the requirements prevent the use of any equipment other than electronic equipment equipped with the required special connector. This prevents a great deal of unwanted interference from other types of equipment that might otherwise share the same AC system and branch circuit wiring.

What to do?

For best results, install a separate transformer, secondary overcurrent and disconnect device, feeder and branch circuit — all at the new 120/60VAC level. This system needs to meet the requirements of the NEC for use on such a system. This will be a separate AC system from the building’s other systems, but it will still need to be AC system grounded. This is done via a grounding electrode conductor (GEC) to an NEC-acceptable earth-grounding electrode that is electrically common to the building’s normal earth-grounding electrode system used by the service equipment and other separately derived AC systems.

Please note that one small glitch exists in the whole process of using the 120/60VAC system arrangement. It involves locations that do not restrict access to qualified persons only. Per the NEC, when the 120/60VAC system is used in areas of general access, it will need to be uniquely configured and identified by cutting off the existing 120VAC plug on its line cord and replacing it with one of the new plugs. This latter action makes for another NEC situation because of the combined effects of Sections 110-2, Approval and 110-3, Examination, Identification, Installation and Use of Equipment; Paragraph (b), Installation and Use. For example, you cannot modify listed or labeled equipment in any way without invalidating its listing or label process. This then causes the equipment to no longer be in listed or labeled condition, which then creates a problem with the two sections just identified. The only out on this is to get the electrical safety inspection authority having jurisdic-
**Power quality and grounding**

When equipment is installed together in a room, such as for audio or video editing, there are typically several racks of equipment involved with a number of signal-level cables routed among them. This type of installation often has hum and other noise problems, all originating in the common-mode (CM) system. Common-mode currents and voltages on the equipment grounding system can cause operational problems with digitally based equipment when the impulses interfere with clocking and related set-reset operations of the logic elements. Once converted into normal-mode current or voltage by the circuit's impedance imbalances, it mimics the desired signals and can directly affect control, audio or video signal processes.

Common-mode currents and voltages classed as noise are problem areas usually addressed by marginally and randomly effective or hazardous practices. These generally involve creating electrical safety problems via equipment grounding methods that violate the NEC or employing grounding/bonding schemes that are based in unreliable art as opposed to predictable engineering practices. A good example of this is the use of the

---

**Equipment grounding for hum and noise control**

When equipment is installed together in a room, such as for audio or video editing, there are typically several racks of equipment involved with a number of signal-level cables routed among them. This type of installation often has hum and other noise problems, all originating in the common-mode (CM). Common-mode currents and voltages on the equipment grounding system can cause operational problems with digitally based equipment when the impulses interfere with clocking and related set-reset operations of the logic elements. Once converted into normal-mode current or voltage by the circuit's impedance imbalances, it mimics the desired signals and can directly affect control, audio or video signal processes.

Common-mode currents and voltages classed as noise are problem areas usually addressed by marginally and randomly effective or hazardous practices. These generally involve creating electrical safety problems via equipment grounding methods that violate the NEC or employing grounding/bonding schemes that are based in unreliable art as opposed to predictable engineering practices. A good example of this is the use of the

---

**Continued from page 92**

A linear voltage regulator circuit cannot withstand the applied voltage and regulation is lost. Too much DC voltage on the power supply's output can upset or damage the connected loads. Alternately, the regulator circuits themselves can become damaged. A DC level crowbar circuit is sometimes the only protection from this kind of problem. It is not an elegant solution, especially if it is not automatically resetting or can be triggered by electromagnetic interference (EMI).

**OTHER EFFECTS**

Because impulses and most oscillatory events contain high-frequency components, they can affect the power supply that they are impressed upon because of EMI effects. EMI problems involving AC line propagated electrical disturbances generally involve power supply designs that provide unwanted coupling between the input and output. This is especially true when higher frequencies in the tens to hundreds of kilohertz are involved, and where small amounts of line reactance can create significant coupling between circuits. The usual problem within a power supply involves H-fields as opposed to e-fields. This is because the currents are relatively high and circuit impedances and voltages are relatively low. Thus, most problems involve stray magnetic fields and the routing of, for example, wiring harnesses and printed circuit boards.

Regarding EMI immunity, the SMPS wins hands down because it is already a prolific generator of EMI in its own circuits. Thus, the SMPS must be well-designed from the very beginning. An EMI and electromagnetic compatibility (EMC) standpoint or interference will be reduced and will also generate interference for the equipment with which it is being used. Making the SMPS immune to its own poison has the desirable effect of also rendering it pretty much immune to externally applied EMI. This is not the case with the typical linear power supply, which is fairly quiet by itself, but is often not well-designed from an EMI immunity standpoint.

As an example, often, when equipment with a linear power supply is being affected by AC line EMI problems, a compatible uninterruptible power supply (UPS) is placed between it and the offending AC line. This change typically cures the problem, but how? Simple. The problem has been fixed by putting an SMPS between the AC line and the linear power supply in the "victim" equipment. After all, that's the real difference between an AC power UPS and the SMPS in equipment except that the UPS is higher power, doesn't have a rectified inverter output and supplies 60Hz instead of DC to its loads? The similarity between the UPS' battery and the SMPS' main input energy storage capacitor is pretty obvious, so I won't elaborate.

![Figure 1](https://www.americanradiohistory.com/)

**Figure 1.** (A) Idealized effect of an input voltage sag on an AC/DC analog power supply, (B) Idealized effect of an input voltage sag on an AC/DC SMPS.
single-point grounding method. This produces marginal and unpredictable performance for analog-based equipment and is useless for digital-based equipment. In addition, it is a lightning damage-prone grounding design for the attached equipment, and an NEC equipment and AC supply system grounding violation when implemented in its classic form.

However, an effective methodology does exist to deal with all of these problems and also to keep the AC supply system and equipment grounding safe. This method is called a signal reference grid (SRG) and it involves AC power and signal-level surge protectors being employed along with some special rules for the termination of cable shields. Taking these items in order, let's start with the SRG.

The signal reference grid

It is generally agreed that if all the electronic equipment is grounded to an underlying ground plane (a flat, wide-area solid sheet of copper), then the best form of grounding available across the broadest range of frequency can be obtained. However, a ground plane is typically difficult to implement and somewhat costly in practical forms. If, instead of a plane, a grid is installed, all the benefits of the ground plane can be had except that the upper effective operating frequency limit will be lower.

Remember, topologically speaking, a grid is just a plane with some openings in it. For the typical grid installation, having openings in the plane is not a problem. The recommended practice designs for SRGs are effective from DC to approximately 25MHz to 30MHz. This is good broadband grounding effective across the entire frequency range needed by analog and digital logic-based commercial audio and video equipment.

The typical SRG consists of a network of bare copper conductors with bonded intersections every one or two feet, completely covering the floor area where the equipment is installed. The SRG is typically installed on the floor and all of the equipment is jumpered to and from it via grounding-bonding straps. All electrical conduits, the equipment ground and the isolation transformer (IT) serving the equipment room are grounded or bonded to the SRG, making it the commonly shared ground reference for everything. Yes, everything. The idea of isolation is long gone; it has too many problems, including electrical safety ones. (The neutral terminal on the secondary, the metal case or enclosure and the greenwires are all tied together within the transformer. The junction point for these items is then grounding-bonding jumpered to the SRG. The isolation transformer is typically placed directly atop the SRG and is not remotely installed.)

Typical construction

Generally, the construction of the SRG involves the use of a cellular raised floor (computer-room-style flooring) under which the SRG, electrical power and signal wiring can be routed. The underfloor volume is also often used for an air-handling space for the supply of HVAC process cooling air into the room above.

Cellular raised floors allow the SRG to be installed directly atop the structural subflooring or suspended just below the floor's pedestal post's top cap by SRG wire-holding and bonding clamps. Either way, it works well. Materials used generally involve bare copper wire AWG 6 or a copper strap about 0.1 inch thick and two inches wide. The crossover points where the junctions are made are typically at 2x2 feet. They can be made a little larger or smaller, because the differing effects are not too noticeable.

For carpeted or uncovered floor surfaces, a flat copper foil is generally used. The foil is typically 0.030 inches thick and two inches wide, with all of the crossovers soldered together. This type of SRG can be directly applied to a floor's surface and then either walked directly on or covered with an anti-static electricity carpet. (You do use this kind of carpet in equipment rooms, don't you?) T-shaped access slots cut into the carpet allow grounding straps or jumpers to be passed through and then soldered to the underlying SRG foil, after which the carpet's edges are folded back down.

Surge protection

The biggest threat to electronic equipment from a physical damage standpoint is from lightning-related transient voltages, commonly called surges. Although somewhat related to the geographical location of the equipment, surges are a real threat almost everywhere in the United States. How much of a threat can be estimated by consulting ANSI/NFPA-780, the National Lightning Protection Code 1992.

A direct strike to the building or the incoming AC supply conductors is not necessary to create a damaging surge current and voltage for the equipment installed in the building. A cloud-to-cloud overhead or a nearby
Power quality and grounding

A direct strike to the building or the incoming AC supply conductors is not necessary to create a damaging surge current and voltage.

strike is sufficient to do the trick.

Because many typical installations involve routing cables throughout a facility, there is ample opportunity for damaging lightning currents to be near-field coupled into them. This is an e-field (electric-field, capacitive coupled) and H-field (magnetic-field, inductive) set of phenomena that is unavoidable. However, they can be mitigated by employing proper grounding, bonding, shielding and surge-protection techniques.

The surge is coupled into the building wiring system and the various control or signal process cables of the affected electronic load equipment. The amount of surge coupled is proportional to the amount of area enclosed by the affected wiring. Big areas mean larger surge currents and voltages are developed from the lightning discharge.

From the victim equipment's standpoint, there are two ports from which the surge threat arrives: the AC power input and the signal or control cable connectors. Therefore, a surge current arriving from one port's conductors is passed into the victim equipment and out the other port and into its conductors. The victim equipment is in the center of a loop into which a surge impulse has been coupled.

This explains why adding surge protection to only one of the two ports does not do much to protect the equipment from lightning-coupled damage.

With the increased use of computers, the control or signal-level port is generally configured to use one of the computer industry's standard protocols, and this is fortunate, as we will see. This is true unless problems arise because of some special interface plug-in card being installed, which may use a non-standard signaling protocol or other configuration.

Proper surge protection needs to be installed on the equipment itself and on the AC power and control or signal cable ports using performance-coordinated surge-protective devices. Typically, this is a metal-oxide varistor-based form of protection on the AC power input port. The signal level port may use a combination of Tranzorbs, gas tubes, series resistances or impedances and common-mode chokes in a specially designed protection circuit particular to the signal port's characteristics and coordinated with the performance of the associated AC power port's protection.

For example, an RS-232 signal port needs a surge protector specifically designed for the RS-232 protocol. It must be used with an AC power port surge protector with which it has been performance tested and rated to work. Anything else will most likely fail to do the job, and the signal port will most likely be the one damaged. The best protection is provided when the AC power and signal protectors are mounted onto and grounded-bonded to the protected equipment's metal frame or enclosure. In most cases, using a rack's metal framework is adequate for this purpose, and this practice is necessary for larger groupings of equipment in any case.

Surge protector units are generally available for any industry-standard signaling protocol, but not for proprietary signal protocols. These need to be specially engineered for the specific application.

The building's AC power system also must be surge protected so that the level of the surge arriving at the electronic load equipment is as low as possible. The protection provided at the electronic load equipment is not usually capable of doing the whole protection job involving high-energy surges, but is rated to do a good job with lower-level surges. By today's means, you cannot provide top-notch performance and high energy level handling in the same package as installed at the victim equipment's level.

The recommended practice is to start with the building's SEQ and to install a device called a secondary lightning protector (or arrester) on the service conductors. The metal frame or enclosure of the SEQ must be used for the surge current's reference point. Generally recommended practice is to parallel this protector with an AC capacitor connected from each line to equipment ground. This is often properly referred to as a waveform modification capacitor. It is sometimes built in as a part of the overall protector chosen to do the job. Most of these protectors are rated for 600VAC systems and are available for single- and three-phase services.

Next, recommended practice encourages the application of surge protectors similar to the one used at the SEQ on each level of switchboard and panel board that exists between the SEQ and the victim electronic load equipment on the branch circuit. In each case, the protector is applied in shunt between each line and equipment ground, such as the metal frame or enclosure of the switchboard or panel board.

The final level of surge protection ahead of the equipment's port protection is applied at the end of the branch circuit itself. The recommended practice is to install a surge-protected receptacle or to plug in a protector to the normal receptacle into which the victim electronic load equipment is then plugged.

Taken together, all of these measures serially shunt and progressively attenuate the level of surge that arrives at the SEQ from the power distribution system. What is left is mopped up by the device-specific and coordinated protection applied at the AC power port for the electronic load equipment, coordinated with that equipment's signal port's protection.
Cable shield terminations

With analog circuits and lower-frequency signal processes, the golden rule was always to ground the shield at one end only. However, this is not recommended with digital signal circuits because of the higher-frequency nature of the circuits. It is not recommended for analog circuits either, if you are concerned with the shield attenuating H-field coupled interference, such as from lightning.

With digital circuits, the requirement is to ground the cable's shield at both ends to obtain H-field protection and to preserve the integrity of the high-frequency signal on the cable. Worries about cable shield current combining with the digital signal on the cable are minimized because, at the involved frequencies, the two currents are separated by flowing on the inner and outer surfaces of the shield with little or no overlap. This is an e-field and a skin-effect function. In fact, most digital signal cables, such as coaxial cables, can have the shield grounded at multiple points along the way with no ill effects and much improved lightning protection.

The telephone company has always grounded the cable shield at both ends between the subscriber loop station and the subscriber's premises. This was done for lightning safety reasons and is required under NEC regulations. A twisted-pair arrangement is used inside the telephone cable's shield, and each of the contained pairs is protected by a surge-protective device (SPD) connected from line-to-line and line-to-ground or chassis. Unwanted cable shield currents caused by conducted common-mode currents are typically dealt with by isolating one end of the shield from ground via a capacitor of a few microfarads. This blocks DC and most audio frequencies (including AC power system harmonics), but lets high-frequency surge-type currents flow with ease. As a result, the shield can function as a means of attenuating H-field-coupled noise and surge currents, but is relatively unaffected by DC and AC power system-related common-mode currents resulting from ground potential offset between the two ends of the circuit.

Shield current problems can also be dealt with via a number of other recognized techniques, such as using Tranzors between the shield and ground, opto-couplers at the cable's ends, common-mode chokes on the cable and transformer isolation of the signal.

Proper surge protection needs to be installed on the equipment itself and on the AC power and control or signal cable ports using performance-coordinated surge-protective devices.

Finally, if you simply must have the cable's shield grounded at one end only, you can still have the benefits of grounding the shield at both ends (for H-field protection) by pulling the cable into a grounded-at-both-ends metal conduit raceway. This practice provides a two-level shielding system. The design also improves the e-field shielding capability of the circuit. The best types of conduit or raceway to use in this role are electrical metallic tubing (EMT), intermediate metal conduit (IMC) and rigid metal conduit (RMC) in ascending order of effectiveness. Note that galvanized steel conduit is markedly better than aluminum conduit in attenuating common-mode noise currents and that tightly made joints and terminations are necessary for the best effect.

Digital logic and SMPS-based equipment is replacing or has replaced the analog circuit-based equipment of yesterday. These newer designs have great advantages, but are still somewhat susceptible to electrical noise arriving on the AC power input, the grounding system and the attached signal level cables used to interconnect items into a system. Equipment of the new and old design types are still susceptible to the damaging effects of lightning-induced surge currents and voltages that are impressed upon the equipment's AC power input wiring, the signal cables and the grounding system being used.

By understanding how AC power problems affect electronic load equipment, you can determine the types of power-conditioning equipment needed. The CBEMA curve was developed to aid in this process and is useful with the analog design equipment and digital logic-based designs.

When using the newer digital-based equipment, abandon many of the older methods of grounding, bonding and shielding. This means strictly following the NEC. Avoid the use of isolated earth-grounding electrode connections. Eliminate single-point grounding systems, instead use broadband signal reference grid (SRG) designs.

Ground signal cable shields at both ends — a requirement for digital signals. Pay strict attention to providing proper surge-protective devices on the AC power and signal circuits if there is a risk of lightning damage at the location. Following these guidelines will ensure a ground system that is safe for the electronic equipment you install and for the people who will use it.

Warren H. Lewis is with Lewis Consulting and Engineering, Julian, CA.

For more information:
1. IEEE Emerald Book entitled "Recommended Practice for Powering and Grounding of Sensitive Electronic Equipment"
2. Federal Information Processing Standard Publication No. 94 [i.e.; Fips-PUB-94]

NEC sections:
Grounding
250.5, 250.26

Balanced power systems:
530-70, General
530-71, Wiring Methods
530-72, Grounding
530-73, Receptacles
The use of MPEG-2 compressed digital TV signals is expanding rapidly throughout the world for terrestrial and satellite video networks. Although the digital technology does bring significant operation and cost savings to users, it also has created challenges for equipment manufacturers as the transition from analog to digital is implemented. The top challenges have been **interoperability** of MPEG-2 encoders and decoders from various manufacturers, **concatenation** of signals and **digital turnaround** of compressed video between satellite and terrestrial networks.

**Interoperability**

Compressed digital television has been around for more than a decade, bringing new capability and flexibility to TV program contribution and distribution networks. The past five years has seen an order of magnitude improvement in performance, efficiency and size of MPEG-2 compression products, largely brought about by the development of RISC technology.

Standards that were developed in the early 1990s for compressed digital TV signals have played an important role in the utility of the new technology. The International Standards Organization (ISO) MPEG-2 digital TV standard brought digital television closer to widespread use in network TV operations. This standard provides a degree of confidence that users can buy equipment from an array of manufacturers and know those digital encoders and decoders would interoperate. This was substantially proven in tests conducted by the industry, but they left the satellite modulation and demodulation standards open, reducing the chance for guaranteed interoperability. The European digital video broadcasting (DVB) standard developed quickly to help solve the problem. Because MPEG-2 and DVB standards have since been adopted by all manufacturers of compressed digital TV systems, interoperability has to a large degree been achieved. Even so, there remain isolated instances where a manufacturer's MPEG-2 encoder or integrated receiver decoder (IRD) does not interoperate with others.

Companies that tested their MPEG-2 encoders, DVB modulators and MPEG-2/DVB IRDs for interoperability at the Intelsat and ISOG trials include Tiernan Communications, News Data Systems (NDS), Scientific Atlanta, General Instruments, Divicom, Wegener, Thomson and Tadiran/Scopus. These companies proved their interoperability in accordance with parameters set by Intelsat and ISOG, designed to meet primary requirements of digital TV broadcast applications. Interoperability will be an ongoing issue as new products are released, such as the new high-performance encoders and IRDs supporting the MPEG-2 4:2:2 studio profile.
The issue of interoperability allowing exchange of digital TV programs between users of different manufacturers' MPEG-2 equipment is no longer a key issue in making the decision to convert from analog to digital technology. CBS Inc. was the first among U.S. networks to adopt the advantages of digital satellite news gathering (DSNG), when in 1995, it began with a single-channel MPEG-2 system for fixed and mobile applications. CBS went further when covering the 1996 Republican Convention in San Diego, by uplinking six channels of MPEG-2 compressed digital TV coverage on a single transponder. This provided extensive coverage of the event to CBS affiliates and international networks using other manufacturers' receiving equipment. European news networks, including the 25 member stations of European News Exchange (ENEX), were faster to adopt the benefits of DSNG and are considered ahead of U.S. deployment.

