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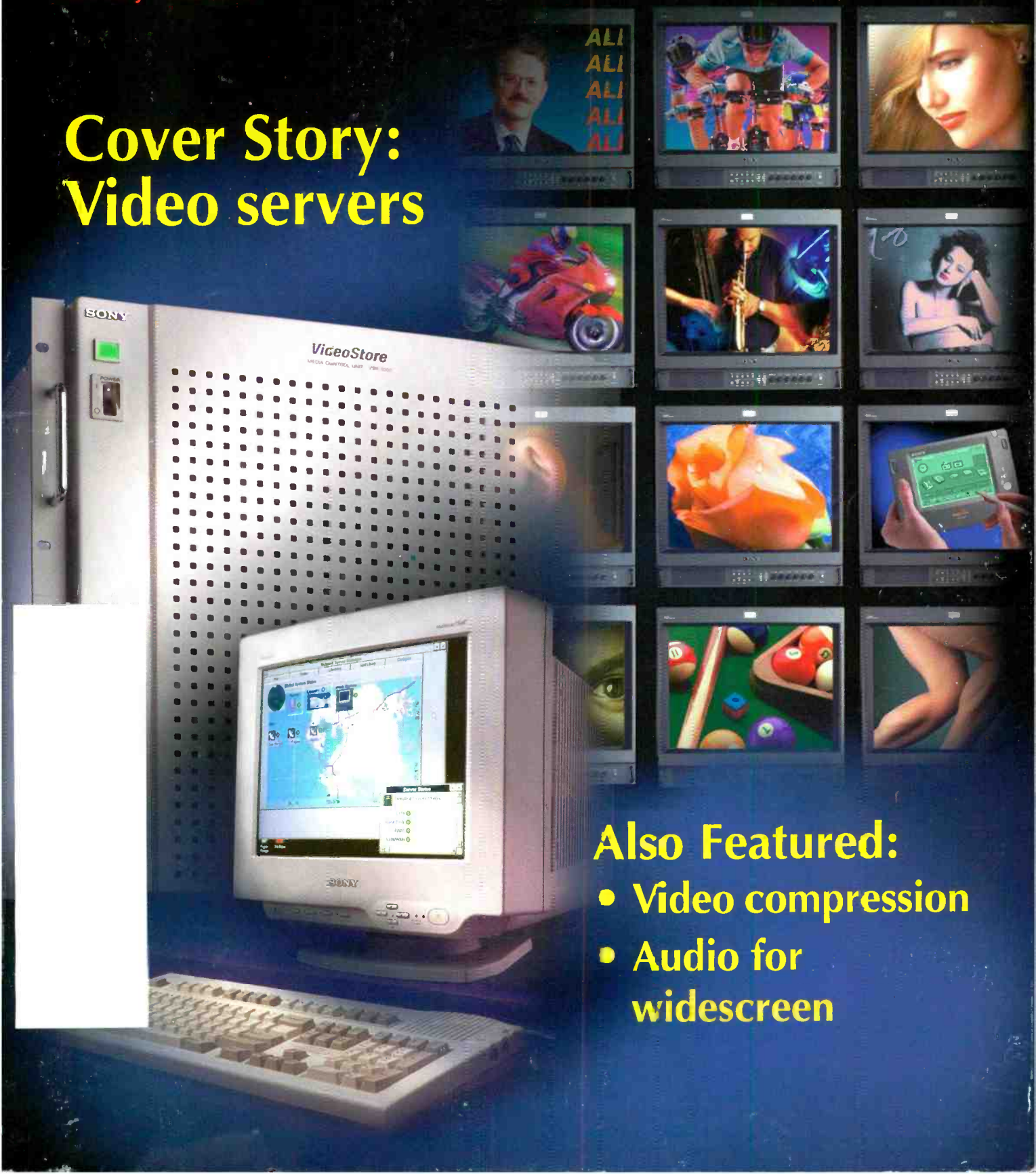
Cover Story: Video servers



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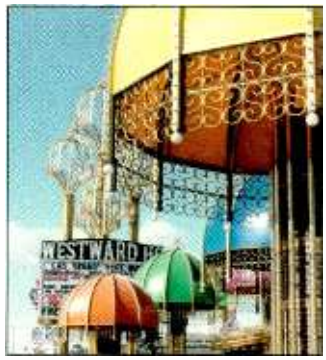

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THIS MONTH...

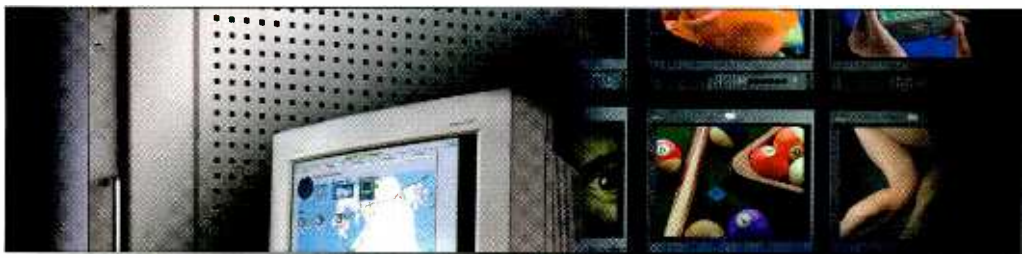
76

88

DEPARTMENTS:

124

COLUMNS:



ON THE COVER: Video servers like the Sony VideoStore, shown on the cover, are increasingly becoming the primary storage technology for broadcast, post production and pay-per-view applications. Photography provided by Sony Broadcast.

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By Dawn Hightower, senior associate editor

President Clinton signs Telecom bill

The Telecommunications Reform Act of 1995 was signed by President Clinton on Feb. 8. It was carried live via satellite and on-line via the Internet. This landmark legislation throws open the market for cable television and telephone services. Now that the barriers erected by communications laws 62 years ago have been broken down, broadcast and telephone companies can move into each others' businesses. This will give consumers a much wider choice in services.

World Media Expo call for papers

The Society of Broadcast Engineers has announced a call for papers for the 1996 SBE Engineering Conference & World Media Expo. The conference will be held in Los Angeles, Oct. 9-12 at the Los Angeles Convention Center.

Papers are requested on the following topics: digital technology for television and radio, RF for television and radio, regulatory issues, facility planning, digital audio broadcasting, advanced television and Internet applications for broadcasters.

A brief abstract must be submitted in writing to the SBE National Office by March 15. Authors whose abstracts are selected will be notified by April 1, and the completed papers will be due to the SBE National Office by July 1. Papers submitted by the deadline will be considered for inclusion in the 1996 SBE Conference *Proceedings*.

Send your abstract to: SBE Engineering Conference, Society of Broadcast Engineers, 8445 Keystone Crossing, Suite 140 Indianapolis, IN 46240 or fax your abstract to (317)253-0418.

FCC OKs Disney's ABC purchase

On Feb. 8, Walt Disney Company's $19 billion acquisition of Capital Cities/ABC cleared its final FCC hurdle on the way to creating the world's largest media company.

The commission approved the transfer of broadcast licenses from Capital Cities to Disney. Commissioners want the merged company to divest some of its media properties in Detroit and Fort Worth, TX.

Disney may be able to keep all of those properties, however, because Capital Cities owns radio stations as well as newspapers in both the Detroit area and Forth Worth. Federal rules prohibit this cross ownership in one market, but Capital Cities had gained an exemption in Detroit and Fort Worth because it already owned the properties when the ban took effect.

Disney had asked the FCC for its own waiver so it could keep all of the Detroit and Fort Worth properties. It could not inherit Capital Cities' exemption.

The Feb. 8 ruling gives Disney 12 months to divest either the radio stations or the newspaper in each market. However, FCC chairman Reed Hundt plans to re-examine the cross ownership rule. If those rules are rewritten before Disney's 12-month deadline, the company will not have to make any divestitures.

The FCC approved waivers from local ownership rules so that Disney may permanently own TV-radio combinations in Chicago, New York, Los Angeles, San Francisco, Flint-Detroit and Toledo-Detroit.

Montreux launches Interactive Media Services Symposium

The first Montreux Interactive Media Services Symposium (MIMS) will be held in Montreux, Switzerland, from June 8-9.

The MIMS Symposium will be held concurrently with the third Montreux International Radio Symposium and technical exhibition, which will take place June 6-9.

The theme for the symposium will be "Moving from traditional broadcasting to interactive and multimedia services."

The third Digimedia Conference, which has been held in Geneva in previous years, will be held jointly with MIMS in Montreux from June 6-8. Digimedia is organized by the International Telecommunications Union, the European Broadcasting Union, Audiovisual Eureka, Geneva University MIRALab and the Montreux Symposia Management.

Sage Alerting Systems receives FCC certification

Sage Alerting Systems, Stamford, CT, is the first manufacturer to receive certification of its Emergency Alert System (EAS) equipment by the Federal Communications Commission. The certification was effective on Jan. 25.

The Sage ENDEC is a microprocessor/DSP-based encoder/decoder that meets all of the requirements of the FCC Part 11 rules.

Harris Broadcast Products Division will be distributing the Sage EAS ENDEC and other Sage EAS products to the broadcast industry.

The system is simple to install and program and is user friendly for operators. It features an 80-character display, multifunction remote control, video character generator and companion multiband receiver to make a complete integrated EAS system for television, cable and radio.

Mega Hertz, Sage's distributor for the cable industry sold the first FCC-certified EAS system to TCI of southern Arizona.

UCLA Extension offers engineering courses

The UCLA Extension Department of Engineering, Information Systems and Technical Management, is offering two courses on digital video technology and charge-coupled devices, cameras and applications.

The Digital Video Technology course will be held April 10-12 at the UCLA Extension building, Los Angeles. The course will provide an intensive 3-day overview of the state-of-the-art in studio-quality digital video. It is intended for computer system designers, engineers, programmers and/or technicians, and will show how to use digital video technology to bring smooth motion and accurate color to computing. For those in the TV industry, the course should impart an understanding of digital images in computing to facilitate the application of video systems, equipment and techniques to the expanding area of multimedia. The fee is $1,295, which includes course materials.

The Charge-Coupled Devices, Cameras and Applications course will be offered May 6-10, also at the UCLA Extension Building. The course is for engineers, scientists and hardware managers involved with CCDs. It will review the characteristics of charge-coupled devices (CCDs) used in imaging camera systems. The course will detail advances in pixel count, quantum efficiency, charge transfer efficiency, read noise, large dynamic range and high-speed operation. Technologies used to achieve such high levels of performance will also be discussed. The course costs $1,495, including course materials.

For more information, contact UCLA Extension by phone at (310)825-3344 or by fax at (310)206-2815 or by E-mail at enroll@unex.ucla.edu. ■

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Cart, but no horse

On Feb. 1, Congress finally passed a new telecommunications bill. The rewrite of telecom rules was years in coming, which didn't seem to bother broadcasters nearly as much as the telco companies — until recently. Broadcasters were pretty much assured of the relaxation of rules regarding ownership and other areas. What they weren't expecting was a government price tag to be placed on their admission to the ATV future.

Telcos, on the other hand, being bound by ole' Judge Green's one-handed decision of a decade ago on providing video services, fared much better. His original "opinion" basically prevented telcos from getting into the video dial-tone business and hampered the development of a high-tech, competitive delivery system within the United States. Without the prohibitions set forth in Green's Modified Final Judgment (MFJ), today's TV viewers could have been selecting from a variety of entertainment sources, instead of only one provided by cable.

In an effort to get past restrictions placed on them by the judge, telcos like Pacific Telesis, Nynex and Bell Atlantic have had to buy their way into the multichannel market using MMDS technology. According to a new study by the Multimedia Research Group, only now is the cable TV industry encountering aggressive competition from multichannel digital video programmers, such as DirecTV. The telcos are close behind with their plans, and the new telecom bill finally opens the door to the benefits of real competition.

Given this background, what's the importance of the new telecom bill to broadcasters? In short, a lot. It means a higher concentration of power in the hands of fewer owners. It also means economies of scale never before available to broadcasters. This alone could mean a rejuvenation of new building, equipment purchases and even hiring.

Unfortunately, while the bill reserves UHF spectrum for ATV, an agreement between Congress and the FCC will prevent the issuance of licenses until Congress revisits the allocation issue in a separate bill. In short, the spectrum has been reserved, but there is likely to be a price for using it.

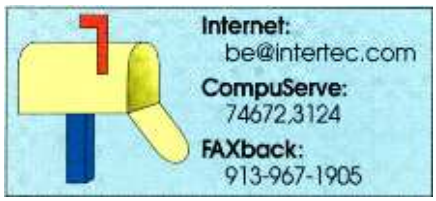
It's sort of good news, bad news. The spectrum has been reserved, but stations can't apply for their new channels, at least not yet. Final resolution of this issue is expected to take months. And if the Democrats and Senator Dole have their way, broadcasters will pay — perhaps a lot — for this spectrum.

Unfortunately, this means that stations are no closer to being able to plan for their ATV future than they were five years ago. Although the commission has adopted the Grand Alliance system, without guaranteed (affordable) access to these channels, nobody moves. We've got the cart, but no horse to pull it.

I wonder if those Washington politicians could be hooked up to a harness. . . ?

Brad Dick

Brad Dick, editor



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Circle (12) on Action Card

By Harry C. Martin and Andrew S. Kersting

TV freeze rumored — ATV allotments expected

The FCC appears close to imposing a freeze on all applications for new TV stations and on modifications that involve a change in transmitter site. This freeze would be designed to allow the commission to finalize a channel-allotment plan for ATV channels.

The FCC has been working on a plan that would allot particular ATV channels to pair with existing TV stations in the communities served by those stations. In order to produce an allotment scheme that will work, the agency needs to have a stable picture of NTSC channel allotments. The anticipated freeze would likely remain in effect until the rules governing the transition to ATV are adopted and go into effect.

The FCC had hoped to have an allotment plan ready for consideration at the January open meeting. With the government shutdown, however, and with the remaining work to be done, the timetable has slipped. Even so, the anticipated freeze is likely to go into effect soon, since the freeze is necessary to provide a stable backdrop for the new allotments.

Many issues remain to be resolved in the ATV arena. The FCC held an en banc hearing on digital television on Dec. 12. Representatives of numerous interest groups, with diverging views of digital television, testified at the hearing. Public-interest advocacy groups argued for increasing broadcasters' public-interest obligations in return for receiving a digital channel. Network representatives argued against such a quid pro quo and against establishing a preset date for returning current broadcast channels.

Many witnesses focused on the issue of whether to auction the new channel, although that issue will ultimately be decided by Congress. The Community Broadcasters Association argued that low-power TV stations should be included in the digital TV plan. Computer-industry executives, on the other hand, objected to the inclusion of an interlace scanning format in the transmission system, insisting that this format will hamper compatibility between broadcasting and computers. Despite these outstanding issues, the FCC appears ready to move forward with a channel-allotment scheme.

New tower-registration procedures

After July 1, 1996, all new antenna structures that require FAA notification must be registered with the commission prior to construction. Thus, even after receiving a construction permit, building of a new tower may not begin until a registration number has been obtained. In addition, owners of existing structures must register their towers according to the filing windows in Table 1.

The FCC will not process applications that fail to reflect a tower registration number. The commission will use revised FCC Form 854 as the sole means to register antenna structures. Tower owners may register either electronically or by mail.

DATELINE: APRIL 1

Commercial TV stations in the following states must file their annual ownership reports or report certifications on or before April 1, 1996: Indiana, Kentucky, Tennessee, Texas, Delaware and Pennsylvania.

Those who register electronically will receive a registration number within minutes. There is no registration fee, nor will owners be required to renew their registration. Structure owners must notify the FCC, however, of any change in structure height, ownership, the owner's address or upon dismantling of the tower.

The antenna structure registration database will accept latitude and longitude data to the nearest second, and height data to the nearest meter. Owners must submit accurate site data regardless of the height and coordinates listed on tenant licensees' station authorizations. In this regard, the commission generally will not issue fines to owners or licensees attempting to correct errant site data during registration. However, changing the coordinates on tenant licensees' authorizations, depending on the magnitude of the error, may result in a violation of the interference-protection criteria set forth in the rules or may invalidate the original FAA determination for the site.

Tenant licensees should note any discrepancies in the site data appearing on the registration form and their station authorizations and notify the appropriate FCC licensing branch. Licensees will not be required to submit a filing fee when correcting site data.

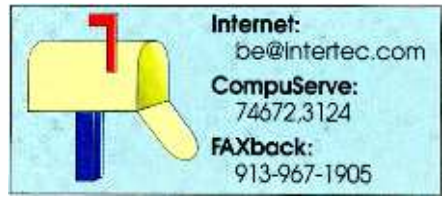
In cases where a correction of site data for a tenant licensee would be in violation of the rules for a particular radio service, the licensee(s) involved may be required to take measures to avoid harmful interference, such as decreasing antenna height, reducing power, employing a directional antenna or perhaps even going off the air. This is a dangerous area that was not closed by grandfathering.

Corrections of previously submitted site data of less than one second in latitude or longitude or of less than one foot in height will not require a new FAA study, and the tower will retain the previously assigned painting and/or lighting specifications. However, a new FAA study will be required for corrections in latitude or longitude of one second or more, or a correction in height of one foot or more. In this case, the owner must seek a new FAA determination prior to registration, and the structure will be assigned painting and/or lighting requirements based on the new FAA determination. In general, the FCC will not require tenant licensees to cease operations while the owner seeks a new FAA determination or while coordinating corrections with the individual licensing branches within the commission. (See "FCC Tower Registration," July, 1995.) ■

Window	States/Territories
July 1-31, 1996	MI, MT
Aug. 1-31, 1996	AZ, HI, NC
Sept. 1-30, 1996	AK, NM, NY
Oct. 1-31, 1996	MA, MO
Nov. 1-30, 1996	IL, WY
Dec. 1-31, 1996	NV, OK, PR
Jan. 1- Feb. 28, 1997	CA, OH
March 1-31, 1997	IA, VA
April 1-30, 1997	GA, Guam, Virgin Isles
May 1-31, 1997	LA, ME, RI
June 1-31, 1997	CO, MN
July 1-31, 1997	NE, PA
Aug. 1- Sept. 30, 1997	FL, IN
Oct. 1-31,1997	DE, KS, WA
Nov. 1-30, 1997	NH, OR, WI, WV
Dec. 1-31, 1997	AL, DC, MD
Jan. 1-31, 1998	AR, ND, UT
Feb. 1-28, 1998	ID, MS, SD, VT
March 1-31, 1998	KY, TN
April 1-30, 1998	CT, NJ, SC
May 1- June 30, 1998	TX

Table 1. The filing window for owners of existing structures to register their towers.

Harry C. Martin and Andrew S. Kersting are attorneys with Fletcher, Heald & Hildreth, P.L.C., Rosslyn, VA.



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EAS update

EAS and NOAA Weather Radio

By Leonard Charles

In designing the new Emergency Alert System (EAS), it was important to examine historical trends during the many years of Emergency Broadcast System (EBS) use. In the EAS Report and Order, the FCC noted that weather-related emergencies represented more than 80% of the total number of EBS activations. These warnings were initiated by the National Weather Service (NWS) over local NOAA Weather Radio (NWR) transmitters before being converted to an EBS alert by broadcast stations.

Beginning recently and continuing through the near future, the NWR transmitters are being upgraded to preface all forecasts and warnings with intelligent digital codes called *Specific Area Message Encoding* (SAME). When you add this up, you may come to the same conclusion that the commission did: Why re-invent the wheel? It was apparent that a lot of time and money could be saved by making the new EAS protocol and the NWR SAME protocol compatible. In that way, all EAS equipment can decode and react to a weather emergency received on an inexpensive weather radio receiver simply by interfacing the received audio to one of the decoder's monitor inputs.

NWR modernization will make it an even larger player in the EAS than had first been thought.

With this direct reception and the proper programming of the EAS equipment, automatic retransmission of life-threatening emergency messages will mean precious moments saved in alerting the public. On the other hand, if NWR SAME-equipped stations can transmit or retransmit EAS-originated messages, a vital background path can be created in the design of an EAS web.

It is, therefore, apparent why the frequency shift keying (FSK) specifications of the EAS protocol match those in the NWR SAME system. This is also why the list of event codes published in the FCC rules for use in an EAS digital header consist largely of the same 3-letter codes that TV stations' meteorology departments have been receiving for years on the weather wire. If you add to these a few codes for a national presidential message and a few more for testing, you have the EAS that broadcasters will all be installing by Jan. 1, 1997.

NWR modernization

The NWR system is undergoing a modernization and restructuring that will make it an even larger player in the EAS than had first been thought. Part of the push for this modernization came on the heels of a 1994 Palm Sunday disaster in Alabama when lives were lost as a tornado wreaked havoc on a large area. Included in the destruction was a church filled with people attending services. In the aftermath of the tornado, Vice President Al Gore publicly responded to the lack of sufficient warning preceding the disaster by announcing the restructuring of the NWR system.

This restructuring includes expanding coverage and converting it to an "all-hazards" warning system. According to Ken Putkovich of the NWS, the number of NWR transmitters has since expanded from 390 to 420 nationwide, including five new stations nearing completion in Alabama.

The expansion has been funded largely by the private sector, mostly by electric cooperatives that provide varying levels of support, ranging from sites and towers for the new stations through complete purchases of entire transmission systems. Once ready for air, the cooperatives turn over control of the new stations to NWR.

Putkovich says that an additional 300 to 400 transmitters are still needed to reach a final goal of 95% population coverage across the country. In addition, contracts have been awarded for manufacture and purchase of SAME equipment with delivery and installation on all existing NWR stations by the end of 1996, just in time for the implementation of the new EAS.

The ultimate result of an ongoing NWS consolidation will be 120 weather forecast offices across the country, each equipped with new digital consoles capable of synthesizing voice from text into a broadcast emergency or advisory message. No longer will these stations be programmed with a stack of sequential cart decks.

Integrating EAS and NWR

The NWS is also forming partnerships with local, state and county emergency managers to complete the transformation to the "all-hazards" service. Situations like chemical spills, forest fires and many other emergencies will be added to the list of items triggering an NWR SAME alert. The NWR system will ultimately be capable of originating or relaying EAS-encoded messages as an integral part of the EAS web.

Beyond broadcasters, consumers will be direct benefactors of the NWR reconstruction. Weather radio receivers are becoming a standard feature in the American home. The next generation of weather radios will likely have SAME/EAS decoding capabilities. This means that consumers will no longer need to have a broadcast receiver turned on and tuned in to receive emergency messages. Likewise, a person will no longer be needlessly awakened for a situation two or three counties away. The properly programmed weather receiver will demute only when the emergency, be it weather-related or not, is relevant to the received location.