This is likely to change in 1998 as the major U.S. networks plan a significant increase in the use of MPEG-2 compressed digital TV technology for their contribution and distribution requirements. This demonstrates the increased confidence in MPEG-2 technology that has without doubt improved substantially over the past couple of years. This was clearly seen at NAB '97 when most of the leading players rolled out new and substantially improved products over those seen a year earlier, including some with the long-awaited 4:2:2 studio profile.

**Concatenation**

The need for concatenation or multiprocessing of MPEG-2 compressed digital TV signals must be considered in designing program contribution networks. Concatenation of MPEG-2 datastreams can generate unacceptably large errors resulting in visual artifacts in the TV image. Signal jitter and timing problems can also be introduced in the multiprocessing environment. In networks where concatenation is necessary, the problem can be lessened by running the originating encoder at higher video data rates. The use of a 4:2:2 studio profile @ main level encoder offering video data rates up to 50M/b/s will improve digital post-production tools and provide a degree of protection in multiprocessing situations, above that possible with 4:2:0 encoding.

Experience has shown that broadcast-quality video can be achieved in single and multihop circuits using satellite or terrestrial links with video bit rates of between 5M/b/s and 8M/b/s (more on this in the next section). However, where post-production editing or re-encoding is necessary, artifacts are likely to overrun when more than three or four concatenations take place at these highly compressed data rates. Higher video data rates help protect against errors that can be
MPEG transmission issues

introduced in multiprocessing environments. In concatenated MPEG-2 applications, video data rates from 8Mb/s up to the 15Mb/s limit of MPEG-2, ML@MP must be considered. Unfortunately, higher data rates are not advisable when heavy concatenation is likely.

In adverse conditions, such as a satellite circuit operating at close to threshold, a low data rate video signal will be less robust than one operating at a higher data rate. This will likely result in disturbing artifacts being visible at concatenations when coded at 8Mb/s or higher using MPEG-2 compression. There is no accurate measurement of the effect that concatenation is likely to cause, other than the measurement of errors in the datastream, which may not be consistent even within the same category of compressed program material. There is always the potential for a video signal to create processing problems in MPEG-2 compression and this

in fewer channels per transponder or terrestrial circuit.

MPEG-2 relies on high compression ratios, reducing the required video data rate by 90% or more. These high compression ratios and low data rates are inevitable for network efficiency, but data integrity is always of prime importance in digital TV networks. Specific attention must be directed to error-free decoded video and audio signals, comparable to uncompressed analog video, while still gaining the benefit of digital transmission. MPEG-2 has been proven adequate and sufficiently robust to render broadcast-standard video at around 8Mb/s. Lower video data rates in the order of 4Mb/s to 6Mb/s are possible with some less complex video, such as news interviews and other less aggressive video, resulting in only slight degradation of quality. However, low data rates are not advisable when heavy concatenation is likely.

Tests show that a high proportion of broadcast program material, including much with high motion, like sports events, can withstand at least two concatenations when coded at 8Mb/s or higher using MPEG-2 compression. There is no accurate measurement of the effect that concatenation is likely to cause, other than the measurement of errors in the datastream, which may not be consistent even within the same category of compressed program material. There is always the potential for a video signal to create processing problems in MPEG-2 compression and this

gets more problematic in concatenated operations.

Digital turnaround and ATM networks

In the world of analog television, turnaround of network signals in program contribution and distribution networks was a relatively easy task. All you had to do was simply re-modulate a baseband signal or even better, do it at the IF frequency. However, noise gets added at each turn-around and there will be signal degradation to varying degrees, which can reach the point where a broadcast-quality picture is not possible.

Many problems were encountered in the early days of multihop digital TV networking, largely caused by the continuation of analog network practices, such as IF turnaround. This technique often resulted in the generation of er-
Digital turnaround has become commonplace with the major networks and common carriers.

Teleglobal International was the first major carrier to offer digital TV service over an ATM terrestrial network using newly available MPEG-2 4:2:2 studio profile equipment. The service was inaugurated in December 1997. The ATM link was established between Teleglobal's Lake Cowagan, British Columbia teleport to Laurentides teleport near Montreal, terminating at Waterfront Communications New York teleport.

NHK was the first to use the new MPEG-2 4:2:2 ATM service from Teleglobal International. NHK was well satisfied with the video and audio quality of the service. Teleglobal is initially offering two levels of MPEG-2 ATM service to its users: 8Mb/s at either 4:2:2 or 4:2:0 profiles and 18Mb/s at 4:2:2 only.

Finally, trials by Intelsat and ISOG have convinced manufacturers and users that interoperability is no longer a major issue. It has been proven that any manufacturer's equipment conforming to the MPEG-2 and DVB standards can be made to interoperate with another manufacturer's similarly compliant product. Continued cooperation is needed between manufacturers to ensure that the new products, including those supporting the new 4:2:2 studio profile will maintain the required interoperability.

Keith Dunford is vice president of Tiernan Communications, Inc., San Diego.
Make it easier for others to reach agreements with you

BY KARE ANDERSON

Are you far enough along into the new year to find that you are already backsliding on your goals for 1998? Want to try on some bite-size “behavioral change” goals instead? These small habits may reap big rewards in reducing stress and friction when trying to reach better agreements more easily.

Tell me which of the following 12 habits you find the most difficult to adopt, the easiest or the most rewarding. E-mail me at kareand@aol.com.

1. Anticipate what you want out of a situation before you go into it. Before you enter into a conversation with someone, consider your main goal. The more you can keep your goal in mind, especially if you have strong negative or positive feelings about the person you are talking to, the more you will remain focused on what is being said and you will be less reactionary to issues that don’t relate to your bottom line. In some cases, your main goal may change in mid-conversation, but having a goal gives you a context for the conversation.

2. Demonstrate goodwill upfront. Be willing to compromise and be genial, even if you don’t like the person or the situation. This is the best way to keep the channels of communication open.

3. Make the other people feel safe before you try changing their minds. Being right or smart or good is often of no help in protecting your interests. Acting in mutual best interests is more valuable. All agreements involve asking people to change, which we initially resist. In almost every situation, people are first influenced by their fears more than their opportunities. Calm their fears, even if they may be unstated, and you will open people up to hearing your needs. Align your goals with their picture of positive possibilities and you may move them more quickly to agreement. Once fears are allayed, they can hear about others who have already done something similar to what you propose.

4. Understand that problems seldom exist at the level at which they are discussed. When you are involved in any argument lasting more than 10 minutes, ask yourself, “Are we arguing about what our disagreement is really about or is there a deeper conflict not being discussed?” Probe for the underlying concern and find a direct or indirect way to address it.

5. Make it a habit to refer to other people’s interests first. Refer to the other person’s interests first (you), then how the topic relates to your mutual interests (us) and finally, how the topic relates to your interests (me). Research shows that others will listen sooner, longer, remember more and assume you have a higher IQ than if you were to address your interests first.

6. Honor commonalities more frequently than bringing up the differences. It is a habit to bring up our concerns more than our agreements with someone else. Whatever you refer to most often and most intensely will be the center of your relationship. Keep referring to the part of them and their points that you can support and want to expand upon. If you want more from other people, wait until they have invested more time, energy, money or other resources to ask for it.

7. Don’t assume that other people see the picture you are presenting. Do not presume that others recognize all the benefits of what you are proposing. Take time to describe them in their terms, relating your suggestions to their most pressing interests and situation. Many seemingly tough “negotiators” are simply acting to prevent looking foolish later on. The best peacemakers work hardest to allay the other people’s worries.

8. Use time, rather than letting it control you. Plan and act early to avoid last-minute rushing and thinking. As you go forward in your discussions, remember that the allure of a successful agreement often clouds our perceptions of whether we can cover all the elements of the agreement in the time we have allotted to discuss it. Do not panic when you have unavoidable outside time constraints. Use the pressure to get more accomplished in less time.

9. Look to your long-range interests and your better side. Even though it is human to gloat in the face of imminent victory or vindication, do not make a victim of the underdog. You will never have their complete attention or trust again; some will retaliate and you will be diminished in the eyes of others who witness your behavior.

10. Recognize your blind spots and your hot buttons. When you get angry with someone, look first to your vulnerable points before you lash out.

11. Be a “synthesizer leader” (SL). The emerging synthesizer leaders have some behaviors in common. They listen to others before voicing an opinion. They ask probing and follow-up questions. They refer to the previous comments of other people with whom they agree as a way of prefacing the idea they advocate. They display consistent values. They offer and keep commitments, without being reminded. Consequently, even if others may not agree with “SLs,” they are likely to respect and work with SLs more than others who may be closer to their beliefs, but who are unreliable in keeping commitments.

12. Aim humor at yourself. The best way to deflect is to poke fun at yourself. Make reference to a situation when you did something foolish.

Kare Anderson is a speaker and author. Visit her web site at www.sayitbetter.com.
In February, over 3900 athletes from 83 countries will compete in 64 events in the 16 days of the 1998 Winter Olympic Games in Nagano, Japan.

35 broadcasters will deliver thousands of broadcast hours, using hundreds of cameras . . .

and

one worldwide standard.

Anton/Bauer continues its support of the Olympic Games and the world broadcasting community in Nagano, with the official battery support facility at the Games. A fully staffed service and support office will be located in the International Broadcast Center (IBC). For more information contact Anton/Bauer 203) 929-1100 or fax (203) 929-9935

Circle (45) on Free Info Card
ORTO'98 served as the host broadcasting organization at the 1998 Nagano Olympic Winter Games. ORTO'98 was responsible for producing the radio and TV international signals of the Games, including events held at the 17 venues, the opening and closing ceremonies, the victory ceremony and the main press center.

BY TAKASHI MIYAMOTO

The Olympic Radio and Television Organization (ORTO'98) dispatched more than 1,800 staff and used some 350 cameras, 32 super slow-motion cameras, two helicopters, 24 cameras mounted on cranes and 20 special effects cameras to cover the competition and ceremonies held at the 17 Olympic venues during the 1998 Nagano Olympic Winter Games, Feb. 7-22.

The ORTO'98 committee started the design of the technical facilities based on a digital platform. The key factors included:

1. The recent availability of broadcast equipment that can interface with serial digital signals made it possible to establish a comprehensive digital system.
2. The transmission of digital signals based on synchronous digital hierarchy (SDH) has been generalized with the recent development of fiber-optic networks.
Finally, a place to stick the FCC's DTV requirements.

Introducing the world's only video jacks to surpass SMPTE® 292M specifications for uncompressed HDTV.

You're looking right up the business end of the SVJ-2 Super Video Jack from ADC Telecommunications. A breakthrough jack that can do far more than help convert your station to digital television — it will take you all the way to HDTV. That's because ADC Superjacks don't just pass SMPTE 292M specs, they blow them out of the water. Our standard-size SVJ-2, for example, can handle bandwidths up to 2.4 GHz. And our mid-size MVJ-3 can go to 3.0 GHz and beyond. Which means these jacks could realistically outlive your entire network. That's why we call them "future proof." No matter what DTV format your station adopts now, you won't have to upgrade again. ADC Superjacks. The best place in the world to stick FCC requirements for DTV. As you'd expect, ADC is innovating the broadcast industry.

© 1998 ADC Telecommunications

See us at NAB booth #6047
Circle (39) on Free Info Card

www.americanradiohistory.com
Winter Olympics:
Putting on the Games in Japan

Video workshop room for CG work at IBC.

3. In order to ensure superior signal quality, conversion from analog to digital and back was minimized.
4. Standard digital multiplexing techniques allowed digital video and audio to be combined on one coaxial cable, which reduced the amount of cables and work required when building large broadcast facilities.

ORTO’98 established a digital system that conformed to NTSC composite digital format SMPTE 259M/272M standard that specifies a serial digital interface with embedded digital audio. In order to secure the host broadcast equipment at the International Broadcasting Center (IBC), Panasonic was selected to be the key system integrator for the Nagano Games in September 1996. The Panasonic installation included digital broadcast equipment, including D-3 format videotape machines with serial digital (SDI) and embedded audio interfaces.

International signals

The international TV signals were handled by SMPTE 170M (NTSC, 525 lines/59.94Hz) with stereo audio in-
A few new additions...

Recent additions to the 200 Series Synthesized UHF wireless family...

All new 250mW belt-pack transmitter
For extreme operating range. 256 frequencies in 100 kHz steps. Adjustable low frequency roll-off.

The best sounding hand-held transmitter
The new VariMic™ electret element offers adjustable bass, midrange and treble to suit individual taste or to match other microphones, plus an attenuator for high sound pressure levels.

All new synthesized plug-on transmitter
Converts hand-held microphones to wireless operation. 256 frequencies in 100 kHz steps.

For more information and a free 50 page wireless guide:
Call (800) 821-1121

Made with pride in the USA
The most advanced wireless systems in the world.
Winter Olympics: Putting on the Games in Japan

As international signals were distributed to world broadcasters on an analog system, digital and analog facilities coexisted in the ORTO'98 central facilities. All video and audio signals transmitted through contribution networks from the Olympic venues were terminated at the distribution center in the IBC before being distributed to the world broadcasters’ areas. The contribution networks consisted of 15 sports venues, a venue for the opening and closing ceremonies, plus main press center and a venue for the victory ceremony, the Olympic village and the panoramic camera feeds.

Distribution of the signals produced by ORTO'98 to world broadcasters at the venues and the IBC were NTSC composite analog with associated stereo sound. Signals were identified, equalized and synchronized in the distribution center. ORTO'98 also handled 73 permanent unilateral circuits from venues to the broadcast suites at the IBC.

Transmission center

The transmission center served as a final supervising point of outgoing signals to be transmitted via terrestrial or satellite circuits in cooperation with telecommunications companies. ORTO'98 handled 51 permanent outgoing circuits from the IBC to overseas and domestic destinations.

Outgoing signals were transmitted via telecom KDD’s uplink facilities as follows: Yamaguchi earth station accessible to Indian Ocean Region (IOR); Ibaraki earth station accessible to Pacific Ocean Region (POR), PanAmSat and Intersputnik; and IBC earth station accessible to IOR, POR and PanAmSat. In addition, a transoceanic fiber-optic link at Ninomiya was used.

ORTO'98 introduced a codec with serial digital interface that was capable of carrying serial composite digital signals on SDH. The codecs, supplied by Grass Valley, accommodated two times AES3 channels in addition to one times serial digital video input. No bit reduction was used on any channel.

Technical facilities

ORTO'98 secured a space of approximately 1,800 square meters, with the IBC as the technical area, to perform the host broadcaster’s responsibilities. Installation of ORTO'98 technical facilities at the IBC started in September 1997 in association with Panasonic. The technical area included the following facilities:

- distribution center;
- transmission center;
- codec room;
- VTR room;
- video workshop;
- quality control room;
- seven edit suites;
- RF communications control room;
- viewing/copying room; and
- radio studio.

VTR and post-production facilities

ORTO'98 was responsible for non-stop recording of all the international signals transmitted live from the venues. In the VTR room, all international TV signals were recorded in digital format conforming to SMPTE 259M/272M standard without any conversion to analog signals.

More than 100 D-3 videotape ma...
The Easy Patch series of easy to use patchbays eliminates signal degradation and offers excellent crosstalk performance required in today’s broadcast facilities, mobile trucks, recording studios and audio installations.

Their analog/digital signal capability, reduced wiring time and quality workmanship are unmatched by competitors’ patchbays.

The Easy Patch gives you features and options no other patchbay provides:
- Galvanized, heavy duty metal housing.
- Flexible depth from 14” to 18”.
- Hard gold plated contacts designed specifically for A/D signals.
- Six jumper switching configurations.
- Ten color coded ID tabs - optional.

You asked for innovation, productivity and value in a patch bay series and Neutrik listened. Demo Easy Patch for yourself. Call 732-901-9488 and ask for our NEW product guide and the name of your nearest Neutrik representative.

Neutrik... your one stop source for all your audio connector needs...today and tomorrow.
Winter Olympics: Putting on the Games in Japan

They are distributed routing configurations. These systems have great applicability in all organizations, ORTO'98 introduced a newly developed commentary system that incorporated advanced digital technology. The commentary equipment was supplied by Aplicaciones Electronicas Qesar (AEQ), which is headquartered in Spain.

Transmission of wideband commentary audio from the venues to the IBC were conducted via digital circuits equipped with codecs that featured short delay times. The source coding technologies were adopted to 7kHz transmission (G722) and 15kHz transmission (apt-X100).

Graphics
Taking into account the large and differing audiences that watched the 1998 Winter Games on television, ORTO'98 designed the graphics for the international signals to be simple and viewer friendly. In order to gain high-speed operations and uniformity of the international pictures, ORTO'98 installed the “Video Work Station” developed in cooperation with FOR-A Company Ltd. in Japan as a graphics/character generator. The graphics/character generator system was linked with data/result/timing systems at each venue.

The graphics information, such as the athletes’ names, countries, starting numbers and running times, were always inserted and placed in an exact location on the screen, giving uniform and stable images to the viewers.

Takashi Miyamoto is director, IBC Operations, ORTO’98, Nagano, Japan.

New Products & Reviews

Applied Technology

Router technology: Bigger isn’t always better
BY DAVE TIEWEL

In today’s world of rapidly evolving technology, stations and production houses need to make careful decisions when selecting new routers. No longer can it be assumed that one central legacy router is the best way to manage audio and video signals. Sometimes, bigger is not better.

This concept has been proved beyond a doubt in the computer industry. During the past two decades, the era of the mainframe computer as the only source of computing power has passed away. Today, every organization has decentralized its computing into a mix of smaller computer systems tailored for specific applications. This distributed processing approach has great applicability in the broadcast industry as well.

Advantages
There are some significant benefits to distributed routing configurations. They are compact in size and can be located in that new edit bay with only a limited number of cable runs back to the legacy router. In addition, these routers simply don’t require the care and feeding of the products of old; no longer do you need a climate-controlled environment and raised floors.

However, the biggest advantage by far is the cost savings associated with buying only the capacity that you need. When large router configurations are installed or expanded, an enormous amount of capacity and costs are added to the system, while in all probability, the majority of this new capacity is simply not needed.

The effective cost of the distributed routers is much lower because the crosspoint use is so much higher. The larger the router, the more crosspoints, but the fewer of them in use at any given time. On the other hand, a decentralized design provides for much greater utilization level, meaning that the cost per crosspoint will actually be much less in smaller routers. This is true even though there is a natural economy of scale realized when building mainframe routers; if the crosspoints are never used, however, there is simply no cost savings to be gained by having them available.

The other similarity to the computer industry is that every year, routers get smaller, faster and less expensive. The lesson here is to buy only what you need to meet today’s requirements.

The VersaFrame
Telect’s VersaFrame products fit well into the distributed routing environment. The VersaFrame is a three-rack unit chassis and power supply into which up to 10 modules may be inserted. These may be scalable router input and output modules, as well as a number of other application modules. The routers are scalable by performance level, as well as by total configuration size.

The VersaFrame uses a building-block
Digital + Analog + Interface Audio Test

True Dual Domain Audio Testing at an Attractive Price Point

The Portable One Dual Domain is the complete portable test solution for analog and digital audio and the AES/EBU/SPDIF serial digital interface. As the first portable Dual Domain audio analyzer, it includes separate and independent hardware for analog, digital and interface signal generation and measurement.

- Comprehensive analog audio analyzer
- True digital domain analyzer with -140 dB residual noise
- Independent analog & digital audio generators and analyzers
- Generate and measure interface jitter
- Digital interface analyzer
- View AES/EBU status bits
- Internal save and recall of up to 30 test setups
- Loudspeaker monitor for digital & analog audio signals

Our worldwide force of Audio Precision representatives will be pleased to demonstrate the many advantages of the Portable One Dual Domain.
The New Strip in Vegas!

5 in 1

TS100E COAXIAL CABLE STRIPPER
• 5 strippers in 1 easy to use hand tool
• Rotary knob selects 5 different cable setups
• Usable cable O.D. range: .175"-.402"
• Replaceable circular steel blade cassettes
• For all Canare 75Ω BNC, RCA & F crimp plugs

See us at the show Booth 10976 LVCC, Hall S-5

531 5th Street • Unit A • San Fernando CA 91340 USA
Tel: (818) 365-2446 • Fax: (818) 365-0479
www.canare.com

Circle (48) on Free Info Card

Broadcast Engineering February 1998

approach of either eight-input x eight-output or 8x16, which provides a granularity sufficient for inexpensive expansion in cost-affordable increments. It allows the station to select more closely the actual router size required, knowing that expansion can be easily performed later. With the VersaFrame, a station no longer has to buy a router with enormous headroom, instead it can buy a router with the capacity to grow.

Room for growth
Each VersaFrame module is made of two components: the electronics portion for input and crosspoint on one module and the output on a second. Each of these is marked with an I/O card that attaches to the back of the VersaFrame. This provides the versatility to configure the router to fit the customer's needs. Signal isolation within the module is assured by the steel plate that backs each module, separating it from all others. The power supply, an optional redundant power supply and all other VersaFrame modules may be positioned in the VersaFrame for optimal access, particularly for cable routing. Output modules include gain adjustment pots for each output. An optional audio input gain adjustment module is available when working with a mix of balanced and unbalanced sources.

All units may be hot-swapped for ease of maintenance. With Telect's building-block strategy, only a limited number of spare input and output modules are required to be maintained on site or in the dealer's location for quick repair. This saves cost and storage space.

Telect offers a variety of video performance levels, ranging from 50MHz to 150MHz to 400MHz. The 50MHz and 150MHz products target NTSC, YC and YUV applications, while the 150MHz and 400MHz products target mid- to high-end RGB applications. With Telect's ability to place various performance products in the same VersaFrame, a user can specify 50MHz video routers for managing external sync signals in combination with a 400MHz RGB router to reduce cost. Each router may have its own unique router address so that controllers to individual routers may all share the same daisy-chained cable. A router may be set up to run component, as well as composite, in order to accommodate a limited number of NTSC signals in a predominantly component environment without requiring a separate router. Each of the scalable routers can grow from their base size up to 72 input x 128 output. This same set of building blocks can be used in a number of sizes and applications within the station, all according to current requirements.

Those stations that installed Telect routers last year have a choice when expanding to meet this year's requirements. Last year's 16x16 router that needs to grow this year to a 32x32 router may be expanded with more of the 50MHz eight-input x eight-output modules that are currently installed. However, if users choose to upgrade with the new 150MHz eight-input x 16-output modules, their total configuration will be less expensive and require fewer VersaFrame slots, even though the performance level is greater. The same holds true for the audio router counterparts. If the new routers are backward-compatible with routers already installed, the justification to grow in small increments only gets stronger.
This is the digital solution chosen by broadcasters around the world including CNN, NBC, and TV Globo. After evaluating digital video quality and built in features, major broadcasters are choosing Wegener.

Making the upgrade from analog to digital is easy with Wegener. Its all in one package:

- Broadcast Quality MPEG-2 Video Encoder
- Broadcast Quality MPEG Audio Encoder
- Integral QPSK Modulator

You can dial in video rates from 2MB to 15MB instantly via front panel control. Higher data rates for maximum picture quality. Lower data rates to utilize less transponder capacity.

Your needs may change throughout the day. The DVT2001 will change with you. Just enter in the configuration you need - all the flexibility is at your fingertips via the front panel control. Preset configurations make channel changing on the DVT2001 a snap.

And you won't need much space. This package is just 3 rack units high.

The DVT2001 includes RS-422 transport stream data output interfaces for network or multiplexed MCPC applications. The transmitter accepts either NTSC or PAL analog video, and serial D1. The DVT2001 is DVB compliant and may be interoperated with other manufacturers compliant products. It can also run in scrambled mode to prevent unauthorized reception.

What about MPEG 4:2:2? Designed for expansion, the DVT2001 can be upgraded to 4:2:2.

This technology was developed by the teamed efforts of COMSAT Labs & Wegener Communications. And it is available now. For more information call 770-814-4000, or email info@wegener.com
Analog audio and video routing are only a small part of how the VersaFrame can be used. In a distributed processing concept, space typically is at a premium, whether it's in the edit bay, the news room, in the production area or in a mobile unit. The VersaFrame leads the industry in configuration flexibility and packaging density. In addition to scaleable routers, Telect builds audio and video DAs, serial digital DAs, serializers and deserializers, stereo audio amplifiers, color bar/black/sync/tone generators, router controller modules for small configurations and 16x16 serial digital routers.

All of these applications modules may be positioned in the open slots not occupied by the routers. The combination of analog and digital, audio and video, routing and distribution, conversion and control provides the ultimate in space conservation.

Looking ahead

Digital transition appears inevitable, but the future of many stations is still uncertain. The strategy of distributed routing, which uses smaller routers like the VersaFrame, can be a valuable tool during this transition phase. As the migration begins, users can install the serial digital modules in the same VersaFrame next to their analog counterparts. By doing so, they'll be easing into the digital world while protecting their current router investment.

Dave Tewel is the eastern region account manager for Telect, Inc., Liberty Lake, WA. He can be reached at davet@telect.com.

Applied Technology

Digital video microwave systems for 2GHz applications

BY DR. JOHN B. PAYNE

The FCC's new rules on HDTV create new opportunities for TV broadcasters. Unfortunately, for some stations, even getting the signal to the transmitter may be a task. In addition, recent FCC actions reducing the amount of ENG spectrum have resulted in severe shortages of new channels for news operations. Fortunately, there are some new digital techniques that can bring solutions to these pressing problems.

Transmission architecture

The modulation and type of microwave radio required to transmit digital video information is considerably different from that used for analog video transmission. In a digital system, the encoder digitizes then compresses the video and audio signals, then multiplexes the compressed bitstream with the digital data inputs to produce a digital transport stream. The encoder output data rate is typically in the range of 1.5Mb/s to 34Mb/s, depending on the amount of compression and forward error correction (FEC). The digital modulator converts this baseband signal to a 70MHz RF signal.

Typical digital modulation techniques include QPSK, multiple-level PSK and QAM, which use a combination of phase and amplitude to modulate the 70MHz signal. The modulator's output is upconverted (heterodyned) to the RF microwave frequency, amplified in a linear-type RF amplifier and output to an antenna or diplexer with other microwave signals.

At the receiver, the reverse process takes place. The RF signal is received, downconverted to 70MHz and demultiplexed to produce the compressed datastream. The decoder then decompresses the signal to generate the final video, audio and data. The receiver, digital demodulator and decoder functionalities are generally combined into a single unit called an integrated receiver decoder (IRD). These units typically accept either a 70MHz or L-band RF signal.

The system is easily scaleable to compress and transmit multiple channels on a single carrier. To support multi-channel transmission, only additional encoders and a multiplexer are added. The multiple encoder outputs are combined by a multiplexer that outputs a digital stream at a rate equal to the sum of the input datastreams. Thus, if two encoders output 15Mb/s and 10Mb/s respectively, then the multiplexer output will be 25Mb/s. The multiplexed datastream is fed to the digital modulator. In this manner, multiple channels can be fed on a single carrier, as long as the multiplexed datastream does not exceed the maximum data rate of the system.

NTSC/HDTV dual-channel STL

Figure 1 shows how an NTSC and an HDTV transport stream can be simultaneously transmitted over a single microwave link from the studio to the transmitter. The NTSC composite signal is digitized and compressed to the desired output rate, 17Mb/s in this example. The 17Mb/s compressed NTSC signal is combined with the 19.39Mb/s HDTV transport stream to yield a muxed output rate of 36.39Mb/s. Using a QPSK modulator, the required transmission bandwidth is approximately 22MHz. Using 16-QAM, the bandwidth is further reduced to 11MHz.

At the receiver, the signal is demultiplexed and applied to two decoders. The NTSC decoder decompresses and outputs the composite video and audio signal to be applied to the NTSC transmitter. The other decoder demultiplexes and passes through the HDTV transport stream to the HDTV transmitter. NUCOMM offers a complete turnkey system for this application that is available now.

DIGALOG — digital and analog microwave system

To meet broadcasters immediate need for continued transmission of analog signals, but to also be ready for the transition to digital, NUCOMM has developed the DIGALOG FT6/FR6 radio system for STL applications (and the DIGALOG MMPT6 for ENG applications). The DIGALOG radio is highly configurable and can operate in...
"These broadcasters needed a CG solution. Here's what they found."

Character generator for Win NT 4.0

Inscriber & DigiSuite: Broadcast CG, animation, still store, and live titling solutions on a powerful, flexible platform.

"One of the main things for us was that the CG is PC-based and not proprietary."

We looked carefully at the quality of the output. Inscriber was equivalent to anything out there. I'm happy with it and would buy another one. We are also satisfied with Matrox; they have a strong reputation, offer good web support, and seem to offer the whole package.

"Cost was also a factor in our decision. Inscriber and DigiSuite fill a void in the mid-range, offering good functionality at a reasonable price."

We ran Inscriber through some tests and found it would accomplish the tasks we needed quickly and easily. The fact it was PC-based was also important for integrating files from other workstations in our network.

"Inscriber and DigiSuite met all our needs. The price was in our ballpark, and our editors have been very happy with the program."

Contact Inscriber for a free demo CD-ROM of Inscriber CG-Supreme.

For more information on Inscriber CG-Supreme please call 1.800.363.3400 or +1.519.570.9111, or visit our website at www.inscriber.com Circle (58) on Free Info Card

www.americanradiohistory.com
either analog or digital mode. Depending on the existing system configuration, optional analog and digital modulators can be added to the 2RU unit. If the input is already a 70/140MHz modulated IF signal, the IF signal can be directly upconverted and amplified for transmission. Using a single switch located inside the front panel, the power amplifier can either operate in analog mode for maximum power output or in digital mode for linear power output. The corresponding receiver is the DIGALOG FR6 analog/digital microwave receiver. Two IF bandwidths, 30MHz and 45MHz, are provided in the IF amplifier. The 30MHz bandwidth filter can be used for analog or low data rate digital operation. The 45MHz bandwidth filter is switched in for data rates of 45Mb/s or higher.

**Data rate vs. bandwidth**

The equation defines the bandwidth required to transmit an encoded bitstream at a given data rate. The transmission bandwidth is a function of input data rate (R), modulation coding (M), FEC and spectrum shape factor (a).

\[ \text{Bandwidth (MHz)} = (1 + \alpha) \sum R a \text{Mb/s} \times \text{FEC} \times \text{M} \]

where \( \sum R a \) = sum of data rates from one or multiple encoders (Mb/s) 
FEC = forward error correction = VC * RS; if no FEC is used, then FEC = 1 
VC = Viterbi coding: typical 1/2, 2/3, 5/6, 3/4, 7/8
RS = Reed-Solomon: typical 188/204, 192/208
M = coding level of the modulator
a = spectral shaping factor

Table 1 shows the spectrum efficiency in bits/Hz and carrier-to-noise level (C/N) for various modulation techniques. As M increases, the required transmission bandwidth for a given data rate decreases proportional to bits/Hz (assuming FEC=1) and the required receive C/N level must increase for a given bit error rate (BER). This is the trade-off for better transmission efficiency.

The most robust and common form of digital modulation is QPSK, which has a spectrum efficiency of 1.66 bits per hertz. In cases where more bandwidth reduction may be required, higher-order modulation, such as 16-QAM or 64-QAM, provides a spectrum efficiency of 3.33 bits/Hz or five bits/Hz, respectively. However, as the coding number increases, the modulation is less robust and becomes susceptible to RF interference and multipath effects. Also, system gain decreases substantially because of lower available output power and the requirement for higher receive carrier levels increases for a given bit error rate.

In an STL link where signal levels tend to be high and the transmission link reliable, the higher forms of modulation can usually be justified. However, in ENG links where multipath and weak signals are the norm, a robust modulation such as QPSK is needed. To fit the digital video data rate within the allocated bandwidth, the encoder data rate and FEC need to be adjusted according to the type of modulation technique used. Reducing the data rate with current encoders has little effect on the picture quality. Therefore, it becomes a judgment call on the part of the ENG management to assess the picture quality given bandwidths. There may be no other option if the 2GHz allocated bandwidths are further reduced by the FCC.

**Table 1. Types of modulation.**

<table>
<thead>
<tr>
<th>Type of Modulation</th>
<th>Bits/Hz M/ (1+ a)</th>
<th>C/N (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSK</td>
<td>1.66</td>
<td>10</td>
</tr>
<tr>
<td>QPSK</td>
<td>1.66</td>
<td>10</td>
</tr>
<tr>
<td>8-PSK</td>
<td>2.50</td>
<td>14</td>
</tr>
<tr>
<td>16-QAM</td>
<td>3.33</td>
<td>17</td>
</tr>
<tr>
<td>64-QAM</td>
<td>5.00</td>
<td>23</td>
</tr>
<tr>
<td>256-QAM</td>
<td>6.66</td>
<td>28</td>
</tr>
</tbody>
</table>

Notes: 1-Normalized C/N corresponds to a BER of 1x10^-6. 2-Assumes No FEC and a = 0.20

**Table 1. Types of modulation.**

Whether you're covering a serene lake, a crowded city street, or the hottest news event, the Bogen/Manfrotto 3141 Professional Video Tripod will keep you stabilized. The 3141 Professional Video Tripod features a lightweight, high-precision aluminum alloy construction that ensures smooth, even camera movements. With its 4-stage tripod legs and durable, adjustable clamps, this tripod is designed to handle the rigors of everyday filming, no matter how intense the scene may be.

![Bogen Manfrotto 3141 Professional Video Tripod](image)

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

With an advanced three-step drag system, zero-torque focusing mechanism, and smooth, fluid-like movements, the Bogen/Manfrotto 3141 Professional Video Tripod is the perfect companion for any filmmaker. Whether you're filming a serene lakeside scene or the fast-paced action of a high-speed race, this tripod is designed to handle the rigors of everyday filming, no matter how intense the environment.

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

Whether you're covering a serene lake, a crowded city street, or the hottest news event, the Bogen/Manfrotto 3141 Professional Video Tripod will keep you stabilized. The 3141 Professional Video Tripod features a lightweight, high-precision aluminum alloy construction that ensures smooth, even camera movements. With its 4-stage tripod legs and durable, adjustable clamps, this tripod is designed to handle the rigors of everyday filming, no matter how intense the scene may be.

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

With an advanced three-step drag system, zero-torque focusing mechanism, and smooth, fluid-like movements, the Bogen/Manfrotto 3141 Professional Video Tripod is the perfect companion for any filmmaker. Whether you're filming a serene lakeside scene or the fast-paced action of a high-speed race, this tripod is designed to handle the rigors of everyday filming, no matter how intense the environment.

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

Whether you're covering a serene lake, a crowded city street, or the hottest news event, the Bogen/Manfrotto 3141 Professional Video Tripod will keep you stabilized. The 3141 Professional Video Tripod features a lightweight, high-precision aluminum alloy construction that ensures smooth, even camera movements. With its 4-stage tripod legs and durable, adjustable clamps, this tripod is designed to handle the rigors of everyday filming, no matter how intense the scene may be.

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

With an advanced three-step drag system, zero-torque focusing mechanism, and smooth, fluid-like movements, the Bogen/Manfrotto 3141 Professional Video Tripod is the perfect companion for any filmmaker. Whether you're filming a serene lakeside scene or the fast-paced action of a high-speed race, this tripod is designed to handle the rigors of everyday filming, no matter how intense the environment.

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

Whether you're covering a serene lake, a crowded city street, or the hottest news event, the Bogen/Manfrotto 3141 Professional Video Tripod will keep you stabilized. The 3141 Professional Video Tripod features a lightweight, high-precision aluminum alloy construction that ensures smooth, even camera movements. With its 4-stage tripod legs and durable, adjustable clamps, this tripod is designed to handle the rigors of everyday filming, no matter how intense the scene may be.

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

With an advanced three-step drag system, zero-torque focusing mechanism, and smooth, fluid-like movements, the Bogen/Manfrotto 3141 Professional Video Tripod is the perfect companion for any filmmaker. Whether you're filming a serene lakeside scene or the fast-paced action of a high-speed race, this tripod is designed to handle the rigors of everyday filming, no matter how intense the environment.

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

Whether you're covering a serene lake, a crowded city street, or the hottest news event, the Bogen/Manfrotto 3141 Professional Video Tripod will keep you stabilized. The 3141 Professional Video Tripod features a lightweight, high-precision aluminum alloy construction that ensures smooth, even camera movements. With its 4-stage tripod legs and durable, adjustable clamps, this tripod is designed to handle the rigors of everyday filming, no matter how intense the scene may be.

**Circle (59) on Free Info Card**

**BOGEN MANFROTTO**

**WE CAN TAKE THE HEAT**

3141-510 VIDEO TRIPOD

With an advanced three-step drag system, zero-torque focusing mechanism, and smooth, fluid-like movements, the Bogen/Manfrotto 3141 Professional Video Tripod is the perfect companion for any filmmaker. Whether you're filming a serene lakeside scene or the fast-paced action of a high-speed race, this tripod is designed to handle the rigors of everyday filming, no matter how intense the environment.

**Circle (59) on Free Info Card**
If You Want To Appreciate The Incredible Design and Construction of Sennheiser Lavalier Microphones, You Have To

LOOK CLOSELY

ME104
The world's smallest true-cardioid microphone

You don't actually need to see a Sennheiser lavalier mic to appreciate its benefits. That's the point. Our mics are designed to be visually anonymous, yet they deliver the finest sound you can get from a lavalier.

Our MKE 2 provides outstanding sonic accuracy in an exceptionally tiny package. The ME 102 and 104 capsules are part of a modular family – interchangeable components facilitate their use for virtually any application.

Is it any wonder that EVERY major network chooses Sennheiser for their news teams as well as their entertainers? Or that major broadway shows choose Sennheiser for their productions?

Stop in at your Sennheiser dealer or call us to find out how Sennheiser can help you get the best out of your audio investment.

To Appreciate Our Incredible Fidelity and Performance

JUST LISTEN

THE EVOLUTION OF AUDIO

SENNHEISER

SENNHEISER ELECTRONIC CORPORATION
SENNHEISER CANADA: 221 LABROSSE AVE., PTE-CLAIRE, PQ H9R 1A3 • TEL: 514-426-3013 FAX: 514-426-3953
World Wide Web: http://www.sennheiserusa.com
Manufacturing Plant: Am Labor 1, 30900 Wedemark, Germany

Circle (60) on Free Info Card
www.americanradiohistory.com
signal level drops, the video S/N becomes linearly proportional to the input signal level. When the receiver threshold is reached (typically -85dBm at 7GHz in current video receivers), the video S/N drops much more rapidly than the input signal level. In a typical analog system, threshold is defined when the video S/N reaches 37dB. At a receive level of about -82dBm, the audio channels become noisy and unusable.