NWS partnerships will complete the transformation to an "all-hazards" service.

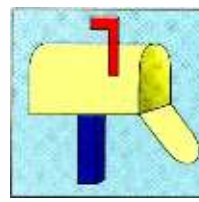
There is no mandated deadline on completion of this NWR restructure. Depending on the procurement of private funding, it may take years for all of the features discussed in this article to become a reality.

The beauty of the new EAS is its ability to evolve. Although the hardware infrastructure has to be in place by Jan. 1, 1997, elements like NWR integration can be added as new sites go on-line. Because such expansion is envisioned, it would be wise to order more monitoring inputs than you think you'll initially need when buying your EAS equipment. ■

Ken Putkovich of the National Weather Service can be reached at 301-713-1736.

Leonard Charles is an SBE board member and an engineer at WISC-TV in Madison, WI. He also chairs the SBE National EAS Committee.

The SBE has published a primer detailing the EAS and its operations. To obtain a copy, contact the SBE national office at 317-253-1640.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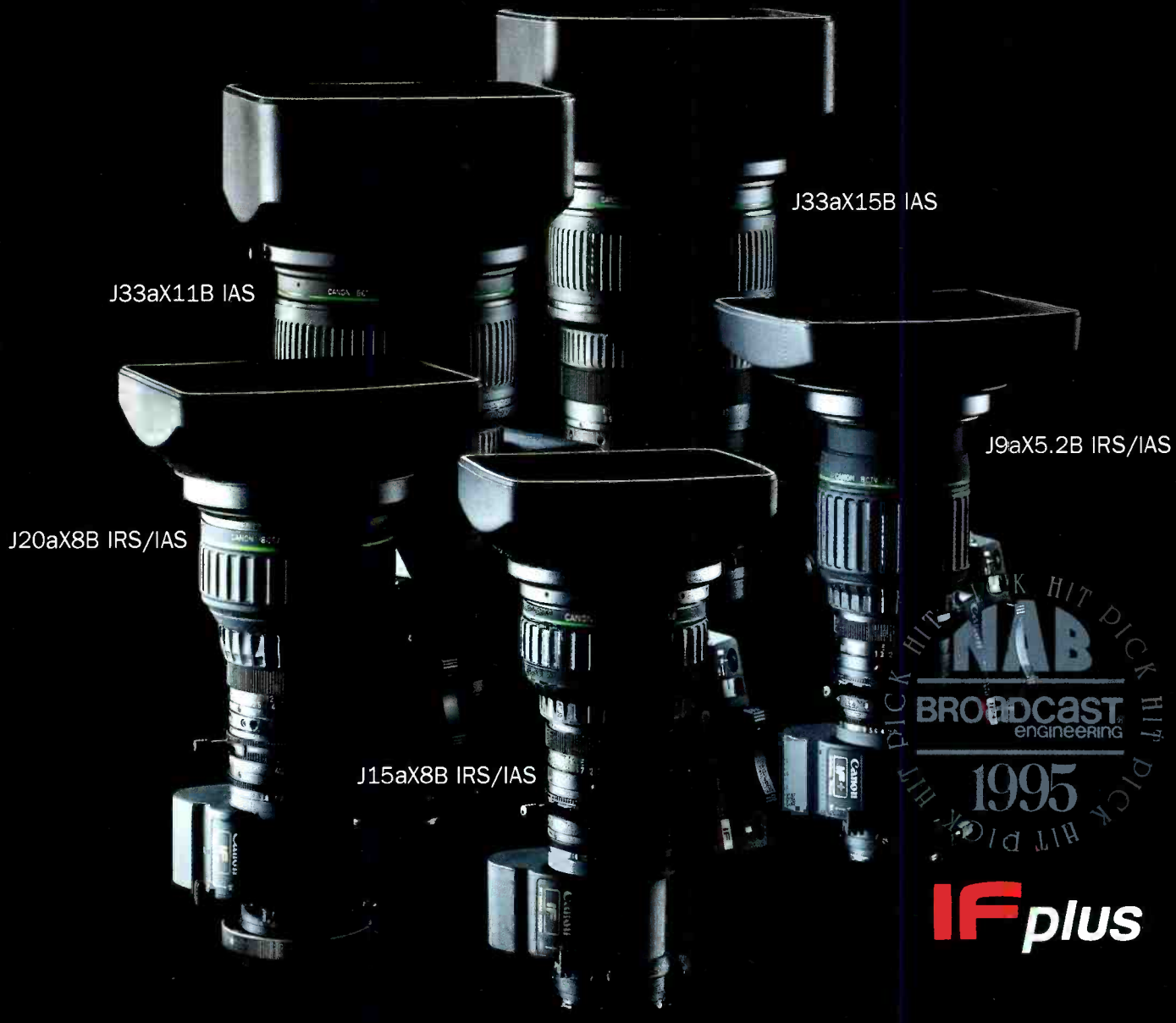

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The Number One Lens

Circle (14) on Action Card

By John Joannou

Choosing a systems integrator, part 2

Last month, we discussed the beginnings of converting to an all-digital facility. This month, we will look more closely at the systems integrator's role in that conversion.

Most people rely on word-of-mouth referrals when choosing their systems integrator. This carries a lot of weight and is a good start, but what worked for someone else may not work for you. The best way is to look at all of the variables. It does not matter whether the integrator is an individual or a large company, the same criteria apply. The object is to make sure the chosen integrator has the required knowledge, experience and resources to complete the project as specified within budget and on time.

Request for proposal (RFP)

Based on the project requirements, have the various integrators submit proposals that include the following:

- *Scope of work:* Full details of the work to be performed, as well as any work expressly excluded.
- *Time and cost:* The estimated time and cost for each function and stage of the project. The time schedule should be in the form of a Gantt chart (a chart that compares planned production vs. actual production).
- *Documentation:* A detailed list of documentation that will be supplied.
- *Project team:* A list of persons involved, from project manager and design engineers, to wiring crew members. Resumes with recent job information should be included for each person.
- *Subcontracting:* A list showing who is staff and who is subcontracted.
- *References:* A list of facilities that have been completed or are in progress that involve similar work.
- *Conceptual diagrams:* Consider asking for a basic video/audio block diagram showing how the integrators visualize the system. Be aware that normally you will be expected to pay for the time required to prepare the drawings.

Evaluating proposals

Once all of the proposals have been submitted, review them and pay special attention to the following:

- *Scope of work:* Make sure it meets your requirements.
- *Cost and time:* It is a competitive business and most quotations should be close to each other. If you find some quotes with cost and time values that are too low, check further. You may find that they either underestimated the scope of the work or have little relevant experience.

For the quotes that are too high, check to see how many other projects are under way by the same company. This is normally an indication that the company has more work than it can handle.

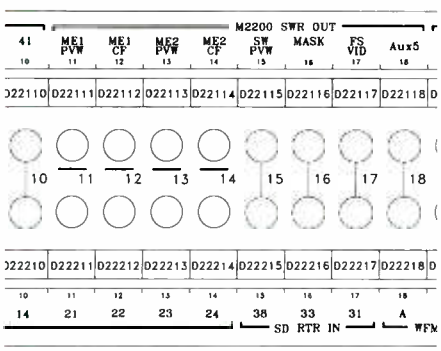
- *Documentation:* Pay special attention to the list of documentation that will be supplied. Once all is said and done, this documentation will be the only reference to your system wiring. Ask to see some samples of documentation prepared for others and look at the amount of detail contained within. (See Figure 1.)
- *Project team:* This is probably the most important part of the proposal. This is the team that will be responsible for putting your multimillion-dollar facility together. Check every resume for appropriate experience and verify all references.
- *Subcontracting:* Be wary of companies that have a number of staff engineers but are subcontracting a substantial part of your project; they may be too busy to take on additional work.

Most likely wiring will be subcontracted; 95% of all installations are put in by freelance wiremen. Wiring labor can have an immense impact on the project timeline, overall system integrity and reliability. Good wiremen are booked most of the time. Without some advance planning, you can end up with second best.

- *References:* Check as many of the references as possible. Don't just ask if they are happy with the work. Ask questions about the scope of the project. Was it completed on time and on budget? Were there any surprises, such as major omissions or large numbers of errors at the final checkout?
- *Conceptual diagrams:* Conceptual diagrams are a quick way to determine whether the integrator understands the application. Have your staff engineers or an independent consultant review the drawings.

Interviewing prospective candidates

Some integrators will be eliminated during the RFP stage. Have the ones that seem appropriate meet with you and your team. Request that they bring a portfolio of their work, i.e., facility and wiring pictures and sample drawings. Discuss how they arrived at the figures and what assumptions were



CABLE RUN LIST

CABLE		SOURCE			DESTINATION						
PRFX	NUM	FROM	CONN TYPE	LOC	TO	CONN TYPE	LOC	COMMENT	SIGNAL TYPE	CABLE LENGTH	CABLE TYPE
D	22111	2200C3J5 ME1 Pv	BNC	RK19	Patch 2-T	BNC	RK11	NON NORMALLED	270 Mbit	37	1694A
D	22112	2200 C11J1 ME1 C	BNC	RK19	Patch 2-T	BNC	RK11	NON NORMALLED	270 Mbit	37	1694A
D	22113	2200 C3J7 ME2 Pv	BNC	RK19	Patch 2-T	BNC	RK11	NON NORMALLED	270 Mbit	37	1694A
D	22114	2200 C11J3 ME2 C	BNC	RK19	Patch 2-T	BNC	RK11	NON NORMALLED	270 Mbit	37	1694A
D	22115	2200 C3J3 SW Pvw	BNC	RK19	Patch 2-T	BNC	RK11		270 Mbit	37	1694A
D	22116	2200 C3J1 Mask	BNC	RK19	Patch 2-T	BNC	RK11		270 Mbit	37	1694A
D	22117	2200 C11J13 FS Vi	BNC	RK19	Patch 2-T	BNC	RK11		270 Mbit	37	1694A
D	22211	Patch 2-B	BNC	RK11	2200 in-21	BNC	RK19	NON NORMALLED	270 Mbit	37	1694A
D	22212	Patch 2-B	BNC	RK11	2200 in-22	BNC	RK19	NON NORMALLED	270 Mbit	37	1694A
D	22213	Patch 2-B	BNC	RK11	2200 in-23	BNC	RK19	NON NORMALLED	270 Mbit	37	1694A
D	22214	Patch 2-B	BNC	RK11	2200 in-24	BNC	RK19	NON NORMALLED	270 Mbit	37	1694A
D	22215	Patch 2-B	BNC	RK11	7K SD in-38	BNC	RK10		270 Mbit	27	1694A
D	22216	Patch 2-B	BNC	RK11	7K SD in-33	BNC	RK10		270 Mbit	27	1694A
D	22217	Patch 2-B	BNC	RK11	7K SD in-31	BNC	RK10		270 Mbit	27	1694A

Figure 1. The drawing and table show a small portion of the patchbay documentation along with the appropriate section of the cable run list.

made during the proposal preparation. Give them a tour of the proposed facility location. It will soon become evident which ones are qualified to do the work based on the questions they ask and the information they offer.

It is important that the selected integrator has sufficient relevant experience in digital systems. A solid understanding of analog systems and good TV principles are the foundation of digital television. However, some new approaches need to be applied for digital. For example, in analog, the choice of cables and connectors is not as critical as in digital. Most analog systems were wired with 50Ω BNC connectors. In digital, however, cable choice and handling become an important part of the design process.