The digital link shows a lower S/N than the analog link for strong receive signal levels. This lower S/N is due to the limitations of the digitizer in the encoder. Typically, a 10-bit digitizer gives a S/N of about 60dB. The advantage of the digital system is that even as the input signal level is reduced, the video S/N remains constant at 60dB. This S/N is maintained until the error correction capabilities are exceeded, at which point the transmission fails. This failure point for a QPSK system is generally at or below the analog threshold point and depends primarily on the amount of error correction and the type of modulation used.

A 45Mb/s QPSK digital signal with error correction was passed through the NUCOMM 7GHz FT6/FR6 DIGALOG transmitter and receiver. The digital threshold for QPSK (-89dBm) was 4dB lower than the systems analog threshold (-85dBm). Using 16-QAM, the digital threshold (-82dBm) was higher than the analog threshold by 4dB. This 7dB threshold increase using 16-QAM instead of QPSK essentially enables the transmission of twice the data within the same bandwidth.

Field tests at 2GHz

When the subject of digital video being applied to 2GHz ENG microwave systems is suggested, oftentimes the response is that digital video will never work for ENG. Operators are typically faced with non-engineered paths where shots are made using multiple bounces in high multipath environments. We recently completed field testing of our 2GHz ENG digital video microwave system in New York City. This city was chosen because it represents one of the most severe and challenging environments for ENG operation.

For this test, the analog transmitter was a NURAD 10W model PT1 that was padded down for an output of 3W. The digital transmitter was a NUCOMM DIGALOG FT6. Its power output was 1.5W. The antenna was a NURAD silhouette antenna mounted on a pan and tilt. To ensure stress testing the digital encoder, a difficult 2.5-minute video clip of a pre-recorded hockey game on Betacam SP was used as source material because it included fast camera panning, fast action, high color contrast and saturated colors.

At the Empire State Building, the output from a steerable Super Quad antenna was divided to feed the NURAD analog receiver and the NUCOMM DIGALOG FR6 digital receiver simultaneously. The 70MHz output from the digital receiver was upconverted to L-band for input into the IRD decoder. Each of the composite outputs from the analog and digital receive systems was transmitted back to the studio over an analog fiber link where the outputs were recorded on Betacam SP tape. Both transmitters operated on the same 2GHz channel.

The first three case tests compared the audio and video quality of the 2GHz analog FM signal with the quality of the digital MPEG-2 compressed and QPSK modulated signal under the following three environments:
1. direct line-of-sight transmission;
2. moderate multipath transmission; and
3. extreme multipath transmission.

The ENG truck was located at E. 90th St. and 5th Ave., and the receive site was the Empire State Building. The procedure for setting up each test was to first establish the analog signal geometry and picture quality. The resultant analog video picture was recorded for 2.5 minutes. Then, without moving the antennas, the digital transmitter was connected and the test repeated. Each digital case tested data rates ranging from 9Mb/s to 15Mb/s and two FEC rates of 3/4 and 7/8.

The first test was a line-of-sight shot to make sure that the system was working properly. Analog and digital transmissions produced overall good pictures for each configuration. Although the analog signal was strong, there were still some multipath and ghosting artifacts. The digital picture showed no sign of multipath or ghosting.

The second case, moderate multipath transmission, is representative of typical ENG operating conditions in major urban cities. The ENG truck was in the same location as in the first case, but
Rugged Dependable Quality

Count on Ross for all your terminal gear needs.

The Ross Gear family includes Converters, Audio and Video Distribution Products, Video Keyers, Telecine Switchers, and a Mini Master Control Switcher.

The Ross name, known for quality video production switchers, is rapidly becoming the name in terminal equipment.

Ross has released over 100 terminal gear products in the last three years.

And a Complete Line of Ross Video Production Switchers

Digital Switchers

And a Complete Line of Ross Video Production Switchers

Switchers, Keyers, & Terminal Gear

NAB Booth 9635

Tel: (613)652-4886 Fax: (613)652-4425 Web: www.rossvideo.com eMail: solutions@rossvideo.com

GVG* and Leitch** Compatible Frames

*GVG is a trademark of Tektronix Inc. **Leitch is a trademark of Leitch Technology Corporation

Conversion Gear

A-D Converters
D-A Converters

Distribution Gear

Analogue Video
Analogue Audio
Digital Video

Video Keying Gear

Analogue Keyers
Digital Keyers

Telecine Gear

Telecine Switchers

Master Control Gear

Mini Master Control Switchers

And a Complete Line of Ross Video Production Switchers

Digital Switchers

Synergy 2
2 MLE

Synergy 3
3 MLE

Synergy 4
4 MLE

Analogue Switchers

RVS 210A 1 MLE, 10 Inputs
RVS 216A 1 MLE, 16 Inputs
RVS 316 1 MLE, PGM/PST, 16 Inputs
RVS 416 2 MLE, 16 Inputs
RVS 424 2 MLE, 24 Inputs
RVS 630 2 MLE, PGM/PST 30 Inputs

And a Complete Line of Ross Video Production Switchers

Switchers, Keyers, & Terminal Gear

NAB Booth 9635

Tel: (613)652-4886 Fax: (613)652-4425 Web: www.rossvideo.com eMail: solutions@rossvideo.com
the antenna was moved to 45°off true North so that at least one bounce was introduced in the path. The received signal measure was lower than the first case, but still quite strong. The resulting analog signal showed noticeable ghosting artifacts and color shifting. The quality of this analog signal was considered a borderline usable picture for broadcasting. The digital signal, on the other hand, had no problem locking up and performed perfectly with no ghost or indication of multipath in the picture.

The third case tested extreme multipath interference comprised of multiple reflections and scattering from buildings and possibly even moving vehicles. Here, the ENG truck antenna was aimed toward the west side of Central Park. The resulting transmitted analog signal was severely degraded to the point where it was not usable and was so bad that a frame synchronizer had to be used to receive the picture. The analog video had significant ghosting artifacts and the audio had severe breaking up. The studio reported that the picture quality was too poor to broadcast. When the digital signal used an FEC of 3/4, the IRD decoder had no problem locking on the signal and it produced a perfect picture.

In the presence of extreme multipath, a 7/8 FEC was not enough and the resulting errors can be observed by occasional slow-picture motion, checkerboarding and drop outs. As predicted, an FEC rate of at least 3/4 was required to adequately recover from random errors induced by multipath interference, and in our tests, an FEC rate of 3/4 seemed sufficient to recover from most errors. This test shows the importance of forward error correction.

The results of these tests surprised all concerned and clearly showed that digital ENG video transmitted in the 2GHz band consistently produced a picture equal to and, in most cases, superior to the analog transmission system.

The results of these tests clearly showed that digital ENG video transmitted in the 2GHz band consistently produced a picture equal to and, in most cases, superior to the analog transmission system.

OUR MAST GETS IT UP FAST
TELESCOPIC PNEUMATIC MASTS

HILOMAST

Applications
- Remote ENG
- Communications
- Field Strength Measurements
- Pop-up Jamming
- Remote Surveillance
- Noise Level Measurements
- Temporary Floodlighting
- Environmental Sensors
- Military Communications

COMPETITIVE PRICING

for Further Information Contact Jim Osborne

ALLEN OSBORNE ASSOCIATES, INC.
756 LAKEFIELD RD.
WESTLAKE VILLAGE, CALIFORNIA 91361
Tel: (805) 495-8420 Fax: (805) 377-6067

See us at our website: www.aoa-gps.com
E-mail address is: aoa@aoa-gps.com

Dr. John B. Payne is president of NUCOMM, Inc., Hackettstown, NJ.

Acknowledgment: The author wishes to thank New York City FOX station WNYW-TV and Rich Paleski for providing the ENG truck and its Empire State Building central receive site, as well as studio recording equipment and personnel. I would also like to thank the WEGENER Corporation/COMSAT Labs, which supplied the encoder and IRD equipment.
Tiernan produces the most comprehensive range of MPEG-2 equipment:

- High-performance MPEG-2 Encoders for 4:2:2 and 4:2:0 profiles
- MPEG-2/DVB IRDs for broadcast, professional and industrial applications
- Satellite Modulators for QPSK and 8PSK
- Interface products for satellite and terrestrial networking (including ATM)
- Conditional access for simple and complex networks
- Network management and control systems

Tiernan products are the cutting edge of technology.

Contact us for an MPEG-2 compression solution that can put you on the crest of the digital wave.

GUESS WHO'S LEADING THE DIGITAL WAVE WITH PROVEN 4:2:2 MPEG-2 RIGHT NOW?

Others promised. We delivered the TE6 Encoder and TDR600 IRD.

The first. The best. Only from Tiernan.

See us at NAB '98: Sands Booth 75159 and our LVCC Outdoor Booth.

www.americanradiohistory.com
Adjacent-channel DTV/NTSC transmitters using Diacrodies

BY TIMOTHY P. HULICK, PH.D.

The FCC's new TV broadcast channel allocations have resulted in many TV stations being assigned a DTV channel adjacent to their NTSC allocation. In the case where the DTV channel is adjacent and below the NTSC channel (n-1), little guard band is present to design and build a channel-combining filter system enabling the user to pipe both signals to a common antenna. A second transmitter, a DTV transmitter, is still needed, however. For the n-1 case, the solution isn't simple. There is virtually no guard band between the channels, rendering the filter combiner solution impractical. Even where a filter combiner is to be used, in this case, the visual and DTV signals enter the combining filter, then go through a notch diplexer where they are combined with the aural signal. This means three transmitters are needed: visual, aural and DTV. Aerodyne has developed an alternative approach called adjacent channel technology (ACT).

Common NTSC/DTV amplification

The answer to both situations may lie in using a common high-power amplifier for the NTSC and DTV signals. If this can be successfully accomplished, a combiner will not be needed. However, this approach does require a linear amplifier and one that is capable of sufficient peak envelope power.

Common amplification of the entire NTSC signal became popular in the mid-1980s when UHF tetrodes were developed for higher power and the klystron/IOT devices were introduced. The tetrode and its derivative, the Diacrodie, along with the IOT, are the UHF choices today because all three offer sufficiently linear performance for amplifying the combined visual and aural signals. Properly designed intermodulation and cross-modulation correction circuits are used to prevent any one carrier from contaminating the other.

The specific circuit and technique used is tube-type dependent. If common amplification of the visual and aural signals is possible, what happens when a DTV signal is added to the mix? Surprisingly, it isn't all bad. This technique is only an extension of methods already used.

Only the tetrode and Diacrodie cavities can be tuned wide enough to accommodate side-by-side channels, however. More than 12MHz of flat bandwidth is needed to allow both channels to be included. The TH-680 Diacrodie cavity can be tuned for a 1dB bandwidth of 14.6MHz, putting the tuning bandpass sufficiently far enough away from the channel edges so that group delay is not a problem. Flatness is with in 1dB across both channels. Input return loss is sufficiently low so that the driver sees an adequately matched load.

The amplifying device type must have sufficient bandwidth and be able to provide the desired power. The TH-680 Diacrodie is capable of at least 104kW of unsaturated peak envelope.
While some companies have been talking digital futures, MRC has been:

- integrating the industry's first 2-channel digital STL at the Model HDTV station,
- working with codec and multiplexer manufacturers,
- building alliances with DTV transmitter manufacturers,
- serving on industry committees, and
- developing a full-line of MRC digital microwave solutions.

MRC's digital microwave systems are optimized for DTV transport applications, such as studio-to-transmitter links, satellite backhauls, and intercity relays. And, they're built with all of the ease of installation and high reliability that you expect from Microwave Radio Communications.

Let MRC make your digital microwave the easiest part of your DTV conversion. Call 1-800-490-5700 today.
power, giving it a rating of 60kW peak of sync along with simultaneous provision of 6kW of aural power.

The actual output power levels derived may be doubled, tripled or quadrupled according to need by using two, three or four Diacodes. A single TH-563 tetrode offers half the power with a PEP limitation of 52kW.

Performance considerations

Peak envelope power limits and tuning bandwidth are not the only considerations in selecting a high-power amplifying device or method. Other considerations also include:

- linear distortion;
- non-linear distortion; and
- how to make the driver clean.

Of all the types of distortion in all TV transmitters, regardless of tube type, only relatively simple correction for a Diacode or UHF tetrode is needed to make the combined output signal competitive in the world of performance specifications. In-band intermodulation distortion, probably the most difficult one to achieve, is routinely recorded at -60dB from sync of all picture levels. Uncorrected 1M output from these tubes is about -49dB with a 10% aural signal.

Figure 1 illustrates the block diagram of the approach taken by Acrodyne to provide near perfect drive. The NTSC driver and all of its lower-level stages back to the modulator and video processor are kept separate from the DTV side. Likewise, the DTV side is kept separate from the NTSC signal. They are brought together only at the driver outputs through a 3dB coupler or hybrid combiner. Although half of the drive power is lost to the combiner reject load, this is a small price to pay for the resulting signal integrity. System details, such as input filters, circulators and correction circuits, are not shown for clarity.

Using a TH-680 or TH-563 tetrode in common amplification has the following advantages for the n+1 situation:

- It is not necessary to use a channel combiner, nor is it necessary to have a separate aural transmitter.
- Split drivers allow for generating the cleanest possible drive for the HPA.
- A single transmission line and antenna may be used for both broadcast channels.
- At a future date, the NTSC side may be turned off and its driver used to work with the DTV side to come to full DTV power.

Using a common amplification Diacode or tetrode approach to solve the n+1 problem has these following disadvantages:

- If the HPA fails, the power output of both signals is reduced to the drive level in HPA bypass mode.
- The tube is not perfect and some additional intermodulation distortion products are introduced because of the presence of the added DTV signal. With a clean drive, it all happens in the tube, but these products are quite low in power and easily dealt with.

Test results

The following data represents test results acquired as of Nov. 21, 1997. Although not every idea has been exploited to date, the results indicate that the common amplification approach ACT works well.

The major equipment used for these tests included:

- An Acrodyne Au60D 60kW 10% aural NTSC transmitter on Channel 27 for NTSC and Channel 28 for DTV.
- A Zenith version 28-VSB modulator with FIR filter linear correction and supporting linear correction software. Non-linear correction software is not available as of yet.

![Figure 1. A simplified ACT system block diagram. By keeping the NTSC signal separate from the DTV signal until they are power combined, near-perfect clean drive is obtained.](image-url)

![Figure 2. With the NTSC side off, the DTV results out of the HPA are shown. Eye opening is good with an EVM of 3.03%. SNR is 29.861 dB. Power output is 2.5kW average.](image-url)

![Figure 3. The NTSC side is turned on and brought to 25kW peak of sync with 2.5% aural power. DTV power remains at 2.5kW. Only slight degradation is seen in the EVM and SNR. The eyes are still widely open.](image-url)
It Takes the Whole Team...

And score big in the digital age.

To win at the digital game, you've got to assemble your whole team—everyone from managers to engineers—and go to NAB98. With so much to see, do, hear and learn, every player counts as you map out your game plan at the most comprehensive broadcasting and e-media convention in the world! Start assigning your key players to test drive and learn about the latest technologies. Register now and enter the digital age like a Hall of Famer!

Spotlighting DTV—in the sessions, on the exhibit floor and at special events!

- Explore more than 1,300 exhibits and uncover hundreds of new products that will change the rules of the game
- Examine critical issues that will lead your station to victory in more than 150 sessions and workshops
- Take a look at the play books of the convergence markets to see how they impact your business

Don't turn this page until you've contacted us for more information!

- Visit www.nab.org/conventions/
- Call Fax-on-Demand at 732.544.2888
- Call 800.342.2460 or 202.775.4970

NAB98 the CONVERGENCE MARKETPLACE

EXHIBITS: CONFERENCES:
April 6–9, 1998       April 4–9, 1998

Las Vegas, Nevada USA
The LX-"5100" Series can read Time Code (ESE, SMPTE/EBU & ASCII), as well as operate as Stand-Alone or Impulse Clocks. These clocks are loaded with many features, here’s just a few...

FEATURES:
- Self-setting time code readers
- 5", 12" & 16" models
- Sweep & Step second hand modes
- Lighted Dial and Rack Mount options
- Time Zone Offset
- 3 Year Warranty

www.ese-web.com
310-322-2136 • FAX 310-322-8127
142 SIERRA ST., EL SEGUNDO, CA 90245 USA

Figure 4. A spectral plot of the DTV signal with full NTSC (25kW) and 2.5% aural power is presented. Linear correction at the DTV modulator is on. The NTSC aural carrier is seen to the left of the DTV pilot with the color subcarrier at the extreme left.

- An HP-89441A vector modulation analyzer with adaptive equalizer.

Figure 2 represents the data as displayed on an HP-89441A for the driver output with the NTSC driver off. The important measurements to watch throughout this discussion are the error vector magnitude (EVM) and the signal-to-noise ratio (SNR), shown in the box at the lower right part of the display.

The EVM is a measure of all that is wrong with the transmitter because it indicates the relative magnitude of the vector at the tip of the desired one pushing it away from its intended position. The smaller this measurement, the less distortion of the DTV signal. Although SNR will be obvious to the reader, it’s important because tests have shown that this number must be greater than 15dB at the receiving point for the signal to be decoded.

The eye opening is a qualitative measurement and it is shown that the eyes are widely open. The plot at the upper left shows the symbols lying generally on the eight I or in-phase levels. Departure from these levels is due to the error vector. Closing of the eyes is also a function of the EVM. It must be mentioned that the measured EVM and SNR for the modulator alone with the FIR correction off is 2.01% and 33.1dB, respectively.

Figure 3 shows the same results when the NTSC signal is on at 2.5kW peak of sync power with 2.5% aural power. DTV power remains at 2.5kW average. The EVM has increased slightly to 4.55%, while the SNR has decreased to 26.408dB. Eyes are still widely open.

The presence of the NTSC signal, even though the aural power is low, has only minimally affected the DTV signal. It must be remembered that for all of these tests, the FIR filter linear correction coefficients are determined by the HP-89441A and fed to the DTV modulator. Linear correction is on.

A spectral plot of the setup condition for Figure 3 is shown in Figure 4. The DTV pilot carrier is shown at the left edge of the upper channel, while the aural carrier is seen just below the pilot. At the extreme left is the NTSC color subcarrier. Closest to the DTV signal is the aural carrier. The high side band edge is awaiting a band edge filter from the vendor.

These results show the out-of-band performance of the Diacode, without help. The flatness of the DTV spectrum shows the linear correction circuits of the DTV modulator at work. The cavity bandpass response has an upward tilt of 1dB toward the right side of the DTV channel. This is corrected by the linear correction of the FIR filter in the DTV modulator. The result is the flat DTV spectrum displayed.

A full two-channel spectral display is...
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.
At add-on color correctors stations purchasing $70,000 NTSC channel
will filter, and -3.58 IMD components may be decreased EVM with increased aural power. The peaks of the +9MHz component is only 31dB below the average power of the DTV signal. These out-of-band components are easily taken care of with an anti-intermodulation component adjusted for best cancellation. The cancellation circuit under development is a modification of the +/-920kHz cancellation circuit in extensive field application. It will allow the EVM and SNR values to return to 3 +% and 29+dB, respectively.

Conclusions and further work
This work shows common amplification of an NTSC and DTV signal at meaningful broadcast power levels may be accomplished using a TH-680 Diacrode for adjacent n+1 or n-1 situations. The secret is in knowing the PEP limits of the tube and the ability to tune a Diacrode (or tetrode) cavity wide enough to accommodate both signals. This means that when station engineers are searching for RF solutions to an n+1 or n-1 configuration, the common amplification method presented should be considered. It is the only viable solution unless you have unlimited tower space and site resources. If common amplification works for combining aural and visual, why shouldn't it work for combining NTSC with DTV? The answer is that it does.

Dr. Timothy P. Hulick, Ph.D., is vice president of engineering, Acrodyne Industries, Blue Bell, PA. For more information on ACT, contact the company's website at www.acrodyne.com or circle reader service number 180.

Field Report
Color my world
BY GARY FREEDLINE

Until recently, only extremely expensive ($4,000 and up) component color correctors existed. For broadcast stations purchasing $70,000 BVW Betacam SP machines, these expensive add-on color correctors were already part of the budget. The introduction of devices record and playback in a three-wire configuration. The Y (luminance), R-Y (red minus luminance) and the B-Y (blue minus luminance) are all recorded independently. There is no easy, one-knob control to adjust the hue or subcarrier phasing. A device that controls the Y, R-Y and B-Y levels independently is called a component color corrector.

Color correctors can cost approximately half as much as a UVW 1600 machine. However, we could not justify spending thousands of dollars just to correct colors. At NAB '97, we discovered that Kramer Electronics was shipping a low-cost component color corrector, the 3001 component video processor. It has a Y input, R-Y input and B-Y input, with individual unprocessed looping for each.

The outputs are well-designed and incorporate a distribution center accommodating three independent outputs per color channel. In addition, the front
Pinnacle Systems Introduces

Lightning™

Image Storage for News and Sports

Lightning Fast
The Lightning Video Image Storage System recalls and plays images in less than 1/2 second. And you can add our ShotBox for your most demanding on-air applications.

Built-in 3D DVE
Our unique built-in DVE lets you instantly size and rotate an image, add borders, a drop shadow, and 3D perspective.

Open Networking
Lightning lets you browse and move images on all your network drives. You can even convert images to and from TGA, TIFF, BMP and JPEG formats in order to import and export images to and from graphic design and paint programs.

Incredibly Easy Image Management
Use our picture-based database to view over 100 thumbnail images at a time, or search by number, date, title, user, subject, and other fields. And you can drag-and-drop any image directly from the picture database into preview or on air.

See for Yourself
Call Pinnacle Systems today for a Lightning brochure. Better yet, if you have a PC with Windows® 95 or a Power Macintosh®, with a CD drive, ask for the Lightning CD-ROM. It will show you everything that's in the brochure, and more.

Call 1-800-4PINNACLE ext. 91 for a Brochure or CD-ROM.
Technology In Transition

Wireless microphones

There’s no doubt about it, audio equipment used for studio and field production is getting lighter and more compact. This advancement in equipment portability without sacrificing audio quality has created a steady acceptance of wireless microphones.

Wireless systems were fraught with complexity, dropouts and noise. For years, the complaint about wireless mic systems was interference, or unwanted signal reception caused by poor receiver selectivity or intermodulation distortion.

Manufacturer’s have, for the most part, solved these problems. The solution was to move up in frequency. Higher radio frequencies mean shorter wavelengths, which mean smaller components and better filtering. Another solution was the development of diversity receiving circuits to address signal dropout.

Replacing an old system or adding a system where one didn’t exist should be approached carefully. If you are adding a system in an area already congested with RF signals, check with the local frequency coordinator to determine which frequencies are available. When buying a system determine whether you need a hidden system or want to plug in a transmitter to a microphone. A hidden system usually relies on a lavalier, in-the-ear or headset microphone and a bodypack transmitter. Receivers can be mounted in racks, on cameras or set on desks, depending on the length of use.

Diversity reception is one area that needs a lot of consideration. There isn’t enough space to cover this area, however, refer to the following back issues for a discussion of diversity and wireless microphones:


See summarized details of microphone features in Table 1 on page 138.

Special features

Audio:
Audio distortion of less than 0.1%@150 kHz deviation; dynamic range of better than 100dB; an operating range of 100m under ideal conditions.

Sennheiser:
Frequency range of 450-960 MHz; switching bandwidth of 24 MHz; Hidyn Plus noise reduction system.

Shure:
797 fully selectable, user-programmable frequencies: up to 20 systems can be used simultaneously; all Shure UHF components are interchangeable.

Vega:
Microprocessor-controlled; 100 channel synthesis; controlled by embedded microprocessor.

Telco:
Tone squelch.

Systems Wireless:
UDR200B features PC control for selecting frequencies, monitoring system operation and performing spectrum analysis; can operate anyone of 256 available frequencies; systems operate in UHF band 470-608 and 614-806.

AKG Acoustics:
Multiple frequency bands available; simultaneous operation of up to 11 frequencies in Widtho; 16 in Widtho, and 40 in Widtho; in Widtho/900; in Widtho/900,000 two receiver sections provide true receiver diversity.

Lectrosonics:
User-adjustable low-frequency roll-off, dual-band comparator, fit microphones with XLR jacks.

Camtek:
Switchable RF circuit; dual-tracking passband; front-end; helical resonator for front-end RF selectivity.
Extron introduces the new MAV 1616 series matrix switchers. There are three switchers in this series: the MAV 1616 (matrix for audio and video); the MCV 1616 (matrix for composite video only); and the MSA 1616 (matrix for stereo audio only). Each of these models is capable of switching up to sixteen independent video and/or stereo audio sources to sixteen independent outputs.

All of the high performance features come standard. The MAV 1616s not only fit your large-scale matrix switching needs, they fit your budget: MAV 1616 $5,850; MSA 1616 $3,250; MCV 1616 $2,750.

The MAV 1616 series switchers provide:
- 16 x 16 configurations
- 80 MHz (-3 dB) video bandwidth, fully loaded
- Audio gain/attenuation settings for each input from the front panel (MSA 1616, MAV 1616)
- Stereo audio is standard and included in one 2U high enclosure (MSA 1616, MAV 1616)
- 16 memory presets
- Simple Instruction Set™ with basic ASCII commands for RS-232/422 controls
- Vertical interval switching
- QuickSwitch Front Panel Control™
- Internal 100-240 volt, 50/60 Hz power supply
- Windows® based control program software
<table>
<thead>
<tr>
<th>COMPANY</th>
<th>OPERATING BAND</th>
<th>CASE TYPE</th>
<th>TYPE OF DIVERSITY</th>
<th>TRANSMITTER</th>
<th>FREQUENCY POWER CONTROL</th>
<th>RS #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azden (516-328-7500)</td>
<td>UHF</td>
<td>-</td>
<td>true diversity</td>
<td>10-15mW</td>
<td>PLL controlled</td>
<td>290</td>
</tr>
<tr>
<td>Sonheiser (660-434-9190)</td>
<td>UHF</td>
<td>multichannel receiver</td>
<td>true diversity</td>
<td>-</td>
<td>PLL controlled</td>
<td>291</td>
</tr>
<tr>
<td>EM1046</td>
<td>UHF</td>
<td>2-channel receiver</td>
<td>true diversity</td>
<td>-</td>
<td>PLL controlled</td>
<td>292</td>
</tr>
<tr>
<td>EM3032</td>
<td>UHF</td>
<td>miniaturer</td>
<td>true diversity</td>
<td>-</td>
<td>PLL controlled</td>
<td>293</td>
</tr>
<tr>
<td>SKM 3072-u</td>
<td>UHF</td>
<td>hand-held</td>
<td>-</td>
<td>50mW</td>
<td>PLL controlled</td>
<td>294</td>
</tr>
<tr>
<td>SKM 5000</td>
<td>UHF</td>
<td>bodypack,</td>
<td>true diversity</td>
<td>50mW</td>
<td>PLL controlled</td>
<td>295</td>
</tr>
<tr>
<td>SK500</td>
<td>UHF</td>
<td>bodypack,</td>
<td>true diversity</td>
<td>50mW</td>
<td>PLL controlled</td>
<td>296</td>
</tr>
<tr>
<td>SK250</td>
<td>UHF</td>
<td>bodypack, hand-held</td>
<td>true diversity</td>
<td>250mW</td>
<td>PLL controlled/16 channels</td>
<td>297</td>
</tr>
<tr>
<td>SHURE (708-866-2200)</td>
<td>UHF</td>
<td>true diversity</td>
<td>PLL controlled</td>
<td>298</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EM1046</td>
<td>UHF</td>
<td>miniaturer</td>
<td>true diversity</td>
<td>-</td>
<td>PLL controlled</td>
<td>299</td>
</tr>
<tr>
<td>EM3032</td>
<td>UHF</td>
<td>miniaturer</td>
<td>true diversity</td>
<td>-</td>
<td>PLL controlled</td>
<td>300</td>
</tr>
<tr>
<td>EM1046</td>
<td>UHF</td>
<td>bodypack, hand-held</td>
<td>true diversity</td>
<td>-</td>
<td>PLL controlled</td>
<td>301</td>
</tr>
<tr>
<td>Vega (600-877-1771)</td>
<td>UHF</td>
<td>studio receiver</td>
<td>true diversity</td>
<td>-</td>
<td>synthesized</td>
<td>302</td>
</tr>
<tr>
<td>T-772</td>
<td>UHF</td>
<td>bodypack</td>
<td>-</td>
<td>50mW</td>
<td>synthesized</td>
<td>303</td>
</tr>
<tr>
<td>T-690 family</td>
<td>UHF</td>
<td>hand-held</td>
<td>-</td>
<td>50mW</td>
<td>synthesized</td>
<td>304</td>
</tr>
<tr>
<td>U2020 family</td>
<td>UHF</td>
<td>bodypack, hand-held</td>
<td>true diversity</td>
<td>40-50mW</td>
<td>synthesized</td>
<td>305</td>
</tr>
<tr>
<td>Telex (512-884-4051)</td>
<td>UHF</td>
<td>portable</td>
<td>posι-phase</td>
<td>50mW</td>
<td>2 channel crystal</td>
<td>306</td>
</tr>
<tr>
<td>ENG-500/ut-500</td>
<td>UHF</td>
<td>receiver &amp; plug-in transmitter</td>
<td>posi-phase</td>
<td>10/1 select.</td>
<td>100 channels</td>
<td>307</td>
</tr>
<tr>
<td>systems Wireless (703-471-7887)</td>
<td>UHF</td>
<td>hand-held system</td>
<td>posi-phase</td>
<td>10/1 select.</td>
<td>100 channels</td>
<td>308</td>
</tr>
<tr>
<td>Systems Wireless (703-471-7887)</td>
<td>UHF</td>
<td>hand-held system</td>
<td>posi-phase</td>
<td>-</td>
<td>100 channels</td>
<td>309</td>
</tr>
<tr>
<td>AKG Acoustics (615-360-0499)</td>
<td>UHF</td>
<td>bodypack, hand-pack</td>
<td>true diversity</td>
<td>10mW</td>
<td>freq. agile</td>
<td>310</td>
</tr>
<tr>
<td>Systems Wireless (703-471-7887)</td>
<td>UHF</td>
<td>metal construction, true diversity</td>
<td>10mW</td>
<td>freq. agile</td>
<td></td>
<td>311</td>
</tr>
<tr>
<td>Lectrosonics, Inc. (800-821-1121)</td>
<td>VHF</td>
<td>bodypack</td>
<td>true diversity</td>
<td>10mW</td>
<td>freq. agile</td>
<td>312</td>
</tr>
<tr>
<td>WMS800/900</td>
<td>UHF</td>
<td>bodypack</td>
<td>true diversity</td>
<td>10mW</td>
<td>freq. agile</td>
<td>313</td>
</tr>
<tr>
<td>UH190</td>
<td>UHF</td>
<td>bodypack</td>
<td>-</td>
<td>100mW</td>
<td>synthesized</td>
<td>314</td>
</tr>
<tr>
<td>UHL200</td>
<td>UHF</td>
<td>bodypack</td>
<td>-</td>
<td>100mW</td>
<td>synthesized</td>
<td>315</td>
</tr>
<tr>
<td>UH200</td>
<td>UHF</td>
<td>bodypack</td>
<td>-</td>
<td>100mW</td>
<td>synthesized</td>
<td>316</td>
</tr>
<tr>
<td>UH200</td>
<td>UHF</td>
<td>plug-in</td>
<td>-</td>
<td>100mW</td>
<td>synthesized</td>
<td>317</td>
</tr>
<tr>
<td>UH190</td>
<td>UHF</td>
<td>plug-in</td>
<td>-</td>
<td>100mW</td>
<td>synthesized</td>
<td>318</td>
</tr>
<tr>
<td>UCR195D/195</td>
<td>UHF</td>
<td>machined</td>
<td>antenna phase/switching</td>
<td>-</td>
<td>-</td>
<td>319</td>
</tr>
<tr>
<td>UCR195D/195</td>
<td>UHF</td>
<td>machined</td>
<td>antenna phase/ single antenna design</td>
<td>-</td>
<td>-</td>
<td>320</td>
</tr>
<tr>
<td>UCR195D/195</td>
<td>UHF</td>
<td>machined</td>
<td>antenna phase/single antenna design</td>
<td>-</td>
<td>-</td>
<td>321</td>
</tr>
<tr>
<td>UCR195D/195</td>
<td>UHF</td>
<td>machined</td>
<td>single antenna design</td>
<td>-</td>
<td>-</td>
<td>322</td>
</tr>
<tr>
<td>UCR195D/195</td>
<td>UHF</td>
<td>machined</td>
<td>single antenna design</td>
<td>-</td>
<td>-</td>
<td>323</td>
</tr>
<tr>
<td>UCR195D/195</td>
<td>UHF</td>
<td>machined</td>
<td>single antenna design</td>
<td>-</td>
<td>-</td>
<td>324</td>
</tr>
<tr>
<td>UCR195D/195</td>
<td>UHF</td>
<td>machined</td>
<td>single antenna design</td>
<td>-</td>
<td>-</td>
<td>325</td>
</tr>
<tr>
<td>UCR195D/195</td>
<td>UHF</td>
<td>machined</td>
<td>single antenna design</td>
<td>-</td>
<td>-</td>
<td>326</td>
</tr>
<tr>
<td>COMTEK (800-496-3463)</td>
<td>UHF</td>
<td>metal</td>
<td>-</td>
<td>50mW</td>
<td>crystal</td>
<td>327</td>
</tr>
<tr>
<td>BST-25</td>
<td>VHF</td>
<td>bodypack</td>
<td>-</td>
<td>50mW</td>
<td>crystal</td>
<td>328</td>
</tr>
<tr>
<td>PR-25</td>
<td>VHF</td>
<td>bodypack</td>
<td>-</td>
<td>50mW</td>
<td>crystal</td>
<td>329</td>
</tr>
<tr>
<td>MRC-82C</td>
<td>VHF</td>
<td>camera-mount</td>
<td>-</td>
<td>-</td>
<td>crystal</td>
<td>330</td>
</tr>
<tr>
<td>Beyerdynamic (516-293-3200)</td>
<td>VHF</td>
<td>bodypack, hand-held</td>
<td>true diversity</td>
<td>50mW</td>
<td>freq. agile</td>
<td>331</td>
</tr>
<tr>
<td>V200/300</td>
<td>UHF</td>
<td>bodypack, hand-held</td>
<td>true diversity</td>
<td>50mW</td>
<td>freq. agile</td>
<td>332</td>
</tr>
</tbody>
</table>

Table 1. Summarized details of microphone features — (-) indicates missing information or that the category is not applicable. To receive more information, use the Reader Service Numbers shown in column 7.
Every step in video production affects the next.

Your first is the most critical – start with 4:2:2!

BR-D40
Dockable Recorder &
KY-D29 DSP Camera –
package under $18,000
(with viewfinder, less lens)

DY-700 Camcorder
under $12,090
(with viewfinder and 13:1 lens)

DIGITAL-S
Acquisition

To get the most out of today's digital editing systems, you need to begin with the best raw footage possible. And that means shooting in 4:2:2. With DIGITAL-S, you get 4:2:2 color sampling with perceptually lossless compression. This produces an image that remains free of annoying artifacts that could build up through various steps in post production and digital distribution.

DIGITAL-S also offers superior chroma resolution, producing more well-defined colors, chroma keys and effects. In fact, all high-end systems, including the best non-linear editors, require 4:2:2 to achieve these benefits. The result is performance and quality that can stand up through each phase of digital video production. Shooting in a 4:1:1 DV format compromises your image, and you can't bring back the quality once it's lost.

Take your first step into high performance. Make it DIGITAL-S. For more information call:

1-800-JVC-5825
www.jvcreo.com

Circle (65) on Free Info Card
New Products

SERIAL DIGITAL INTERFACE OPTION FOR VIDEO MEASUREMENT SET
Tektronix VM700T video measurement set with serial digital interface (SDI) option: the VM700T video measurement set is a highly accurate, multiformat serial digital video analyzer; the SDI option is a comprehensive and affordable upgrade for professional video manufacturers and terrestrial broadcast engineers that are beginning the transition to full-bandwidth digital applications while still requiring precise analog testing; 503-627-7111; fax 413-448-8033. www.tek.com

Circle (273) on Free Info Card

DVCPRO RACK-SLIDE KIT
Winsted rack slide kit model F8203: this kit is the latest addition to Winsted’s line of rack slide kits designed specifically for Panasonic, JVC and Sony VTRs (the line also includes models for Vicon and Barco monitors); model F8203 features heavy-duty chassis support brackets, Accuride ball-bearing slides for smooth pulling action, and pivoting rear finger brackets to allow mounting in sloping, vertical racks; 612-944-9090; racks@winsted.com

Circle (274) on Free Info Card

DIGITAL CAMERA SYSTEM
Thomson Broadcast’s 1657D camera system: based on the portable 1657D, the Thomson Broadcast camera system provides many different configurations, such as Microcam and Sportcam; the 1657D is a digital camera with 12-bit quantization combined with intermediate processing stages of up to 20 bits providing the type of contrast ratio only previously available in film; it accepts a full range of accessories, including triax and multicore adapters, Betacam SP and Betacam SX recorders; other standard features include the switchable 16:9-4:3, dynamic pixel correction, video noise slicer, sensors, and shutter and clear scan; 201-569-1650; fax 201-569-1511

Circle (272) on Free Info Card

ONE- AND TWO-LINE VIDEO DISPLAY
Matthey Electronics 2550 broadcast-quality delay: the 2550 broadcast-quality video delay was designed for applications where one line or more of analog video delay is required; the 2550A delays the video signal and compensates for errors, such as large timing errors that can occur when new production equipment is installed; the Matthey 2550 has a fully variable range of two microseconds up to one or two lines, with two 75V outputs — NTSC or PAL; the 2550A also provides front-panel toggle switching of the delay range in 1ns steps; internal processing and Matthey filtering expertise to full CCIR-601 recommendation optimize all standard video measurements; 914-763-8893; fax 914-763-9158

Circle (275) on Free Info Card
No matter how extreme the conditions, BASF professional video tapes are designed to deliver first-rate video and audio playback every time. With over sixty years experience as innovators in the formulation and manufacturing of magnetic media, BASF sets the world standard for video performance and reliability. That's why BASF media is in use throughout the world today at hundreds of leading broadcast and post production facilities.