Timing

System timing is a subject of its own. Digital brings with it large auto-timing ranges. Many engineers make the mistake of ignoring timing considerations during design. In analog, fixed timing values are in the nanosecond range; in digital, auto-timing ranges are in microseconds and can exceed several horizontal lines.

Each piece of equipment needs to be closely studied to determine input and output timing ranges. Some switcher inputs are not auto-timed and need to be manually timed. Converters add to the complexity of timing as propagation delay can run in the several-lines range.

It is important that the selected integrator has sufficient relevant experience in digital systems.

A systems engineer that has not studied the timing requirements or does not fully understand the implications, can cost you several unnecessary frame synchronizers and frame delays. It is easy to say, "Just add a frame synchronizer." Throw enough frame delays and synchronizers and you can hide timing problems of just about any badly designed system.

Switching or embedding AES/EBU audio also has its own set of timing considerations. Add the different rates of digital audio, rate converters and router requirements and you end up with another subject of its own. Some manufacturers are still struggling with digital audio problems.

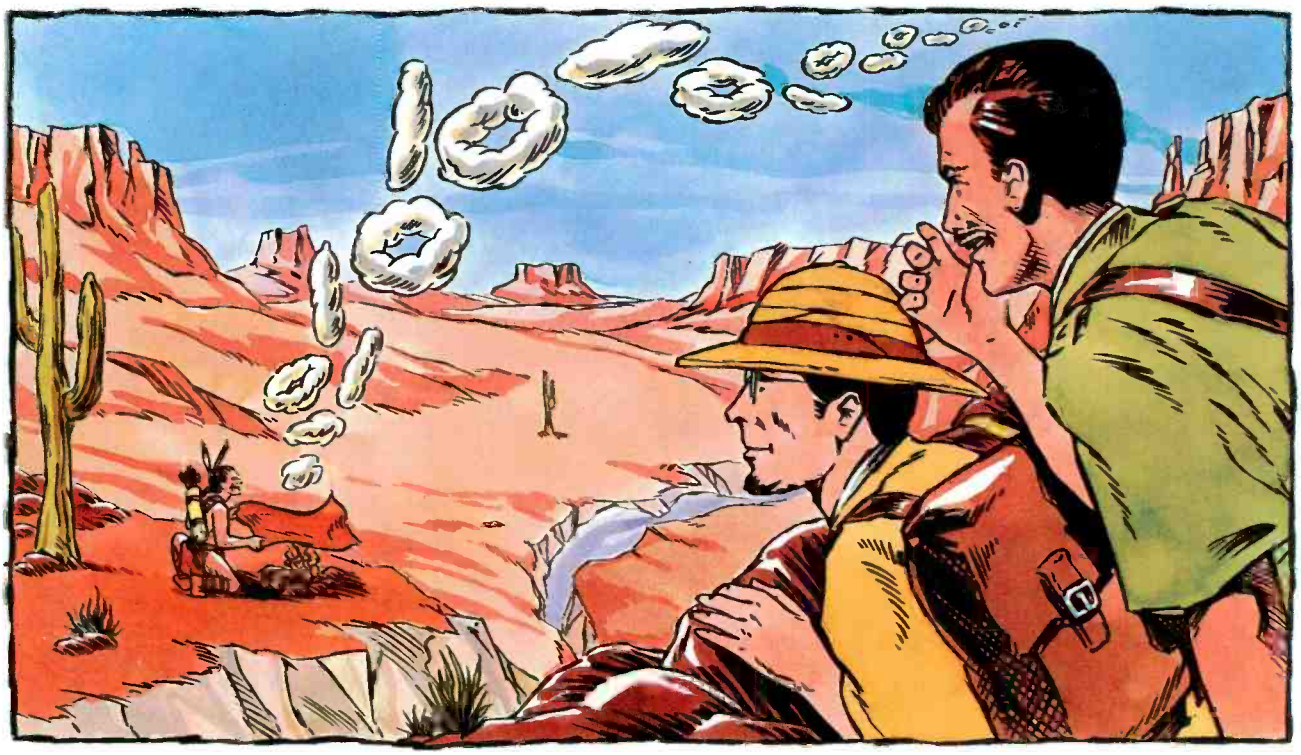
Router considerations, such as control system, tie-line and resource management, multiformat, multistandard, virtual matrix mapping and so on, need to be carefully studied. The tight communications control of production switchers with digital effects devices, routers and edit controllers have now become major deciding factors in the choice of equipment. The systems integrator you choose needs to understand how to make this technology work best for your application.

Expectations

Any conversion process has several phases, and the planning and decisions made affect subsequent phases. Here is a list of the basic expectations of the systems integrator's role during each phase.

<u>During equipment selection:</u>

- Inform as to which pieces integrate well together, such as switchers, DVEs and routers;
- Identify and bring to your attention equip-



"LOOK WILCOX, THE DIGITAL COMMUNICATIONS TREND IS CATCHING ON EVERYWHERE," WHISPERED SNELL.

ment needed but missing from the equipment list;
• Offer objective advice as to which equipment choices are best-suited for your application;
• Point out weak areas and make recommendations on redundancy and safeguards for key components along with methods of bypassing faulty equipment in emergency situations.

During design and installation:
• Design the system to meet the requirements;
• Include expansion requirements in the design future and allow rack space for future equipment and patchbays;
• Provide for proper equipment cooling as part of the rack layout;
• Allow for at least 25% headroom in the air-conditioning and electrical power requirements, over and above the planned future expansion;
• Anticipate future needs and allow for them in the design.

After installation:
• Perform a point-to-point checkout of all wiring and pinpoint and correct any errors;
• Set system timing;
• Check and set all video and audio levels;
• Provide a checkout sheet indicating signal levels of various paths;
• Verify proper operation of each piece of equipment;

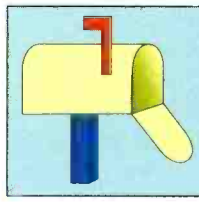
A systems engineer that has not studied the timing requirements or does not fully understand the implications, can cost you several unnecessary frame synchronizers and frame delays.

• Get together with various manufacturers in resolving any technical issues;
• Set up and configure major equipment, such as production switcher, router, digital effects devices, edit controller, intercom system, etc.;
• Provide technical assistance and system training to your technical staff;
• Assist with the transitioning of operations.

An integrator with operating knowledge of the equipment will be invaluable to operations during the startup phase. Many of the problems encountered, although apparently major, turn out to be setup errors or operational in nature. In the long term, your integrator needs to be available to support the technical staff with systems issues and training. This becomes especially important if staff members familiar with the system decide to move on.

Next month, we will look at what you should expect from a systems integrator, in terms of education and experience, as well as duties during and after the conversion process. ■

John Joannou is the owner of Teklogic Systems, a consulting firm based in Woodland Hills, CA.



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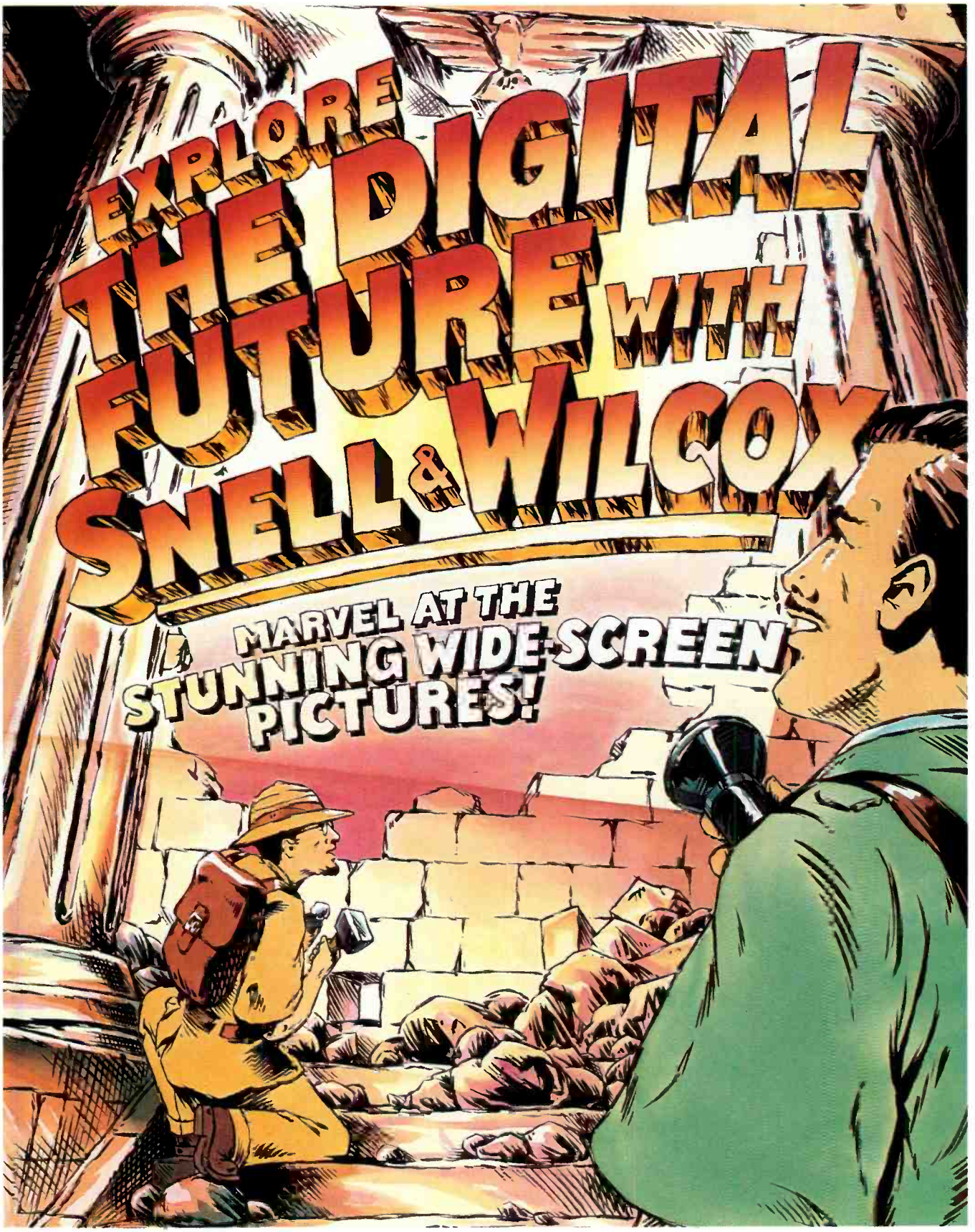

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Engineering with Vision

Circle (6) on Action Card

By Curtis Chan

Selling yourself

Whether you are dissatisfied with your job, have been laid off or have quit because of company politics, it's time to take stock of your career goals and your marketable skills. NAB is coming up, which can be a key networking opportunity for individuals on the move. Keeping your personal portfolio handy, assessing your marketable traits and abilities and developing solid references will significantly increase your chances for job advancement.

Overcoming barriers

First, let's overcome a common barrier that the most restrictive limits you face are those that you put on yourself. The lesson is simple in thought, but difficult in execution, "If you want to be a serious contender for a new career, don't put any limits on your thinking."

For instance, you might be bucking for a job upstairs, but only think of yourself as an engineer or maintenance technician. That thinking quickly limits your options. Instead, think about any experience you have had in a way that makes the experience and your skills more transferable.