Now, for a limited time, your local authorized BASF dealer is offering a special 10% discount on all BASF professional video tapes purchased before March 31st, 1998. This includes BASF Betacam SP Mega, Digital Betacam, the entire range of S-VHS and VHS products and 1” C-format tape. Act now to take advantage of this special offer and experience BASF’s legendary quality.
HIGH-SPEED DATA TRANSMISSION OVER RING NETWORKS

ADC Telecommunications Fast EtherRing switch: ADC’s first product based on its new EtherRing technology that enables data to be transmitted over fiber rings for the first time in native Ethernet format; the Fast EtherRing switch allows high-speed, high-capacity transport of data, Internet Protocol (IP) video and IP voice over telephony and MPEG digital video over fiber-optic rings of virtually unlimited distances; it initially uses a dedicated fiber or works in conjunction with ADC’s DV6000 high-speed digital transport system; 800-366-3891 (ext. 3475); www.adc.com

Circle (276) on Free Info Card

INTERFACE FOR BROADCAST MEDIACLUSTER AND OMNIBUS SYSTEMS

SeaChange International and OmniBus Systems broadcast development effort: SeaChange is developing an interface between its Broadcast MediaCluster video server and OmniBus Systems’ broadcast network operation system; the interface will allow the Broadcast MediaCluster to be efficiently used in TV transmission systems that have selected OmniBus Systems as their broadcast vendor; OmniBus is a real-time network operating system that enables distributed control of a wide range of broadcast TV equipment from simple intuitive user interfaces; 508-897-0100; fax 508-897-0132

Circle (250) on Free Info Card

Back in the days when the .(dot) was known as a period, you had to actually visit the NAB convention in Las Vegas to get the latest news.

Broadcast Engineering is going beyond the printed page to bring you direct coverage from the NAB show floor.

Visit our homepage at www.broadcastengineering.com for your link to the 1998 NAB Internet Show Daily. Broadcast Engineering’s editorial staff is doing the leg work to bring you up-to-the-minute updates from NAB...all on-line. With a click of your mouse you can stroll through the convention centers at your own pace. Check out the new product releases. Sit in on a press conference or two. Catch up on the latest industry news.

Just because you’re not going to the show, doesn’t mean you have to miss the show. Log on to www.broadcastengineering.com for complete coverage from the NAB show floor.

Contact your marketing manager for advertising opportunities on the Internet Show Daily. See page 161 for the marketing manager nearest you.

www.broadcastengineering.com

Now you can get there with the click of a mouse.

Broadcast ENGINEERING
THE JOURNAL OF DIGITAL TELEVISION™
PRODUCTS NOW SHIPPING

SADIE OWNERS CAN ADD PORTIA RANDOM ACCESS VIDEO

SADIE Portia NTSC: Portia, a random access video system, eliminates the need for a VTR during sound-for-picture processes by providing instant access to the visual elements; with the release of V3.03 software, all Portia functionality is now available in NTSC video format; when Portia is installed into a SADiE or Octavia DAW, video can be recorded into the EDL along with the audio; the video appears as a dedicated stream in the playlist, and audio and video can be scrubbed simultaneously; editing functions such as cut, copy and paste, can be performed on the video clips, as well as placement of the original recorded time code; 615-327-1140; fax 615-327-1699

Circle (287) on Free Info Card

ADVANCED VERSION OF EMULATOR OPERATING SYSTEM

E-mu Systems EOS 3.0: the latest version of E-mu software developed specifically for the Emulator 4 line of products is now available; EOS 3.0 has several new features, including 48-track sequencer with loop record and performance control features such as arpeggiator, split mode and layer mode; the advanced version also offers new modulation sources and destinations; EOS 3.0 ships with Emagic's EOS SoundDiver, a preset editor that is designed for EOS products; 408-438-1921; fax 408-438-8612; www.emu.com

Circle (288) on Free Info Card

INTEGRATION OF SEAGATE'S STORAGE TECHNOLOGY WITH ANDATACO'S APPLICATION-SPECIFIC ARCHITECTURE

Andataco GigaRAID Application-Specific Architecture (ASA) product line shipping with Seagate Technology's 10,000 RPM 9GB Cheetah disk drives: combining Seagate's advanced storage technology with Andataco's application-specific architecture (ASA) allows you to match the attributes of specific data structures to receive maximum levels of performance, availability and scalability in heterogeneous UNIX and NT computer environments; Andataco's GigaRAID high availability series offers extensive RAID and RAID-ready storage for ASA-targeted applications; new products in the series include Ultra SCSI and Fibre Channel solutions, as well as advanced new data sharing, remote mirroring and disaster recovery software that will soon be released; 800-335-9191; fax 619-453-9294; www.andataco.com; inquire@andataco.com

Circle (289) on Free Info Card

www.americanradiohistory.com
**WIDE-POWER LENS**

Fujinon A10X4.8B-10: this wide cine-style lens features a 90° horizontal field of view in the 16:9 format and over 85° in the 4:3 format with less than 1% distortion at a wide angle; it has a two-foot MOD that is measured from the object plane, unlike other TV production lenses that traditionally have measured MOD from the lens front; other benefits include a newly designed inner focusing system that reduces image size change to a minimum when focusing, zoom and focus gearing that accommodates most cine-style controls, and large orange numerals for focal length and "T" stop that are visible from both sides of the lens; 800-553-6611; fax 201-533-5216

Circle (259) on Free Info Card

---

**MINI-M SAT PHONES FOR VEHICLES**

LandSea Systems Mini-Ms: LandSea Systems is offering the latest of Thrane & Thrane’s satellite communications products, the TT-3062A and TT-3062B INMARSAT phones for vehicles; both phones use spot beam technology allowing them to be more compact and use less power than their predecessors; the TT-3062A vehicular Mini-M Satphone uses a rod antenna and is fully omnidirectional; the TT-3062B model uses a stabilized disc antenna that uses steered beam technology and its internal components constantly move to locate the satellite as the vehicle moves; both antennas can be mounted to vehicles magnetically; 757-468-0448; fax 757-468-0625; www.LandSeaSystems.com

Circle (253) on Free Info Card

---

**QUIET SWITCH AES ROUTER**

Leitch ASR-16x16: this router includes the new synchronous quiet switch (SQS) process that guarantees quiet switching of AES digital audio; the SQS provides two processing steps — synchronous switching and user-selectable crossfade; the synchronous switching maintains AES framing during and after crosspoint switches, so that the downstream equipment does not lose lock during a switch; the crossfade guarantees a quiet switch between any two sources by fading the two signals near the switch point; the fade duration is user adjustable and the fade can be enabled or disabled; 800-231-9673; fax 757-548-4088

Circle (255) on Free Info Card

---

**HDTV DIGITAL WAVEFORM MONITOR**

Leader LV 5150D: a monitoring unit that handles serial digital and analog components for HDTV signals in the 1125/60 (59.94) format; it provides full waveform monitoring functions including line select, cursors and memory presets of test setups; picture display of the Y or G component, with a line select strobe provided; the unit offers a vector display of chroma component, as well as a Lissajous display for stereo audio; 800-645-5104 or 516-231-6900

Circle (254) on Free Info Card

---

**TLM103**

Large diaphragm capsule derived from the famous U87 transformerless circuit, 7dBA self noise figure. LIST $999.00

PROFESSIONAL AUDIO SUPPLY

5700 E. Loop 820 S. - Ft. Worth, TX 75460
Phone: 817-483-7474 - Fax: 817-483-9952
E-mail: pas@lights-audio.com
www.lights-audio.com

CALL TODAY 1-800-433-7668

Circle (56) on Free Info Card
EDIT MPEG-2 FILES DIRECTLY
Applied Digital Technology ADnet MPEG editing station: Greenway Ltd. announced the release of the ADnet MPEG editing station from Applied Digital Technology that allows you to edit MPEG-2 files directly; it provides frame-accurate editing of first-generation MPEG-2 files, and in the edit mode, beginning and end points can be marked to create an EDL in the same manner that videotape is edited; edits can be previewed and modified and the final EDL, in industry-standard format, can be exported for further editing; this release allows simple cuts and dissolves, with additional functions scheduled for implementation later this year; +44 1635 528700; rcrosoer@greenway.co.uk

NEW VERSION OF ARGUS MPEG-2 ENCODING SYSTEM
Vela Research's Argus 3.0: now shipping, this Windows NT-based MPEG-2 encoder system is designed for a broad range of applications that need broadcast-quality digital video; the Argus 3.0 is a full-featured MPEG encoder on the Windows NT platform; new features include variable bit-rate encoding, caching FTP, improved API and inverse telecine; available as a rack-mount or desktop configuration, it creates streams at MPEG-1, SIF, MPEG-2 Half D-1, MPEG-2 D-1 (DOE) and MPEG-2 D-1 (AFF) resolutions; 813-572-1230; fax 813-573-2508; www.vela.com

WIDESCREEN CAMCORDER
Sony DNW-9WS: this widescreen digital Betacam SX camcorder is shipping to news operations migrating to widescreen digital TV production; it uses a new, high-performance widescreen Power HAD IT CCD designed specifically for ENG environments; the DNW-9WS offers superb video and audio acquisition, direct digital recording according to MPEG 4:2:2 P@ML, high-speed field-to-station transmission, networking within a nonlinear disk-based system; with the ability to switch between 16:9 and 4:3, the 13-pound camcorder features an extraordinary sensitivity capable of making full level in-scene illumination of only 0.7 lux (new Turbo Gain function); 800-686-SONY; www.sony.com/professional
**DIGITAL CONSOLE**

**Studer D950 digital mixing system:** featuring a fully scalable and configurable central DSP core, the D950 allows you to configure exactly the right console design for a given application; up to four control surfaces can share a single DSP core for maximum flexibility in multroom installations; the maximum DSP configuration (20 hot-swappable DSP cards) allows for as many as 256 fully-featured channels, while a 40-channel console can be provided with as few as three or four cards; the console is controlled from a central PC-compatible system running on Microsoft Windows NT; 615-399-2199; fax 615-367-9046

Circle (265) on Free Info Card

---

**TEST SOLUTION FOR DIGITAL TV TRANSMISSION STANDARD**

**Hewlett-Packard HP 89441V VSB/QAM signal analyzer:** this analyzer tests VSB TV signals providing comprehensive radio frequency (RF) and modulation test capabilities in addition to powerful troubleshooting features; it provides a visual display of VSB constellation and eye diagrams, allowing TV system designers to identify design errors quickly; TV broadcasters can conduct reliable transmission power-level measurements and generate accurate statistical measurements for peak-to-average power; this instrument also provides a statistical percentage of the time transmission power that exceeds a user-specified level; 800-452-4844 (ext. 5522); www.hp.com/go/tmdir

Circle (260) on Free Info Card

---

**12 PRECISION VIDEO TEST SIGNALS, AUDIO TONE $469**

- TSG-50 generates 12 composite video test signals plus 1KHz or 400Hz audio tone, and composite sync.
- All test signals computer calculated and digitally synthesized for perfect RS 170A accuracy with no drift or SCH adjustments required.
- Convenient 12 position rotary switch for quick, easy pattern selection. 13th signal of 100% white field can be substituted for full field color bars.
- 30/60 second timer switches from pattern to black after timeout.  Ref Frame Pulse/59.97 Hz output.
- TSG-50B model adds 5 black outputs or 4 black plus subcarrier - $628.
- Available in rackmount version.

**Horita**

P.O. Box 3993, Mission Viejo, CA 92690  (714) 489-0240

Unconditional Guarantee.

Circle (67) on Free Info Card

---

**REAL-TIME VIDEO EDITING**

**Pinnacle Systems Reel-Time:** a dual-stream desktop video capture card with onboard real-time special effects; ReelTime supports dual audio and video stream playback, and data rates as high as 13.4Mb/s (per stream) for lossless MJPEG compression; with its dual-stream engine, ReelTime eliminates the performance limitations imposed by conventional video capture products, enabling Adobe Premiere to operate render-free in real-time editing; ReelTime allows for the playback and scrub of three tracks, including titles and keying at a lower cost; 650-526-1000;

www.pinnaclesys.com

Circle (256) on Free Info Card

---

**DELAY CANCELLOR**

**Avocet Instruments delay cancellor:** this product eliminates delayed audio or echoes of remote audio from the off-air return heard at remote sites; unlike the mix-minus systems that require a dedicated return path to the remote site, the delay cancellor allows the remote talent to use the air feed as their return audio from the station; a special DSP program compares audio that is transmitted to the studio with audio that is being received at the remote site via the on-air signal, satellite line or microwave path; the delay cancellor will compensate and correct for transmission delays of up to 800ms; 800-443-0728; fax 503-671-9626; www.avocetinst.com

Circle (265) on Free Info Card
The Chyron

DTV Fiber Optic Transport and Distribution

DTV-200 Series of Modular Digital Products

- Supports SMPTE 259M, 4:2:2 Component and Wide Screen, 540Mbps 4:4:4:4, SONET and ATM.
- Distribute and transport data from DC to 650Mbps up to a 10Km distance.
- Coaxial and Fiber Optic interfaces.

MULTIDYNE

Web http://www.multidyne.com

1-(800)-4TV-TEST Fax 1-(516)-671-3362

Visit NAB #8116. Call for a FREE pass.

Shively Labs

Series 2000 UHF Broadcast Antennas
B-LINE Transmission Line

Shively Labs offers superior engineering support and accessibility from your first contact through the life of your Shively UHF broadcast system.

Offering Complete Solutions for Your DTV Requirements!

UHF & FM Antennas and Related RF Equipment

P.O.Box 389, Bridgton, Maine 04009 USA
Tel.: +1-207 647-3327 FAX: +1-207 647-8273

NUEVO web site: www.shively.com
- An Employee-Owned Company -

The results are in...
WinMasterCG™
is the leading Master Control application for the Chyron Codi

Finally a Master Control Character Generator Program with the Master Control Operator in mind.

WinMasterCG has the new 44 TV Guidelines Ratings Icons Manually or with timed display fade accomplished with a click of the mouse. WinMasterCG has an incredible list of features for the Chyron Codi and supports 36 file formats which are translated to Codi format within WinMasterCG.

Simply click on the desired icon and your MC task will be accomplished in seconds.

"WinMasterCG is the simple solution for Master Control"

The Chyron

For more information:
1-800-273-4033
FAX (561) 776-8464

See our web site at broadcastsoftware.com for a free demo and additional features
PRODUCTS NOW SHIPPING

HIGH-PERFORMANCE STORAGE DRIVES

Avid's iS Pro Series: this powerful line of storage drives includes 9G and 18GB storage drives in a 3.5-inch format; ideal for digital video and audio applications, the iS9 Pro and the iS18 Pro are available in fixed and removable formats and offer increased performance, reliability and investment protection; these ultraSCSI drives are designed to work with Avid's MediaDock removable storage systems and in Avid MediaDrive fixed storage devices; using iS18 Pro drives in a fully loaded MediaDock (eight drives) allows storage of 140GB of digital media; 978-640-6789; fax 978-640-1366; www.avid.com

Circle (284) on Free Info Card

NEXT-GENERATION NEWSROOM COMPUTER SYSTEM

Avid’s AvidNews Newsroom Computer System: the first component of AvidNews newsroom and control system, the AvidNews Newsroom Computer System, is now available; it streamlines news production with tools that enable text, video and audio management on your desktop; built on three core systems—AvidNews Newsroom Computer system, Media System and Broadcast Control System—AvidNews allows you to access and share video, scripts and rundowns; 800-949-AVID; www.avid.com

Circle (285) on Free Info Card

NT VERSION OF ITS IMAGING CONTROL PANEL SOFTWARE

Miranda Windows NT version of Its ICP-S remote-control software: the Windows NT version of its ICP-S software control panel is now shipping; the Imaging Control Panel (ICP) software allows you to remotely control and monitor Miranda’s line of digital encoders, decoders, converters, frame syncs and more from a software environment; ICP-S offers three menu levels that allow you to continuously monitor the status and control of all Imaging family modules connected to a particular workstation via a given RS-422 daisy chain; 514-333-1772; fax 514-333-9828; www.miranda.com

Circle (286) on Free Info Card

PROFESSIONAL MULTICHANNEL DECODER

Tandberg TT1100: a state-of-the-art, cost-effective multichannel IRD that simultaneously decodes one to six video channels in one unit; major CA systems are implemented, and the TT1100 receives and transcodes components of a digital TV signal into the preferred format; it transcodes to PAL/NTSC and offers MPEG-2/DVB conformance and interoperability; other features include closed captioning (NTSC), flexible conditional access handling, test signal (VITS) generation and automatic language selection for sound, subtitling and teletext; +47 67 11 62 00; fax +47 67 11 62 01; sales@tandbergtv.no

Circle (277) on Free Info Card

HDTV DIGITAL DISK RECORDER

Digital Video Systems’ ProntoVision: new I/O features are now available on the ProntoVision HDTV disk recorder products; concurrent storage of virtually all interlaced and progressive HDTV and SDTV formats is provided in a single ProntoVision system; some of the enhancements include the ability to switch from HDTV to a multichannel SDTV server, record/play of the Panasonic HD360 compressed stream format and a frame doubler playout option that allows any material recorded in progressive-30 format to be played out in progressive-60 or interlace-60 formats; ProntoVision is compatible with all major edit controllers using the Sony RS-422 protocol and it easily emulates or replaces the traditional VTR in edit suite applications; 818-846-9444; fax 818-846-7444; www.digitalvideosystems.com

Circle (271) on Free Info Card

LARGE-CONFIGURATION MATRIX SWITCHERS

Extron Crosspoint 1616 series switches: RGBS/RGBHV, 16x16 matrix switches offer new options for large-scale routing; available in four models — 1616, 1616A, 1616HV and 1616HVA; each model has 16 memory presets and can switch S-Video and composite video for easy use with any large-screen projector and monitor currently available; when fully loaded, the switches deliver 200MHz (-3dB) video bandwidth; the inputs and outputs are each isolated and buffered, allowing any single input or combination of inputs to be switched to any outputs with virtually no crosstalk; 714-491-1500; fax 714-491-1517; www.extron.com

Circle (266) on Free Info Card
USDA is a handy 2-in, 4-out stereo "mini-DA" that can combine or split audio signals for distribution. Mix stereo to mono, get both stereo and mono outputs from a stereo source. Gain trims for each output. Great specs with lots of headroom. Keep one on hand!

HENRY ENGINEERING
503 Key Vista Drive
Sierra Madre, CA 91024 USA
TEL (626) 355-3656 FAX (626) 355-0077
FAX-on-Demand Doc #103 (626) 355-4210
http://www.henryeng.com

QUALITY.
RELIABILITY.
EASE OF
OPERATION.

ENG, SNV and EFP trucks, vans and trailers

BAF Broadcast Vehicles
TOLL FREE (800) 633-8223
WEB www.bafcom.com
FAX (407) 324-7860 SAT. SPACE (800) 966-3822
E-MAIL baf@gate.net WORLDWIDE +(407) 324-8250

They got their machines under control... so what are you waiting for?

The Secret is Out!
Two of the world's largest BOSS operators have our OmniJET™ Machine Control Server and DTx-800™ DTMF transceiver systems.

Check out these features:

OmniJET™
- LAN/WAN TCP/IP
- RS-422 Ports
- Sony S-BUS interface
- VSYNC/LTC input
- Web Browser set-up

DTx-800™
- DTMF cue tones 8 channel receive AND transmit
- Built-in GPIO and Relay, with LTC reader option...
- Web Browser set-up

And that's only the beginning. How about independent router control, advanced digital ad insertion, client server machine control, router protocol conversion and much more for your scalable system automation requirements.

Don't wait... get yours NOW!

February 1998
Broadcast Engineering
Business

More than 14 Canon DIGI-SUPER 70 lenses were used in Superbowl XXXII. Canon's 70X zoom lens DIGI-SUPER 70 provides the longest telephoto and widest angle combination of any lens, and is engineered to incorporate internal focusing and IF+ technologies for long-range telephoto applications.

Already a fixture at sporting events, Canon's breakthrough DIGI-SUPER 70X lens is also gaining attention as a valuable tool in the entertainment business. Black Entertainment Network (BET), Washington, DC, purchased four Canon 70 lenses for use at entertainment productions, as well as sports events. Because the DIGI-SUPER 70 provides extremely high performance without regard to object distance, the camera can be placed in the back of a concert hall or large theater and still get good close-ups, without obstructing the audience's view. At BET, the 70X lens has been able to get tighter shots from a greater distance, than they normally get with a 45X lens that is closer to the object.

Cinetel Studios, Knoxville, TN, installed an AMS Neve 24-fader Libra fully automated digital music console. The console will help in Cinetel's production of programming for networks, such as Home & Garden, The History Channel, A&E and The Nashville Network. The installation represents the final stage of a facility-wide upgrade to digital.

The Associated Press was awarded the contract for the new newsroom computer system at CBS-owned, KUTV-TV in Salt Lake City. KUTV-TV uses NewsCenter on 35 workstations to manage all areas of its news operations, including program management and timing, on-air control, prompting, captioning and assignment planning.

Boston University's College of Communication also awarded a contract for its newsroom computer system to The Associated Press. It will use NewsCenter on more than 40 workstations for production of local cable newscasts and for classroom training. Since its introduction, more than 160 stations, networks, cable programmers and broadcast bureaus have chosen AP's NewsCenter.

Hitachi announced that four of the CBS mobile trucks sent to Nagano, Japan for production of the 1998 Winter Olympics were equipped with Hitachi cameras. Three expandable units with a total of 18 SKF-710s, nine SKF-3s and three SKF-300 cameras were used to cover the games. This was the third time the expandable units (MU1, MU11, MU12) were used to cover the Winter Olympics and the units were also used at the Daytona 500.

Acrodyne Industries was awarded a contract to manufacture and install an adjacent-channel technology (ACT) transmitter at KBLR-TV, Las Vegas. The ACT transmitter enables KBLR to operate two channels, NTSC Channel 39 and DTV Channel 38, through a single transmitter, transmission line and antenna.

In related news, Acrodyne was awarded contracts by Pappas Telecasting Companies to manufacture and install Diacrod-equipped UHF transmitters at WWSWS-TV in Opelika, AL, and Channel 63 in Merced, CA.

Panasonic announced that Warner Bros. will invest in high-definition recording systems from Panasonic Broadcast for high-resolution film-to-tape transfers of its movies. The initial purchase will be for two Panasonic AJ-HD2000 high-definition recording systems, but the station plans to buy several more over an 18-month period. Warner Bros. will standardize on Panasonic's D-5 format for high-resolution masters that will be used in creating products for DTV, NTSC and PAL delivery.
Vinten
Vision SD 12
Pan and Tilt Head with Serial Drag

The new Vinten Series 12 Pan and Tilt Head System of Vinten Vision is a unique, permanently sealed fluid drag head that provides smooth, steady drag control and is factory calibrated to allow for precise, controlled movement in any axis. The Series 12 Pan and Tilt Head System with Serial Drag (Vision SD 12) is designed for smooth, steady, and reliable performance in any environment, making it ideal for a wide range of broadcast and production applications. With its intuitive and user-friendly controls, the Series 12 Pan and Tilt Head System with Serial Drag delivers excellent performance in any situation, ensuring consistent and stable movement.

Vision Two Stage ENG and LT Carbon Fiber ENG Tripods

The Vinten Vision Two Stage ENG and LT Carbon Fiber ENG Tripods are a versatile and reliable solution for ENG and ENG/LT applications. These tripods are designed with a focus on durability and performance, making them ideal for professional and broadcast use. The Vision Two Stage ENG and LT Carbon Fiber ENG Tripods feature a carbon fiber construction, providing exceptional stiffness and low weight, while also being resistant to wear and tear. The tripods are equipped with a variety of accessories, ensuring that they can meet the needs of any production environment.

Vision 12 Systems

Vision 12 Systems include the popular Vision 12 ENG, Vision 12 ENG LT, Vision 12 ENG B, and Vision 12 ENG LT B models. These systems are designed for broadcast use, providing a combination of stability, precision, and ease of operation. The Vision 12 Systems feature advanced engineering and proprietary technology, offering unparalleled performance and reliability.

V-ISS and VIN-10ST

V-ISS - Vinten Image Stabilization System

The V-ISS system is an advanced, lightweight, and compact image stabilization system that provides smooth, steady image stabilization for ENG and ENG/LT cameras. It is designed to be easy to use and provides excellent performance, making it ideal for a wide range of applications. The V-ISS system features a range of customizable settings, allowing users to fine-tune the image stabilization to meet the specific needs of their production.

VIN-10ST - Vinten Perfect Viewfinder System

The VIN-10ST system is a high-quality viewfinder system that provides clear and accurate views of the camera image. It is designed to be lightweight and compact, making it ideal for use with ENG and ENG/LT cameras. The VIN-10ST system features a range of customizable settings, allowing users to fine-tune the viewfinder to meet the specific needs of their production.

V-J5S-18B

V-J5S-18B Series 1/2" and 1/3" 3-CMOS Video Camera

The V-J5S-18B Series 1/2" and 1/3" 3-CMOS Video Camera is a high-performance camera that provides excellent image quality in a compact, lightweight design. It is ideal for ENG and ENG/LT applications, delivering exceptional performance and reliability. The V-J5S-18B Series 1/2" and 1/3" 3-CMOS Video Camera features a range of customizable settings, allowing users to fine-tune the camera to meet the specific needs of their production.

JVC

GY-X2B

3CCD-SD Video Camcorder

One of the most sensitive cameras ever manufactured, the GY-X2B has the largest 3-CCD sensor that is ideal for today's digital recording formats. With a resolution of up to 720 lines of horizontal resolution, the GY-X2B is perfect for ENG, PAL, and NTSC formats. The camera also includes a range of advanced features, including a 3-CCD color filter, offering exceptional color accuracy and detail. The GY-X2B also includes a range of other features, such as a built-in viewfinder, allowing for a clear and accurate view of the camera image.

K2D9-3

3-Color Video Camera

The K2D9-3 is a high-performance 3-Color Video Camera that provides excellent image quality in a compact, lightweight design. It is ideal for ENG and ENG/LT applications, delivering exceptional performance and reliability. The K2D9-3 includes a range of customizable settings, allowing users to fine-tune the camera to meet the specific needs of their production.

 Canon

Case

The EOS Rebel T9i is a high-performance DSLR camera that provides exceptional image quality and performance in a range of applications. The camera includes a range of advanced features, including a high-resolution 30.3 Megapixel sensor, offering exceptional detail and clarity. The EOS Rebel T9i also includes a range of other features, such as a high-speed 7fps continuous shooting mode, allowing for fast and accurate capture of movement.

C-Log

C-Log is a color grading tool that allows users to fine-tune the color and exposure settings of their footage. It is ideal for use with the EOS Rebel T9i, providing exceptional control and accuracy over the color and exposure of their footage. The C-Log tool is designed to be easy to use and provides excellent performance, making it ideal for a wide range of applications.

C-Image

C-Image is a feature that allows users to fine-tune the color and exposure settings of their footage. It is ideal for use with the EOS Rebel T9i, providing exceptional control and accuracy over the color and exposure of their footage. The C-Image tool is designed to be easy to use and provides excellent performance, making it ideal for a wide range of applications.

C-Shot

C-Shot is a feature that allows users to fine-tune the color and exposure settings of their footage. It is ideal for use with the EOS Rebel T9i, providing exceptional control and accuracy over the color and exposure of their footage. The C-Shot tool is designed to be easy to use and provides excellent performance, making it ideal for a wide range of applications.
The Power Vest combines the comfort and performance of an economical style vest with the power of NRG's high-end battery packs. Available in two styles, the Field (front designed) for general purpose use, and the Event model for more specific applications. The Event model is specifically designed for use in television production, providing the ultimate in lightweight and high performance. It is available as a complete vest or as the vest alone, with or without battery packs. The vest features a variety of ergonomic fits, including a belt for varying arm which creates the shock absorption necessary for ultra lightweight use. The vest can be easily configured for various purposes and is also available in a black vest.

The Dyna-Elastic Arm

The Dyna-Elastic Arm is designed to present the weight of the combined camera and Camera Mounting Assembly. It is highly efficient when using lightweight carbon fiber or standard carbon fiber. It can be used in combination with other camera accessories to create a complete camera system.

Vite Light

Vite Light provides a basic or professional级 joystick in a lightweight and high performance design. It is designed for use in television production, providing the ultimate in lightweight and high performance. It can be used as a basic joystick or as a professional joystick.

Logic Series DIGITAL

Logic Series DIGITAL batteries are not recommending for the television production a technology it is not compatible with a television production technology, the Logic Series DIGITAL batteries are not compatible with professional television production.

PRO DIGITAL PACS

The ultimate professional camera battery and recommended for all applications. It is designed to deliver the right amount of power and high performance even under high current loads and adverse conditions (voltage drop).

Digital Trimpac

Extremely small and light weight, the Digital Trimpac has more energy than twice the weight of a 24-volt sealed battery. It is designed for use in television production, providing the ultimate in lightweight and high performance. It can be used as a basic joystick or as a professional joystick.

Interactive 2000 Power/Chargers

Interactive 2000 Power/Chargers offers an advanced solution for power and convenience of NRG's Charger (V6, V10). This high performance system allows you to work, run, go, and down while on the go. It is available in two models: the V6 and the V10. Both models feature a high performance battery pack and an advanced battery charger. The V6 features a high performance battery pack while the V10 offers a high performance battery pack and an advanced battery charger.

QUAD 2702/2401

The QUAD 2702 is a 2400 watt hour battery pack, designed for studio and location applications. It is designed for use in television production, providing the ultimate in lightweight and high performance. It can be used as a basic joystick or as a professional joystick.

Dual 2702/2401

The Dual 2702 is a 2400 watt hour battery pack, designed for studio and location applications. It is designed for use in television production, providing the ultimate in lightweight and high performance. It can be used as a basic joystick or as a professional joystick.
BT-S1360Y 13” Color Video Production Monitor

The BT-S1360Y is a full function professional 13” production monitor with a wealth of features. It includes superb 480 line horizontal resolution, 5:4 video output, analog RGBI, and all the other features you’d expect in a high end video monitor.

- Incorporates advanced, proprietary white balance control.
- High quality Analog RGBI inputs.
- High contrast, crisper, balanced picture quality.
- Includes remote control with transport and locate functions.
- Optional 18-bit/14M2U and 20Bit/14N2U models incorporate according.

PVM-14N1U/14N2U & 20N1U/20N2U 13” & 19” Presentation Monitors

With high quality performance and flexibility, Sony’s presentation monitor range offers advanced features for an impressive combination of performance, portability and functionality. The PVM-14N1U and PVM-20N2U models offer a stunning and superior aspect ratio for more sophisticated applications.

- 100,000 hours of operation in max. 85% B/C mode.
- Four models are available - 13” or 19”, standard or wide aspect models, designed for simple picture review, the PVM-14N1U and PVM-20N2U combine high performance and a broad selection of superior aspect ratios for more sophisticated applications.

- Onboard - dynamic and flexible color management system for easy-to-use control of the entire image.
- RGBI inputs are also available.
- Wide screen display in the 14N2U models.
- Professional color adjustment feature.
- 10-bit internal processing for accurate color reproduction.

PVM-14M2U/14M4U & 20M2U/20M4U 13” & 19” Production Monitors

Sony’s leading production monitors offer the PVM-M series of monitors, blending picture quality, ease of use and a range of optional tools. These are ideal especially for those who require comprehensive service during production, such as video production, digital audio production, and digital video production. The Sony U-20M series incorporates a highly versatile, high-resolution 19” LCD panel, with a variety of response times, from 14ms to 10ms. The U-20M series includes 15” and 17” models, and is available in a variety of colors, including black and white.

- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.
- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.

PVM-14M2U & 20M2U 13” & 19” Production Monitors

Sony’s leading production monitors offer the PVM-M series of monitors, blending picture quality, ease of use and a range of optional tools. These are ideal especially for those who require comprehensive service during production, such as video production, digital audio production, and digital video production. The Sony U-20M series incorporates a highly versatile, high-resolution 19” LCD panel, with a variety of response times, from 14ms to 10ms. The U-20M series includes 15” and 17” models, and is available in a variety of colors, including black and white.

- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.
- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.

PVM-14M2U & 20M2U 13” & 19” Production Monitors

Sony’s leading production monitors offer the PVM-M series of monitors, blending picture quality, ease of use and a range of optional tools. These are ideal especially for those who require comprehensive service during production, such as video production, digital audio production, and digital video production. The Sony U-20M series incorporates a highly versatile, high-resolution 19” LCD panel, with a variety of response times, from 14ms to 10ms. The U-20M series includes 15” and 17” models, and is available in a variety of colors, including black and white.

- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.
- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.

PVM-14M2U & 20M2U 13” & 19” Production Monitors

Sony’s leading production monitors offer the PVM-M series of monitors, blending picture quality, ease of use and a range of optional tools. These are ideal especially for those who require comprehensive service during production, such as video production, digital audio production, and digital video production. The Sony U-20M series incorporates a highly versatile, high-resolution 19” LCD panel, with a variety of response times, from 14ms to 10ms. The U-20M series includes 15” and 17” models, and is available in a variety of colors, including black and white.

- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.
- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.

PVM-14M2U & 20M2U 13” & 19” Production Monitors

Sony’s leading production monitors offer the PVM-M series of monitors, blending picture quality, ease of use and a range of optional tools. These are ideal especially for those who require comprehensive service during production, such as video production, digital audio production, and digital video production. The Sony U-20M series incorporates a highly versatile, high-resolution 19” LCD panel, with a variety of response times, from 14ms to 10ms. The U-20M series includes 15” and 17” models, and is available in a variety of colors, including black and white.

- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.
- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.

PVM-14M2U & 20M2U 13” & 19” Production Monitors

Sony’s leading production monitors offer the PVM-M series of monitors, blending picture quality, ease of use and a range of optional tools. These are ideal especially for those who require comprehensive service during production, such as video production, digital audio production, and digital video production. The Sony U-20M series incorporates a highly versatile, high-resolution 19” LCD panel, with a variety of response times, from 14ms to 10ms. The U-20M series includes 15” and 17” models, and is available in a variety of colors, including black and white.

- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.
- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.

PVM-14M2U & 20M2U 13” & 19” Production Monitors

Sony’s leading production monitors offer the PVM-M series of monitors, blending picture quality, ease of use and a range of optional tools. These are ideal especially for those who require comprehensive service during production, such as video production, digital audio production, and digital video production. The Sony U-20M series incorporates a highly versatile, high-resolution 19” LCD panel, with a variety of response times, from 14ms to 10ms. The U-20M series includes 15” and 17” models, and is available in a variety of colors, including black and white.

- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.
- Sony’s exclusive color management system for synchronization with other monitors.
- Available in a variety of colors, from 14ms to 10ms.
The NovaStudio Frame series is a modular, flexible, digital logic processing system. It is designed to efficiently and effectively combine a wide variety of technologies into a single unit. The series can be configured in a number of ways to meet the needs of a wide range of applications, including those in the broadcast, video production, and post-production industries.

The NovaStudio Frame series includes a variety of modules, each designed for a specific function. These modules can be combined to create a powerful and flexible system that can handle a wide range of tasks. The system can be expanded as needed, allowing for greater flexibility and scalability.

The NovaStudio Frame series is ideal for use in a variety of applications, including broadcast, video production, and post-production. It is designed to be both efficient and effective, allowing for greater productivity and efficiency.

The NovaStudio Frame series is designed to be easy to use, with intuitive operating controls and user-friendly interfaces. It is designed to be reliable and durable, with high-quality components and robust construction. The system is also designed to be cost-effective, allowing for greater value for money.

Overall, the NovaStudio Frame series is a powerful and flexible digital logic processing system that is designed to meet the needs of a wide range of applications. It is ideal for use in broadcast, video production, and post-production, and is designed to be both efficient and effective, allowing for greater productivity and efficiency.
Dielectric Communications signed an agreement with NBC for the purchase of DTV and NTSC TV station equipment. Under the agreement, Dielectric will be NBC's supplier for its current and future O & O TV stations nationwide. The agreement covers all passive RF components including, but not limited to, antennas, transmission lines, filters, combiners, switches and dehydrators.

Comark Digital Services (CDS) and the WGBH Educational Foundation are teaming up to develop strategies for the implementation of DTV. Comark and WGBH will develop plans for digital television, including HDTV, SDTV, multicasting and data broadcasting, as well as access services such as closed-captioning and descriptive video. WGBH plans to have a digital signal on the air by the end of 1998.

Avid Technology Inc. announced that FOX Television Stations, Inc. will incorporate its new AvidNews newsroom system in each of its 22-owned stations. The AvidNews newsroom system increases news production by streamlining all text processes. With the integration of Avid's newsroom computer system, Fox plans to have 200 seats installed by this June. Avid also announced that WSB-TV, Atlanta's ABC affiliate, will also install AvidNews; the sale will involve the installation of 171 seats.

Sony announced that the Washington Redskins' home stadium, the Jack Kent Cooke Stadium, is now equipped with the TX-7 component triax system and DXC-D30 DSP cameras. Professional Products of Bethesda, MD, integrated and installed an advanced A/V system that is used to feed game action and crowd shots to the Sony JumboTron system during games and for the stadium's commercial and promotional video production. In addition to allowing for quick camera setup and multiple camera direction by a small crew, the triax system is designed for high-quality component video and extensive control of DSP functions.

More than 20 of its DV6000 Universal Digital Transport Systems from ADC Broadband Communications are being used by WorldCom in the United Kingdom. With the DV6000 system, TV stations no longer need an on-site truck to do post-production work, instead the signal is sent directly to the production studio to be edited and transmitted.

In an effort to consolidate regional operations, the WIC-Television Group in Alberta has chosen the Louth Automation ADC-100 to provide comprehensive solutions for automated satellite recording, program timing, media preparation and multichannel commercial and program playback. The two main centers, CICT Calgary and ITV Edmonton, originate the five signals. Calgary's CICT provides a second feed for CISA Lethbridge, while CITV in Edmonton provides a total of three on-air channels.

Hewlett-Packard installed eight HP MediaStream broadcast servers at the FOXTEL Management, Pty., Ltd. facility. Based in Sydney, Australia, the FOXTEL facility went operational with the new servers in October and presently is running more than 16 channels to air. The installation consists of seven HP MediaStream servers connected via a fiber channel network. Each server delivers one input channel and five output channels and will accommodate up to 1.5 hours of spot and promotional insertion material.