The key is that if you don't have the right experience, then your knowledge can be your best asset. If you do have experience that falls within your target goals, then think about how your experience can be described in various business functions and duties. Use action verbs that describe how your work resulted in quantifiable achievements. Getting back to knowledge, don't overlook its importance. Many supervisors hire people based on an applicant's knowledge in a key area and accept the fact that they will need to learn the business.

Marketable traits

Another marketable trait is your personality. Whether or not you believe it, you are always selling yourself, in business or in your personal life. If you realize the importance of having a "marketable personality," then your chances of getting the gold ring are even better. Consider your leadership capabilities, problem-solving abilities, interpersonal skills, the ability to stay calm under pressure...all of which tell a strong story about yourself to others.

Those scaling the ladder show a deep interest and enthusiasm in what they do, i.e., *passion* and *attitude* balanced with a certain amount of calculated *risk*. Two quotes from the Corporate Impressions card company are for attitude and risk: "Attitude is a little something that makes a BIG difference," and "You can't discover new oceans unless you have the courage to lose sight of the shore...." Often, people get stuck in the bog because they lack these two opportunistic traits.

When opportunity knocks

Another marketable topic is *opportunity*. If you can make an employer aware of an opportunity that you can develop, or a problem that you can solve, you can probably create a job for yourself.

Another key is that the opportunity may be in a different field altogether. Think about how many engineers have evolved to become product managers, sales engineers, business development managers and even production personnel.

Industry networking

Monopolizing on your marketing traits comes through industry networking or sales (yourself) leveraging. The key is that positive references can make all of the difference in helping you move up the ladder. The first thing to remember is to choose references that can have a direct impact on your future, and make sure that your references understand your career goals. It does you no good if you are looking for that chief engineer's job, and when called, your reference only describes your technical ability, leaving out your leadership and managerial skills. In this lesson, like shopping, you need to choose wisely.

Whenever possible, use people with a prestigious title, who are respected, have an established influence level and whose judgments are valued by others. Above all, avoid using people that don't communicate well. Get permission from your references before using their names and consider their accessibility. It does you no good to have a great reference if your prospective employer can't reach them. Try getting at least three good references that can speak highly of your experience, knowledge, management traits and personality. For instance, if you want a senior-level position, you don't want your reference talking about how detailed and task-oriented you are.

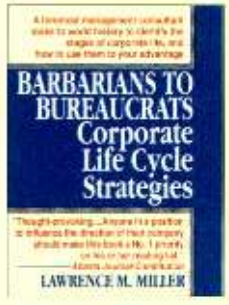
After you've chosen your references and have gained their approval, make sure that they know the full story about you. Time spent in this area will prove invaluable in the turbulent times ahead. Make sure that your references understand that you are not going to abuse that privilege. Simple insight into people should tell you that too much of a good thing can turn out bad after time. As an example, consider that you have been asked to be a reference for your co-worker. After several weeks and a dozen calls, even the most stout of human beings will start to wane and the level of sincerity and enthusiasm soon diminishes.

Keep your references up-to-date as to your career path and interests. Research has shown that for higher-level jobs, you need to make sure that your record can be traced back for at least three jobs or 10 years. Even if you have been fired, in most cases, people in business don't hold grudges long...they may be in the same boat one day.

As a last note, be prepared for the problem of bad references. If you are asked for a questionable reference, defuse the conversation by explaining why you might have had your differences, but be objective and unemotional...above all else, avoid being negative about that person. If you are paranoid, have a friend call that particular reference before your prospective employer calls them. If necessary, explain that their negative input is keeping you from attaining your goals or that they are making it hard for you to support your family. The worst case is to imply that you will have to seek a legal recourse if they persist. ■

Curtis Chan is president of Chan & Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton, CA.

The November 1995 "Management" column referred to different leadership styles referenced in Lawrence Miller's book "Barbarians to Bureaucrats: Corporate Life Cycle Strategies."



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By Kenneth Hunold

The audio impedance dilemma

The term *impedance* is probably the most misunderstood parameter in modern audio systems. Although some may think that the issue of standard operating levels is of greater concern, remember that impedance problems often masquerade as level problems.

One of the axioms learned early by engineers states that power transfer is maximized when source and load impedances are matched. In the RF domain, or in the long-line world of telco circuits, maximum power transfer is important, so impedance matching is the rule. But the lower powers and relatively narrow bandwidths of most intrafacility analog audio interconnections create a different environment.

Full understanding of this difference has been slow to unfold. Proper practice in dealing with impedance for audio circuit interfacing has evolved over time, and much of the information today's engineers hold dear on the subject may now have more historical significance than technical merit. Within a given facility, several generations of differing impedance standards may exist, causing occasional level and/or frequency-response problems throughout the operation.

Within a given facility, several generations of differing impedance standards may exist.

Sorting things out

In the analog days, telco used balanced, true 600Ω circuits for its transmissions between switching facilities, usually terminated by transformers. The impedance of these transformers matched the impedance of the circuit in order to reduce reflections and standing waves — important because these circuits were often an appreciable portion of the signal's wavelength.

Yet, most audio lines in broadcast facilities are less than one-tenth of a wavelength at audio frequencies, so most audio circuits do not behave like transmission lines at all, but instead act like simple, point-to-point interconnections. Therefore, telco's power-matching criterion does not apply. Remember also that the telco standard was set when all amplifiers were tube-based. Today's nearly ubiquitous solid-state technology allows more flexibility in circuit I/O design.

These variations have created an environment for at least the last 30 years in which there has been no industry-wide agreement on impedance for intrafacility audio-circuit interfacing. But in the last decade or so, a more sensible approach has emerged in which impedance-matching for analog audio interfacing is eliminated.

Voltage sourcing

This method, called *voltage sourcing*, treats audio outputs as voltage sources rather than power sources. Consider a hypothetical DA with an adjustable input impedance. If you change its input impedance from 600Ω to 10kΩ, the DA will "bridge" an incoming line. (*Bridging* is generally defined as a condition in which an input's impedance is 10 or more times higher than the source impedance of the output feeding it.) This means that little or no current is drawn from the source by the DA, which implies that there is little voltage drop across the source's output. Therefore, the output voltage of the source stays nearly constant.

Using this approach, *termination* (which is defined as the load that drops an output meter by 6dB when applied) is never encountered. Low impedance (lo-Z) outputs feed high-impedance (hi-Z) inputs. Many devices can be fed directly by the same source without "loading down" its output, as long as the combined impedance of all the inputs does not fall much below 10 times the output's source impedance.

Looking at the output side of the hypothetical DA, reducing the output impedance of the DA also has many advantages. First, the output impedance of the semiconductor devices used in a DA is low to begin with — typically <10Ω. Second, most cable used in audio circuits does *not* have a characteristic impedance of 600Ω, but more typically 50Ω to 100Ω. So, even if you really did want to match impedances to your DA, 600Ω would be a poor choice for the cable available. Lowering the output impedance of the DA to around 60Ω would better match the cable, but also offer other benefits.

For example, because a 600Ω input impedance is the lowest that is likely to be encountered, taking the DA's output impedance down to 60Ω means that *any* device will present a bridging load to the DA.

Lowering the output impedance also greatly increases the length of cable that can be driven with full fidelity. The DA output impedance and the capacitance of the cable form a low-pass filter. Lowering the resistance portion of this network raises the cutoff frequency of the R-C network. To complete this capability, however, the DA's output-driver devices must be able to supply enough current to feed the capacitance of the cable at high frequencies or distortion will result.

Changing the reference

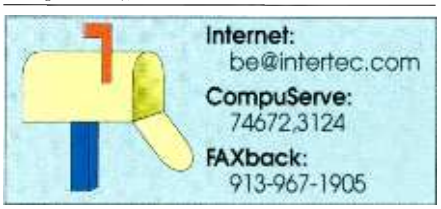
Because audio circuits are now being bridged rather than terminated into 600Ω, the dBm unit is, strictly speaking, no longer applicable. Recall that the 0dBm reference is defined as 1mW unit of *power*. Across a 600Ω load, 1mW develops a voltage of 0.775V, but with a different or variable impedance, a 1mW reference would produce different voltages.

In the new voltage-sourced system, the reference *voltage* is more critical, of course, so the term dBu (*decibels-unterminated*) has been introduced. It is a voltage-referenced, impedance-independent unit, with 0dBu = 0.775V. Using this voltage as a reference makes the transition to the dBu scale easy, because only the power-referenced derivation of the dBm is changed. The same voltage level that 0dBm produced into 600Ω is retained as a reference, so voltage-sensing level meters (like VUs and PPMs) remain unaffected by the change.

None of this does anything to clear up the ambiguity of the term "0dB" (without any suffix), however. Is your "0" really 0dBu? +4dBu? +8dBu? Or is it dBm? At least you won't have different voltage levels when you connect your new hi-Z DAs across circuits with different operating impedances.

Does all of this talk of differing levels and impedances make you hope for a speedy transition to digital audio? Will all of these problems go away in the digital domain? Don't answer yet. The April 1996 issue will cover the difficulties of interfacing *digital* audio signals — so stay tuned. ■

Kenneth Hunold is audio/video project engineer at the ABC Engineering Laboratory, New York.



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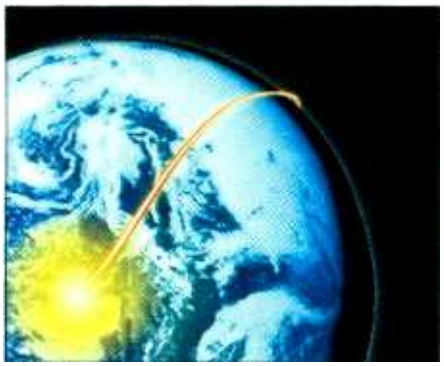
Circle (8) on Action Card

By Steven Blumenfeld and Mark Dillon

Web browsers — what's out there



The "web browser" has become the super-hot software product du jour. If you don't have one on your computer, well, you've probably encountered the raised-eyebrows-in-disbelief that such a public admission can generate. If you're about to acquire a web browser for yourself or your enterprise (or even if you already have one), there are some things to know about today's browsers and where they may be taking us.

FAQs

At the end of the day, browsers are just software, so they should be subject to the same user criteria as most other applications:

- Does it do what I want at a reasonable price?
- Is it reliable?
- Is it compatible with the other users' hardware, software and data in my immediate work group?

Unfortunately, for this line of thinking, the task for which browsers were intended — roaming the Internet — is rapidly changing. But, to begin with, here are answers (or pointers to answers) to frequently asked browser questions.

1. *What are the most popular browsers?*

Netscape is used on approximately 75% of the world's clients, Mosaic on 15% and the remaining 10% is shared by approximately 25 other browsers. (For more details, visit: http://www.cen.uiuc.edu/bstats/latest.html.)

2. *What browsers are available for my operating system?*

Most browsers work on Windows, although there are quite a few for Macs and Unix. If you've got an Amiga or other platform, go check these sites: http://www.uark.edu:80/studorg/wrg/public_html/ or http://152.1.24.177/teaching/manuscript/0400-0-macintosh-browsers.html

3. *What features do these browsers have?*

This is a constantly moving target. For its present location, try these sites: http://www.pcmag.ziff.com/~pcmag/1403/03web_hi.htm#reviews and http://www.browserwatch.com/.

"Does it do what I want at a reasonable price?"

This hyperevolution of product versions has distorted the market experience. Most browsers are free for the downloading off of the net. In what seems like a state of "perpetual beta," most of these versions expire every few months and must be replaced with the next beta version.