People

Dr. Yeshwant Kamath was appointed president of Videonics, Campbell, CA, and will serve on the board of directors.

Inscriber Technology, Ontario, Canada, has appointed Hugh Smyser as director of U.S. operations. Smyser will be responsible for strengthening the U.S. dealer network, expanding U.S. marketing and support systems and leading all operations in the U.S. marketplace.

Dan Ambauen was promoted to Harmonic Lightwaves' director of sales for the Western United States, Sunnyvale, CA. Ambauen will oversee the sales team responsible for servicing Harmonic's customers west of the Mississippi River.

Tan Yee Tiang was named director of operations and engineering at Asia Broadcast Center, New York.

Telemetrics, New York, has appointed James D. Wolfe to the position of sales director for the company's lines of camera control and robotics systems.

Romolo Magarelli has been named president and chief science officer of the Everetz Corporation, Burlington, Ontario, Canada. Everetz also announced Douglas A. DeBruin as chief financial officer and Alan Plaunt as technical director.

Harris Broadcast division, Richmond, IN, announced that Chuck Maines has added the role of radio and TV audio advisor to his other duties.

Rajnish Babbar has been appointed program manager, network management for the Broadband Communications Division, Meriden, CT.
GO PROFESSIONAL

HDTV Doesn't have to mean High Dollar TeleVision™. Check us out at www.AstreSystems.com

“Say It Better”
See more than 300 tips (and related books and tapes) from “gut instincts” expert, Emmy-winner and former Wall Street Journal reporter Kare Anderson at www.sayitbetter.com

JOHN H. BATTISON P.E.
CONSULTING BROADCAST ENGINEER,
FCC APPLICATIONS AM, FM, TV, LPTV Antenna Design, Proofs, Fieldwork 2684 State Route 60 RD # 1 Loudonville, OH 44842 419-994-3849 FAX 419-994-5419

CONSULTING ENGINEERS
2104 West Moss Ave. 
Pearsi, Illinois 61004 (309) 673-7511
FAX (309) 673-6128 Member AFCCE

Why not run your business card here?
Promote your services and increase business!

Only $151.00 per insertion.
Frequency discounts available.
Call 1-800-896-9939

Stainless, inc.
50 Years of Broadcast Tower Design - Fabrication - Construction
210 S. Third St. Voice 215-699-4871
North Wales, PA 18464 Fax 215-699-9597

East Coast Video Systems
consultants • engineers • systems integrators
3 Mars Court
Boonton, NJ 07005
973.402.0104
Fax:73-402-0208
www.ecvs.com

Advertise in Broadcast Engineering Classifieds!

http://www.broadcastexchange.com
The new way to buy and sell preowned broadcast video gear. Free listings. Online database.
1-888-FAX-GEAR Toll-free 24-hour Fax-on-Demand
Uni-toll-free at call: 1-310-242-9461 to have the latest hot flat sent to your fax

VAC Hirose Morsani Noutrik Cool Codi Edac
FREE CATALOG
Bi-Tronics Printed & Distributed Products

Clearly Prudent.
For video duplication, demos, audition reels, work tapes, our recycled tapes are technically up to any task and downright bargains. All formats, fully guaranteed. To order call:
(800)238-4300

Available at a store near you!

WhisperRoom, Inc.
SOUND ISOLATION ENCLOSURES
Vocal Booths
Broadcast Booths
etc...
PH: 423-585-5827
FAX: 423-585-5831
E-MAIL: whisper@ics.com
WEB SITE: www.whisperroom.com
116 S. Sugar Hollow Road
Morncton, Tennessee 37113

THON-TEK
Microwave
Video Equipment

Miniature S-band 2 and 2.5 GHz Links
- Fixed Frequency - Selectable Output
- Tunable - Continuous
- Remotely Tunable - Via RF or Phone
- Tower Cams - Various Configs
- Repeaters - In-band Available

Call for Free Catalog
918-663-4877

TRON-Tek, Inc.
6570-B East 51st Street
Tulsa, OK 74145
(FCC TYPE ACCEPTED)

Classifieds
New!!

SDV 4-4 - Serial Digital and Analog Video Monitoring DA - 4 2/270 bps.
Four redocked SDI outputs, plus four CVBS or RGB outputs. 10 bit DACs. EIA 423 D500/8000.
DA frames. .......... $895

TBC-RMT - TBC Remote Control Unit
Remote control of up to 3 TBC's. For use with internal TBC's on BVW, DVI, PVM, UVW, and BVR Beta machines or any machine using Sony BVR-50 controller. Purchased with 1, 2, or 3 modules. With 3 modules. Now available on IVC machines - Series 22, 80, 85. $960

SCR-4X8 - Serial Machine Control Router - Input/Output: Twelve rear mounted DB9-F connectors (four controllers, eight devices). EIA RS-422 send and receive. Controls: Twelve lighted pushbuttons for channel assignment. ............... $980

SCP-10 - Serial 422 Patch Panel
10x10 passive non-normalising serial data patch panel. Two rack units high. Legend strips and 10 patch cords included. .......... $350

VU2-P - VU/Peak Meter with Phase Indicator - Simultaneous peak and VU display. Solid state phase indication. Highly-usable LED arrays. Adjustable headphone output. Hi-impedance looping inputs. $890

SPK-2 - Two Channel Audio Monitor
Two channel audio confidence monitoring. Accepts both balanced and unbalanced inputs. Five switchable listening modes. Headphone output with speaker mute. ............... $650.

---

THE 5D VIRTUAL TELEPORT
Serving USA and Canada
Digital and analog video, data
C Band Transponders
available on GE1
Occasional Space
24 hr booking
Worldwide Service
Call 1-800-565-1471
Program Playout and Uplink Facility
located in Ottawa, ON, CAN.
Uplink installed at your location, remote controlled and monitored from ours
KU Band Transportable
Hire/Lease/Sell
Engineering and Technical Services
Call: Graeme Fournier
1-800-267-1221 x152
e-mail: gfournier@5d.com

* Studio Exchange *
Burbank
(818) 840-1351 Fax (818) 840-1354
New and Used Video Equipment
Audio/Video Dealer
Starring
Panasonic & Sony
BUY, SELL, TRADE & CONSIGN
816 N. Victory Blvd.
Burbank, CA 91502
email: studioex@ecom.net
www.studio-exchange.com
Help Wanted

ENGINEERING SUPERVISOR/ASSOCIATE DIRECTOR The University of Central Florida's Office of Instructional Resources is seeking an Engineering Supervisor/Associate Director with knowledge of television and radio broadcasting and cable delivery, video and audio engineering, microwave systems, fiber-optic and digital compressed data communications, satellite transmission, multimedia hardware systems, and data and computer networking. A Master's degree and four years directly related professional work experience are required. A Master's degree in an appropriate area of engineering specialization is preferred. A FCC general broadcast license is required. Candidate screening will begin on January 5, 1998 and will continue until the position is filled. http://www.oir.ucf.edu/jobs. To apply, send resume to: University of Central Florida, OIR Engineer Search Committee, P.O. Box 1672800, Administration Building, Room 326, Orlando, Florida 32816-2800. Affirmative Action, Equal Opportunity Employer.

MAINTENANCE ENGINEER Immediate full time position in broadcast television. Must have studio and transmitter maintenance experience. If you can trouble shoot all aspects of a television station and solve the problems, send your resume to Chief Engineer, KAYU-TV, PO Box 30028, Spokane, WA 99223. EOE.

STAFF ENGINEER INFRASTRUCTURE AND ENGINEERING SERVICES Bradley University Infrastructure and Engineering Services seeks to fill the position of Staff Engineer. The successful candidate will support the broadcast operations of WTVP-TV, WCBU-FM and the instructional technologies of Bradley University. This is an exciting opportunity for the individual who is ready to work in a diverse technical and cultural environment. Required qualifications: Associates degree in electronics technology and/ or 3 years of electronics repair experience; Ability to obtain an Illinois class B Commercial Drivers License with air brake endorsement and drive a 30 ft. straight truck; Lift equipment weighing up to 33 lb. to the work bench top; Limited evening and weekend work required. Some overnight travel. Desired qualifications: Experience in the repair of broadcasting equipment; FCC General Class License; Society of Broadcast Engineers Certification; Experience with computers in a networked environment. Submit letter, resume and three professional references to Chairman, Staff Engineer Search Committee, Bradley University-Infrastructure and Engineering Services, 223 Jobst Hall, 1501 West Bradley Avenue, Peoria, IL 61625. This position will remain open until filled. Bradley University is committed to diversity in the work force and is an Equal Opportunity/Affirmative Action Employer.
LEADER IN COMPUTER GRAPHICS

FAST-FORWARD YOUR CAREER WITH THE VIDEO/TV INDUSTRY

We’re Pro-Bel America, a premier supplier of signal distribution and signal products for over 25 successful years, and a division of the Chyron Corporation—always on the cutting edge of product development for the broadcast and multi-media industries. We are seeking broadcast technical professionals with excellent communication skills for the following opportunities:

TECHNICAL SUPPORT ENGINEER-LOS ANGELES, CALIFORNIA
You will be responsible for accurately defining operations and product issues to field service and support personnel, plus serving as key contact with the engineering, maintenance, and operations staff at TV stations. You should have basic technical knowledge of television station operation.

PRODUCT SPECIALIST-ATLANTA, GEORGIA
We will thoroughly train you in hardware and software products relating to routing, master control, and automation, with a concentration in hardware. You will then be responsible for oral and written presentations plus supervise development of large-scale proposals. You should have solid understanding of the television process (acquisition through transmission) and an eagerness to expand your technical knowledge.

We offer excellent compensation and benefits packages including relocation allowance plus room for growth. For strictly confidential consideration, please mail your resume, indicating salary requirement and position of interest, to: HR Department-BE, Chyron Corporation, 61 Hub Drive, Marlboro, New York 11747; FAX #: (516) 845-2090; e-mail: careers@chyron.com.

We are an equal opportunity employer dedicated to affirmative action.

To learn more about CHYRON and our employment opportunities visit our website: www.chyron.com

pro-bel AMERICA
A Chyron Company

CHIEF ENGINEER WUAB-TV, Cleveland, has immediate opening for Chief Operator. Requires knowledge of FCC regulations. FCC license or SBE certification a plus. Minimum 5 years experience in television broadcast engineering, including working with UHF transmitters. Must be responsible, able to lead and work on team and individual projects, and have excellent communication and interpersonal skills. Fax resume and cover letter to: (216) 348-4014, or mail to: Cennell Cleveland, Attn: Station Manager, 1717 East 12th St., Cleveland, OH 44114. EOE: women and minorities encouraged to apply.

IMMAD-ECVS, (www.immad.com/www.ecvs.com) one of the North America’s largest combined system integration companies, is seeking both Senior and Mid-level Television System Engineers for our new Boonton, NJ facility. Our growing public company is currently designing and building DTV solutions for the broadcast community and have positions open for the right candidates. The Senior Engineering candidate should have the following: a B.E.E., or/and P.E., a strong background in Television and Engineering management experience; financial management skills at the project level; computer literate and a working knowledge of AutoCAD. The Mid-level Engineering candidate should have the following: a good background in television engineering, extensive knowledge of AutoCAD; and computer networking and management skills. An EE or PE would be a plus. Please send all info to Rich Bisignano, at rbsign@immad.com.

EASTERN CONNECTICUT STATE UNIVERSITY POSITI-
ON ANNOUNCEMENT Engineering Studio Support: Leading Connecticut State University seeking technically proficient, highly motivated studio professional. Experienced in maintaining and calibrating University TV Studio, Satellite system, cable Channel and editing facilities, Systems includes Grass Valley 200, Panasonic SVHS, DVC-Pro and Media 100 Non-Linear. Repair and trouble shooting of all Media equipment required. Administrative staff position, B.S. degree required and SBE certification a plus. Salary negotiable, full benefits including tuition waiver for self and dependents. Interested candidates should send resume and three references to: Jack Boyko, Associates Director of Media Services, Eastern Connecticut State University, Willimantic, CT 06226-2295. ECU is an AA/EOE employer. Women, members of protected classes and people with disabilities are encouraged to apply.

MAINTENANCE ENGINEER - VACATION RELIEF Responsibilities include the maintenance of Studio, Video Tape, and Electronic News equipment, including Cameras, Video Tape Recorders, Video Switchers, Editing and Transmitting equipment. Digital Video and Audio hardware and software component or SBE certification a plus. Send resume to: Bill Beam, WABC-TV, 7 Lincoln Square, New York, NY 10023. No telephone calls please. We are an equal opportunity employer.

TBS is an equal opportunity employer.

KCX TV IS SEEKING an Assistant Chief Engineer to fill hands on role in broadcast TV. This individual will be a hands on, self-motivated person who possesses UHF knowledge and experience. Come and join our team, we offer a competitive wage. Send resumes to: E.O.E. Mail or fax resume and cover letter to: KCX-TV, Attn: Human Resources-MR, 180 E. 4th Street, Chico, CA 95928. Fax # (530) 893-1953.

KXLY BROADCAST GROUP has openings for two Broadcast Engineer positions. Excellent benefits package, ideal surroundings and lifestyle. Requirements include electronics degree, exp. in broadcast industry, computer knowledge. Must be physically fit and flexible with schedule. Send resume to: EEO Coordinator, KXLY Broadcast Group, 500 W. Boone Ave, Spokane, WA 99201. EOE. No phone calls.

SALES ENGINEER FOR HELICOPTER ENG
Seattle area: Geneva Aviation is a leading manufacturer of a full range of electronic equipment designed to produce the most capable news gathering helicopters. Geneva is interviewing for a sales engineer to meet with potential customers. Fax resume to Cherie Hasson at 800-546-2220.

ELECTRONIC TECHNICIAN NBC 25 has an excellent opportunity for an experienced television maintenance engineer to join our growing operation. Primarily job responsibilities include component-level repair of video tape recorders, cameras, switchers, eng. equipment, etc. A minimum of 2 years of broadcast equipment maintenance experience is required for this position. SBE certification and FCC general class license and/or prior transmitter maintenance experience a plus. Drug screen required. NBC 25 is a small market NBC affiliate. We offer a comprehensive benefit package, including 401(k) and section 125 plans. Send resume to NBC 25, Dept. Z, 13 East Washington Street, Hagerstown, MD 21740. Faxes or email are also accepted. (lexxton@nbc25.com) EOE. No phone calls please.
When is an organization not an .org?

BY PAUL MCGOLDRICK

I was ruminating the other day about NAB; the annual event that some of us wish would never be repeated, and yet, we would be broadcasting hermits if we ignored it. Over the last 30 years I have been on the exhibitor side of the aisle for five companies and on the looking-in side with three organizations. Don’t ask which is the most fun.

The change in the show over the years has been incredible; not just the growth, but the change in the people, the locations and the attitudes. It was decided years ago that the exhibition should always be in Las Vegas. Not a surprise. Although it is not the largest production in Las Vegas (CES and COMDEX are), it actually makes the utility meters run faster than any other show. There is no other show floor in North America that can provide the power needed.

NAB sells

It is also a practical show for the exhibitors. Visitors come to make purchasing decisions. Compare NAB with Montreux (a chance to spend a few comfortable days at the lake with your spouse) or SMPTE (where the papers and technology are wonderful, but you are prohibited from talking money) or some SBE shows of recent years (that were compared to bowling alley parties). Whenever I hear the phraseology quoted by an exhibitor in the show’s press, “We were able to spend some real quality time with the visitors,” I start to squirm. Broadcast is not the only industry with exhibitions and conferences that should be euthanized; I can think of electronics shows, like Wescon, which really died a few years ago, but people forgot to notice.

No, NAB has not been in those categories. The technical program has never been the centerpiece, but it is respectable. I always thought a five-day exhibition/conference with NAB running the exhibits and SMPTE running the papers would be a not-to-be missed show.

Although buyer and seller meet well at NAB, it is not a cheap way to go. Even the smallest company (a three- or four-person operation in a 10’x10’ booth) will end up spending $15,000 for NAB. A 40- to 50-person company will have to budget about $75,000 and be committed to a custom-made booth on a 20’x20’ space. “Have to” because if you don’t look big in the broadcast business, customers won’t believe you ever will be.

What does all this money buy? NAB ’98 will cost exhibitors $29 per square foot — if you are a member of NAB — and $35 per square foot if you’re not. Other costs include freight of the booth and equipment (and any booth refurbishing, new graphics, etc. since its last outing), drayage at the show floor, set-up labor, power, special rentals, airfare, hotels and meals for the staff, special advertising, promotional and collateral pieces. Also, company sales people better be out there entertaining every moment while they have so many customers in one place.

Earning $75,000 to pay for such a mid-sized venture means having to sell about $750,000 of equipment or services. As of the beginning of January, according to its web site, NAB had sold more than 750,000 square feet of exhibit space to more than 1,200 exhibitors with another 200 exhibitors expected. The “sold” space, if you assumed it was all sold at member rates, represents about $22 million of revenue. But wait, there is more.

Hype, glorious hype

Around Christmas, every NAB exhibitor and, presumably, every PR company involved with those accounts, received a box by Priority Mail from NAB. It contained a marketing extravaganza the likes of which I’ve never seen — a three-ring binder with laminated cover containing 74 sheets (148 pages) of “It’s a Mad, Mad, Mad, Mad Advertising Rate Card.” At least 50 sides were four-color, with a lot of special photography, and the remainder were at least two-color with spot varnish. For about a 2,000-piece circulation, my guess is this piece of work was upward of $40 a copy — that’s exhibitors’ money.

Some of the advertising is genuine; the remainder is covering NAB’s costs of events, from the Amateur Radio Reception to the International Leadership Dinner where 300 of the world’s finest — no doubt including the NAB board — get invited to a $60,000 bash that exhibitors are paying for! The granddaddy of them all is sponsorship of the Internet Theater on the floor of the Sands: A cool $150,000 . . . oh, plus expenses. What broadcasting equipment company do you think could afford that? Microsoft? Intel? H-P? Are we seeing a progressive image here?

I have watched the NAB exhibition go from being run marginally close to Mafiosi, to squeaky clean, to greedy.

Paul McGoldrick is an industry consultant based on the West Coast.
Matrix Routers by Videotek.

The difference is control!

The entire SDR family of digital and analog matrix routing switchers was designed from an operator's point of view. The power is in the control, and control is yours to take... by name, by number, by "From" and "To", by input and output, and also by salvos. Identify sources, destinations, and salvos with alphanumerics that are easily configured from the front panel, or simply download the information from a PC.

With a wide range of sizes, types, and levels, the compact and expandable SDR series meets your needs for today and in the future at a surprisingly affordable price.

Take control... contact Videotek for more information on the SDR series and single bus routing switcher family today. With Videotek, you control the router... it doesn't control you.

Premium Quality, Intelligent Design, Smart Price... That's Videotek.

See us at NAB '98 Booth 10761!
The Difference Is NOISE

Leitch can handle it

Most decoders can’t handle noisy feeds, but you can count on Leitch decoders to transform noisy satellite signals into useful, synchronized, 4:2:2 signals. Leitch’s DES-6801 has a 3-line adaptive comb filter decoder, analog genlock, a full frame synchronizer and infinite H & V phasing.

The decoder fits the FR-6801 frame and is the world’s most compact decoding/synchronizing combination. The DES-6801, like the DEC-6801 for A to D conversion and the VFS-6801 for 4:2:2 digital frame sync, is just one of many digital solutions in Leitch’s Digital Glue family of products.