As beta software, they are not supported in the traditional sense except as upgraded in the next free (and still not fully supported) beta copy. In the case of Netscape's Mozilla browser, official release copies with traditional support are available for sale. However, this process creates a conundrum — the product that you buy is less powerful than the free just-released beta version. You choose: Old and costly or new and free?

There have been two configuration models for Internet access software. The first is a mix-and-match component approach to E-mail, web browsing, FTP and Internet chat. You, the client, select different applications to perform different functions, say Mosaic for web browsing, Eudora for E-mail, Newswatcher for newsgroups, etc.

Increasingly, we are being moved to integrated or "suite" applications. Netscape now contains full E-mail management and a news viewer, enabling users to surf the web, check their mail and subscribe to newsgroups all from the same application.

Other developers, like Netcom (http://www.netcom.com/netcom/netcrz.html), have been providing highly integrated products for some time. Such integration must overcome the skepticism of mix-and-matchers that the functionality of each component is as complete as their favorite dedicated newsgroup reader or E-mail program.

A more intriguing role to integration is being taken by Apple (with Cyberdog, see: http://www.ziff.com/~macuser/mu_0895/news2.html) and Microsoft with Internet Explorer (http://www.microsoft.com/windows/ie/iexplorer.html). Boot up Internet Explorer and you'll immediately feel comfortable with the Word/Excel interface. In fact, Explorer will launch these other programs when their functionality is required — like Word to write an E-mail message. Each of these rely upon OLE or Open Doc protocols, which allow applications to freely share data within and among themselves.

"Is it reliable?"

The reliability of a browser depends less upon its internal flakiness than on how well it accepts the rapidly emerging new feature of HTML. Basic hypertext capabilities are no longer sufficient — it is the multimedia power of the web that has made its growth so explosive. So, to stretch the capability of HTML to include images, graphics, audio files, rigid page layouts, even video, new standards have been developed that allow for additional data types.

Since Netscape has taken the lead in increasing the HTML functionality, its latest browser version is likely the most robust because Netscape was probably involved in developing the upgrades. Regardless, other browser developers are quick to incorporate most recent HTML innovations — and come up with a few of their own. Mosaic and Internet Explorer are both in the same league as Netscape.

"Is it compatible with the other users in my immediate work group?"

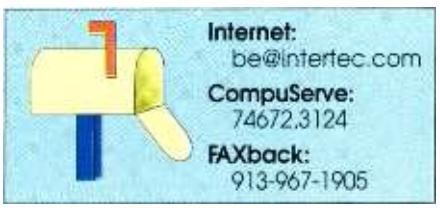
Acquiring software for a single PC is not the same as distributing it through a network and supporting the users at those workstations. A web browser, like any piece of software, must conform to the rigors of the network distribution and end-user support.

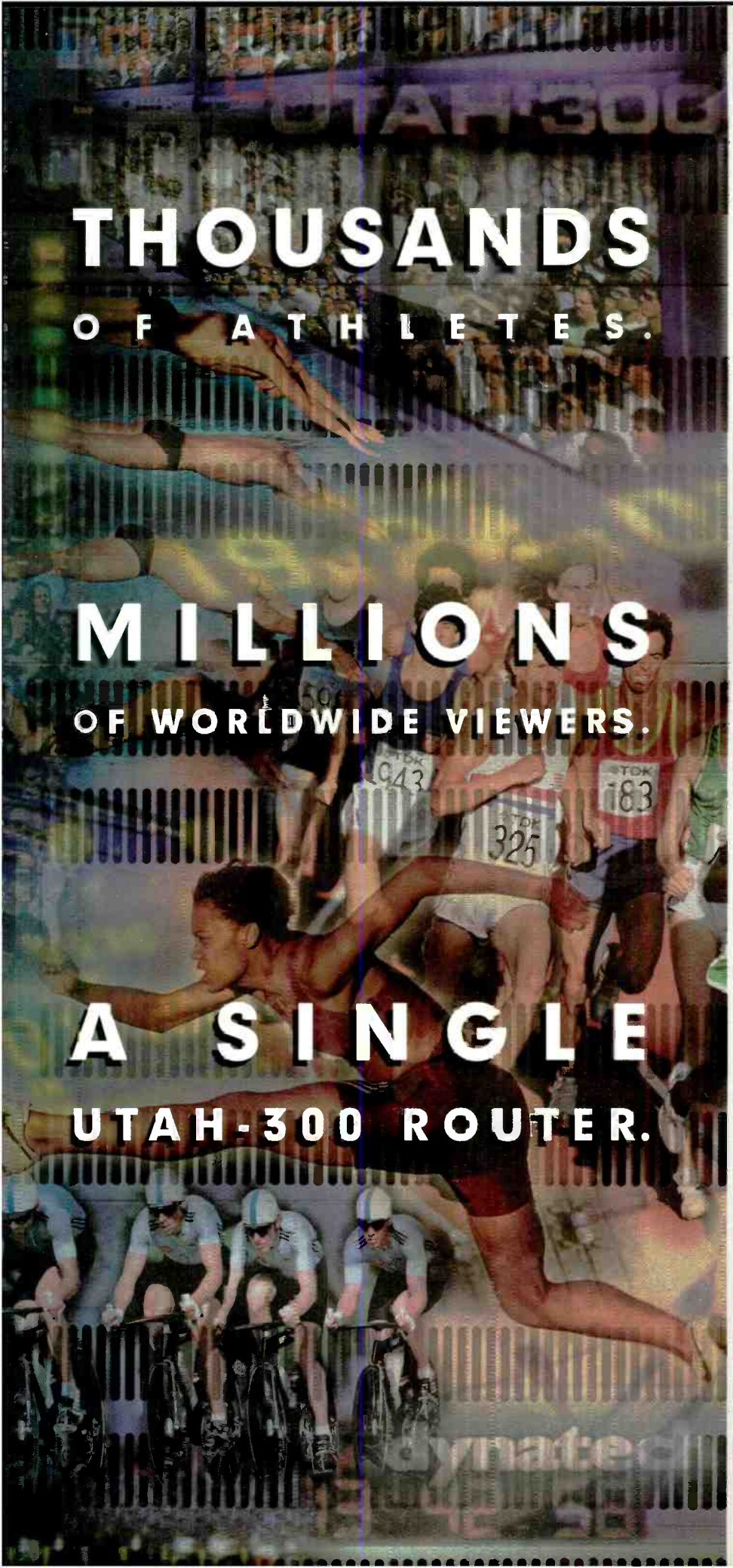
After choosing a browser that fits your style — the icons are pretty, the keyboard function keys make sense, the features include the ability to get to your mail/newsgroups and it supports advanced functions (VRML, Java, etc.) — next you have to figure out how to install it on all of those different machines in your shop. Here are a few check-list items that can help.

- Is it network installable?
- Does it come on a CD-ROM?
- Does it have an installer?
- Do you have to supply all of the helper applications?
- Do you need to install all of the items separately?
- How many diskettes does it come on?

The most important thing in doing a facility-wide software installation/upgrade is to develop a plan and share it with all of your users. You would not rebuild your studios without first having detailed drawings and letting everyone know what's going on, would you? ■

Steven Blumenfeld is vice president of technology and studio operations and Mark Dillon is director of on-line services with GTE, Carlsbad, CA.





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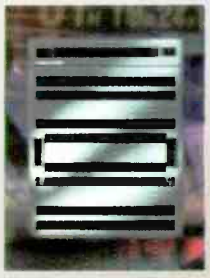

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By Louis Libin

The ATV broadcast antenna

The groundwork must soon be laid for chief engineers to design an effective and efficient advanced TV (ATV) station. In a short time, the FCC will set the standard for the new ATV broadcast service.

The commission will assign each of the approximately 1,700 TV stations a new channel for ATV. In all probability, the new channel will be paired with the current NTSC channel and the vast majority of the new ATV assignments will be in the UHF band. Each NTSC station will be assigned a new ATV channel with a specific numeric value. Early tests have confirmed that ATV will outperform NTSC transmission, and we now know that ATV can deliver HDTV-quality pictures into the fringe areas of NTSC and do it with lower transmitter power.

The antenna question

There are still additional questions concerning the transmission planning aspects for ATV service for the United States. One of the least common, but important, questions concerns the type of broadcast antenna that each station will require. It is an important question because, in some cases, you must plan now for its installation. If the antenna and transmission line are of significant weight or require much additional space for installation, the necessary planning and preparation could pose a significant delay in implementation of the station's ATV service.

Design of the ATV antenna

There will be many different antenna configurations for the ATV broadcast antennas and antenna systems. The spectrum requirements alone determine that antennas will be different, because the spectrum allotted for TV broadcasting varies over an extremely wide frequency range. From the lower end of Channel 2 (54-60MHz) to the upper end of Channel 69 (800MHz-806MHz), the variation in frequency is nearly 15 to 1. The current TV broadcast channels occupy four non-contiguous bands. The center channel wavelengths vary from 5.3 meters (209 inches) at Channel 2 to 0.37 meters (14 inches) at Channel 69. The propagation disparities between the different channel groups is easily seen. Channels 2-6 require signal strengths in the 20-30 microvolt per meter (μV/m) range. For Channels 7-13, the requirement is around 60μV/m, and for UHF it varies from 120 to 200μV/m.

The following is more important to us because we will soon be exclusively occupying the UHF band: For a given effective radiated power (ERP), the low-band VHF channels produce a usable NTSC TV picture at much greater distances than UHF channels. This will have an impact on ATV powers and antenna dimensions as well. For the "old" NTSC rules, the antenna height above average terrain (HAAT) was limited to 2,000 feet — except that in the heavily populated northeastern portion of the country termed Zone I, HAAT for the VHF channels was limited to 1,000 feet. This is particularly significant because on existing towers, the ATV antennas will be mounted below the NTSC antennas.

CHECK LIST	STATION ISSUES
History: station, market and tower	What are the past and current station contour populations? How did the station come to be on a multiplexed antenna or candelabra? What were the original competitive issues and original design criteria?
Real estate analysis	Where will the new antenna be placed? Will it be co-located with the NTSC antenna? Will the antenna be stand-alone or part of an antenna farm?
Tower inspection	Has a thorough inspection been made of the tower? Has tower aging and general maintenance been studied? Have tower positions been logged?
Tower loading stress analysis	Has wind loading been analyzed? Has occupance been determined? Has an individual member stress analysis been done?
Antenna choices	Have power requirements and desired coverage been determined? Has the station decided on specific antenna design? Polarization? Side mounted, top or wrap-around?
Pattern design	Have the population counts and coverage contours been verified? Have multiple options been outlined?
Cost analysis	What will the transmission system cost, component by component? Have the transmitter, transmission line, antenna, tower modifications, planning and installation costs been determined? Have multiple scenarios been studied for feasibility?

Table 1. The chief engineer's check list for what is needed for the new ATV antenna.

The transmitted signal

A minimum signal strength is needed for ATV reception. The ATV signal is digital. This means that the picture and sound information is encoded into a datastream of binary numbers. As long as there is sufficient signal strength for the decoder to decode digital data, a perfect picture will result. If the signal strength falls below that level, the system crashes and no reception is possible. There is no gradual deterioration of picture quality with increasing distance from the transmitter, as is the case with NTSC. Power measurements for ATV are based on average transmitter power, while measurements for NTSC are based on peak power. However, ATV signals can produce random peaks 6dB, or four times the average power. In order to handle an average ATV signal power of 100kW, a transmitter with a peak power rating of 400kW must be employed.

What is needed for the ATV antenna?

New antennas for transmitting ATV may not be that different from current NTSC antennas. Certainly, there will be modifications and enhancements; but in general, the ATV antenna of tomorrow will look similar to today's NTSC antenna. However, there are many technical issues that need to be resolved prior to going "on-air" with ATV. (See Table 1.)

Responsible engineering dictates that now is the time to begin the planning and preparation phase of ATV transmission facilities. Each ATV transmission facility will be as different as today's NTSC facilities. One broadcaster may have a tower with light loading and space for a new antenna. Another broadcaster may have an older tower with no room to expand. Others may share a multiplexed arrangement or a candelabra facility on a loaded tower. The solutions for each of these situations will be different, but the end result will be the same — ON-AIR with the digital channel. ■

Louis Libin is director of technology for NBC, New York.

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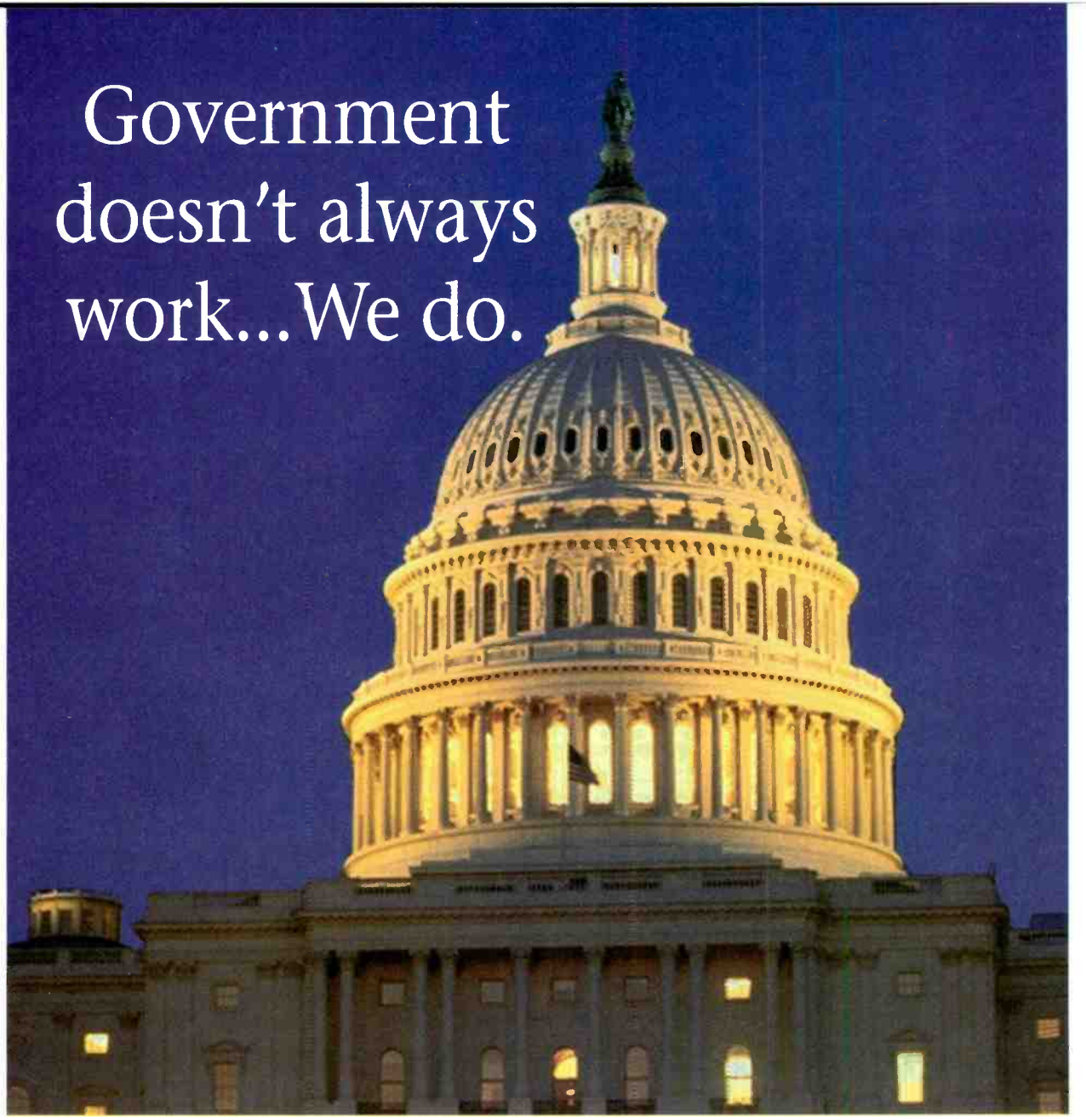

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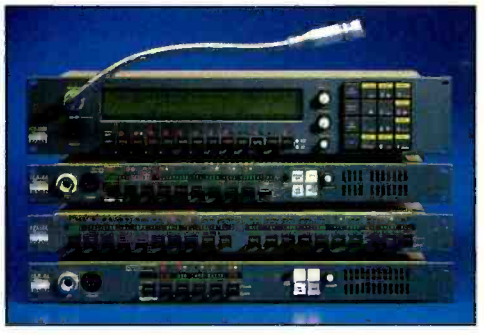

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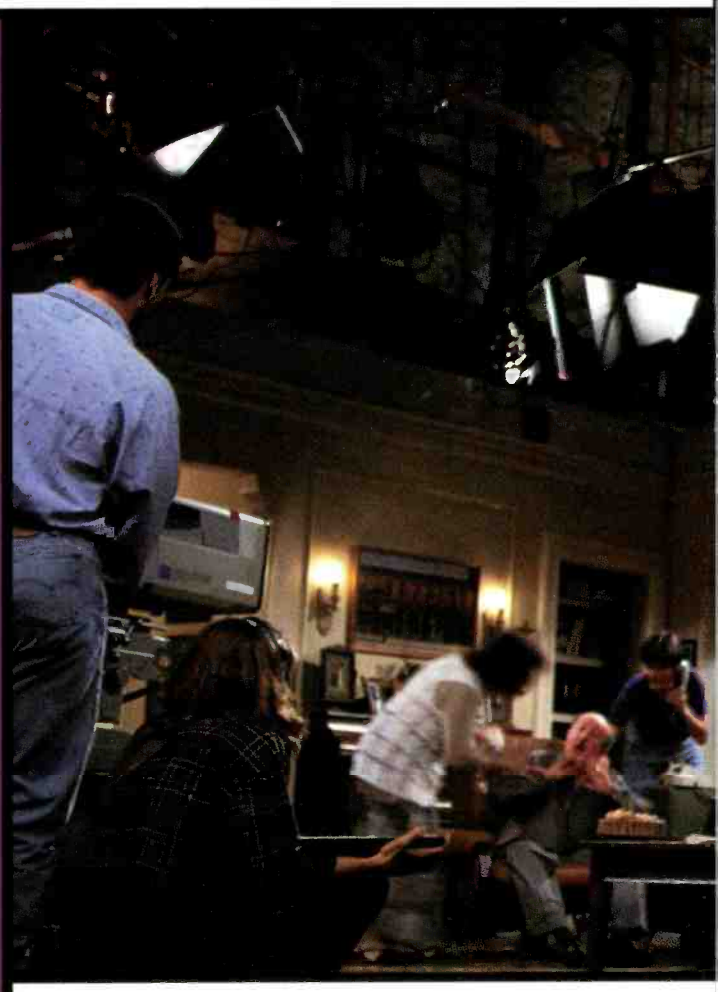

Given the popularity of the BVP-700/750, which set a new standard in high-end studio and field production, we figured it was time for a sequel. Presenting the BVP-500/550: cost-effective cameras that spin off the advantages of Digital Signal Processing into a wide variety of new applications. But here's the real crowd-pleaser.

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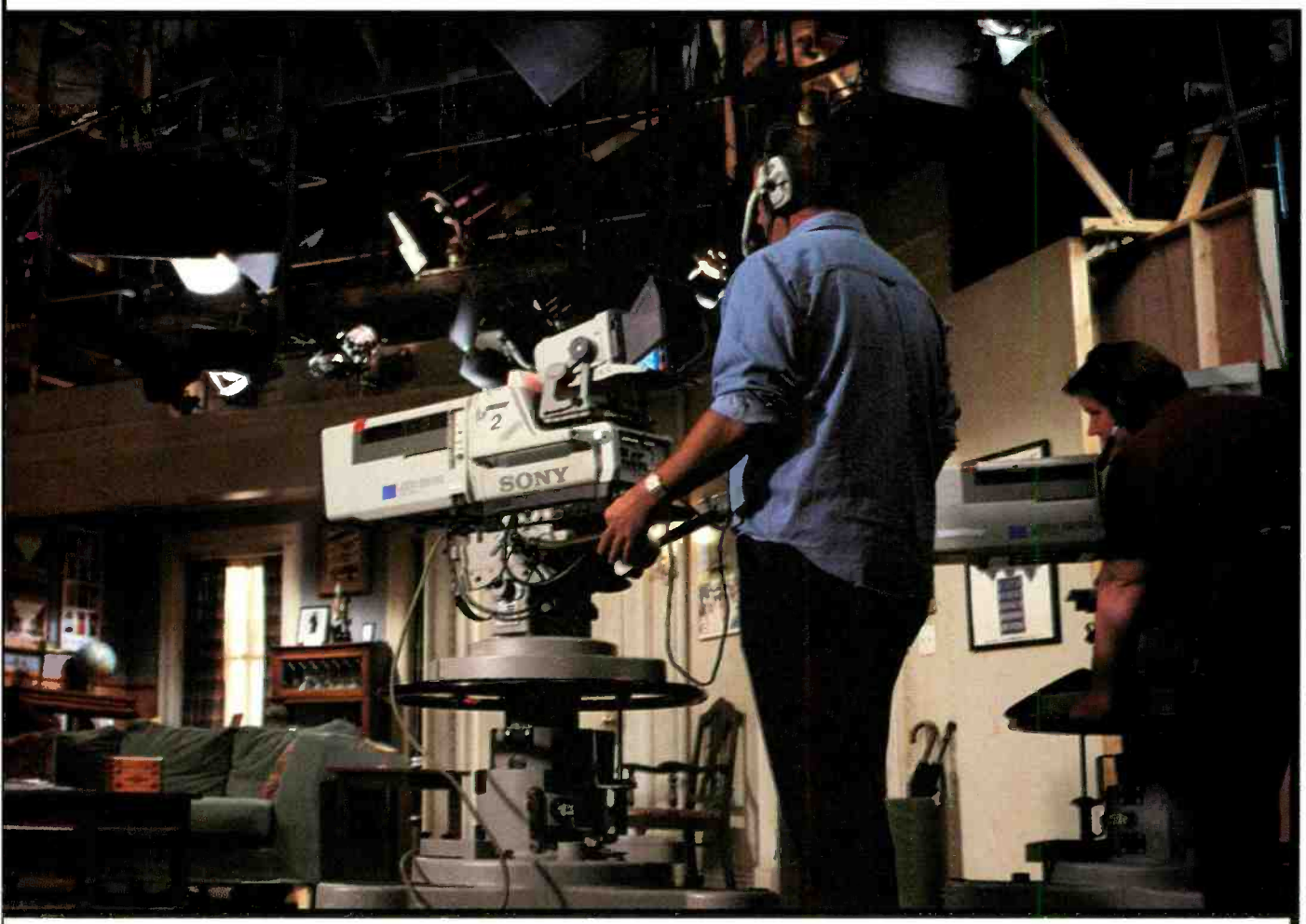

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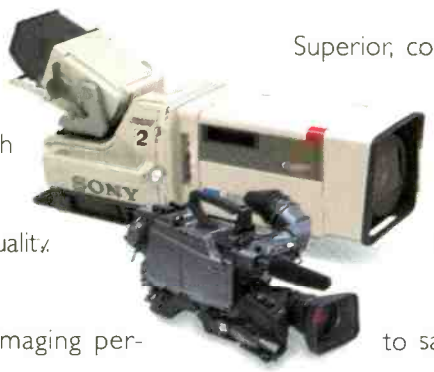

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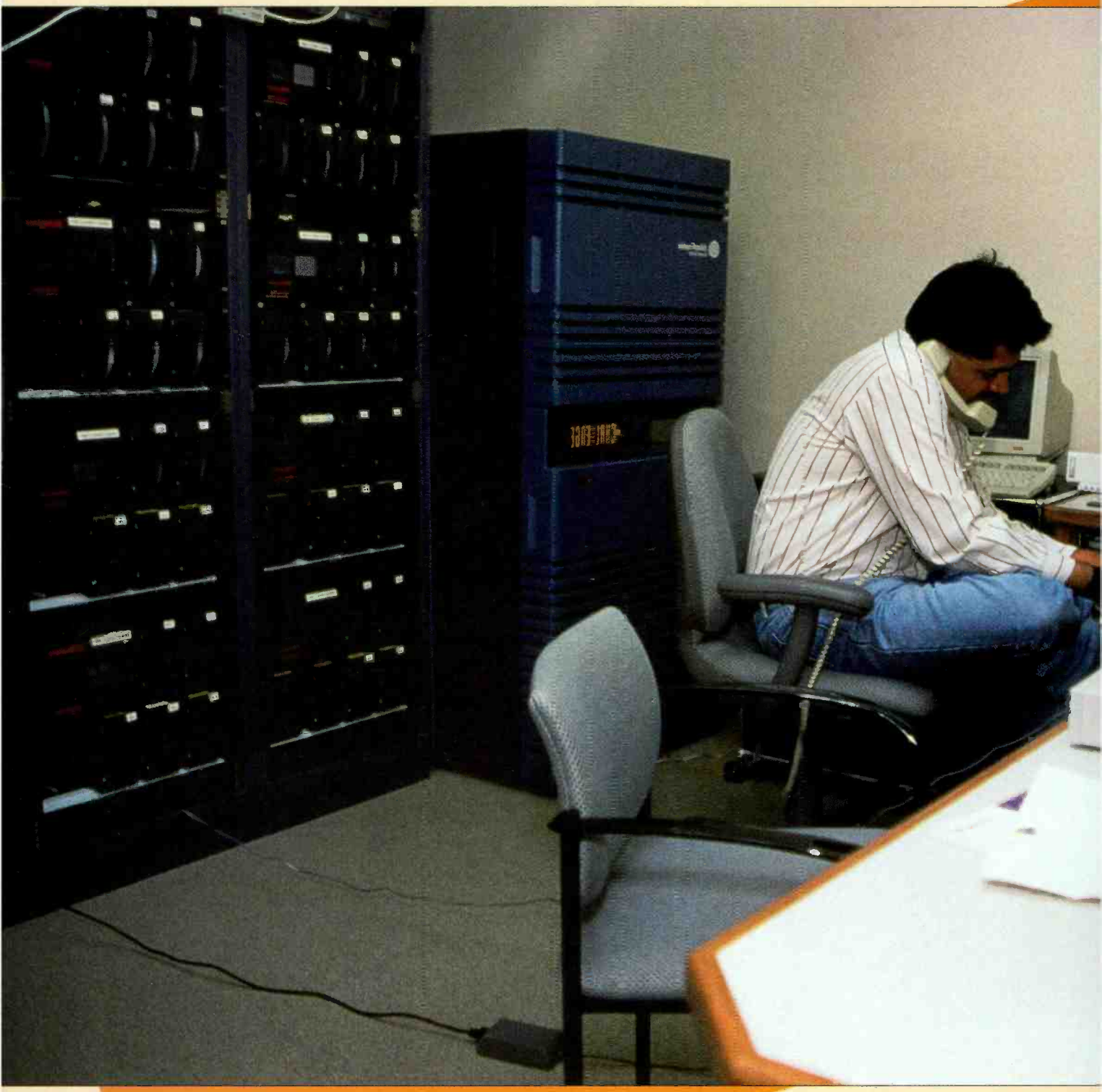


NorthWest Cable News (Seattle) producer at work in the "Avid MediaServer" room. Featured in the background are the SGI Challenge Series server and the Megadrive storage used by the Avid MediaServe- production system, as well as a server control monitor and an Avid NewsView newsroom computer system. (Photo courtesy of Avid.)

By Philip J. Hejtmanek

Video servers

When it comes to video servers, one size doesn't fit all.

The Bottom Line:

Video servers have become the darling child of the broadcast and post-production industries. While some manufacturers claim that servers have eliminated the need for tape and that they solve almost every type of storage application from play out to graphics, the truth is somewhat less ambitious. Although video servers offer many advantages, selecting the design best-suited to your application involves much more than writing specs and taking bids. First, you must know just what your needs are — then, how each system meets those needs. $

It is no surprise that many terms used in the computer industry are becoming common in the lexicon of the TV video engineer. With the conversion from analog to digital comes the requirement that today's video systems designers be familiar with the terminology and architecture of networked computer systems, in addition to those of traditional analog video.

The computer industry has written about the use of servers, but it's only been in the last couple of years that serious video applications have become common. The term *server* comes from the notion of a *client-server* relationship in a computer network.

The *client* is typically represented on the network by a single user workstation. The *server*, on the other hand, is a system that provides organized mass storage of data and/or application programs to be used by one or more of the clients connected to the network.

The actual architecture or design of the video server is dictated by the applications for which it is intended and the specific types of mass storage devices employed. A given basic server design can often be 'tweaked' to maximize its performance for a variety of applications. For instance, the I/O speed and bandwidth needed for a PPV application is quite different from what's needed for a broadcast on-air playback server. In all cases, video encoding/compression techniques, data transfer rate, capacity and reliability are key elements in the overall success with which the server meets the needs of the applications.

The most common application for servers in the broadcast TV environment is for on-air playback and record. A second-level application typically involves the storage and playback of video clips to be assembled into news stories or features. Because of storage cost, few stations rely on servers for program-length material storage or play out.

Editing systems also rely on server technology, and the applications vary widely. For many editing systems, the video disk recorder (VDR) provides sufficient storage capacity. Massive storage capacity is seldom needed in a desktop editing system. However, as facilities build local networks, the concept of a central server becomes not only possible, but in many applications, desirable.

Some broadcasters and most cable applications require that the server provide multiple program outputs for pay-per-view or near-video-on-demand (NVOD). Keep in mind that the performance characteristics for a PPV or NVOD application are different than for a graphics or on-air playback system. When it comes to video servers, one size doesn't fit all.

Engineers need to be aware of the choices in the marketplace in order to select the video server most appropriate to the application at hand. Not every engineer will have the option of building a new digital facility from the ground up, so the ability of the

server to interface easily with an existing computer network, automation system or facility signal distribution backbone, may be paramount in the selection process.

Critical factors in video server design

The earliest broadcast TV video servers were really analog quad videotape spot players developed in the 1970s. While the early Ampex ACR and RCA TCR systems were limited in storage capacity and were mechanical maintenance nightmares, they provided a level of on-air automation never before available. These early systems soon gave way to more-sophisticated devices that centered on multiple record/playback drives and robotics for cassette handling.

About the same time digital tape formats became popular, hard-disk technology began to offer enticing features for on-air applications. Soon, HD storage was common for editing applications. Although the early products offered rapid access to any point in a recording, they often suffered from limited storage capacity — and quality was always of concern.

Modern systems

Many on-air automation systems are actually a marriage of the two technologies, with tape drives used for long-time archival mass storage and the hard-disk devices used as a cache for rapid random access to a limited amount of frequently used video information.

The SGI Challenge Series server and Megadrive storage used by the MediaServer at North West Cable News. It is designed to increase production speed, efficiency and reliability by providing shared, simultaneous access to a library of disk-based media. (Photo courtesy of Avid.)

Reliability of the video storage subsystem becomes an important feature and depends largely upon the individual reliability of the components used to implement the server. Disk-drive MTBF figures have been increasing, but individual disk units still have a rated component life span (and also warranty coverage) of about five years. Additional reliability is gained by configuring groups of disk drives into redundant array of independent disks (RAID) arrays, which add error correction and the ability to swap out a defective disk drive from the array without loss of video information.

Optical and tape-based servers

We typically think of server technology as being based on HD technology, but that needn't be the case. Optical storage can provide many of the same benefits of HD storage, often at a lower cost per minute of storage.

Optical disk drives offer high reliability, high media bit density and few moving parts. However, the media elements are typically write once, read many (WORM) disks and that may preclude their use in some applications that require frequent revision of the video.

Digital videotape storage subsystems provide the lowest media cost, but have the highest maintenance requirement for reliable operation. Robotic media handlers for tape or optical disks, though relatively reliable, can also require significant maintenance effort. All of these factors can make the selection of a server difficult.

Storage and control

Storage system bandwidth and bit-rate re-

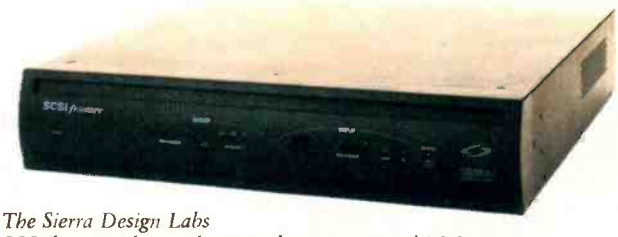
Sierra Design Labs SCSI framer

By Philip J. Hejtmanek

The Sierra Design Labs SCSI framer is a unique video server solution for the post-production and animation/effects market. In combination with the Quick-Frame high-capacity digital disk recorders, the SCSI framer provides concurrent access to uncompressed component disk storage for up to eight workstations.

The SCSI framer provides uncompressed 4:2:2 component video and AES/EBU digital audio to multiple video workstations in a star topology extending up to 90 feet with copper cabling or 2km over fiber. Using a workstation's standard or fast SCSI ports, the SCSI framer can serve up to 15 frames per second on a single port or 30 frames per second aggregate on multiple ports simultaneously.

Up to eight users in separate suites working on SGI, HP, Macintosh or other workstations can tap into one or more 3-to 48-minute high-capacity digital disk recorders at the same time. The system features either two or four fast/wide SCSI ports, a full-bandwidth CCIR-601 frame buffer for each SCSI port, built-in component analog and composite analog video outputs and a multi-SCSI striping mode for real-time CCIR-601 performance. ■



The Sierra Design Labs SCSI framer is designed to provide uncompressed 4:2:2 component video and stereo AES/EBU audio to multiple workstations.

we can think of a thousand uses for tape.

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duction techniques are also important features in a video server. Uncompressed serial 4:2:2 10-bit video requires 270Mb/s (or almost 34MB/s) of continuous data flow. This is currently faster than a single hard-disk drive can deliver, so a variety of techniques must be used to achieve that data rate.

One frequently used solution is to distribute or stripe the video data files among an array of individual storage subsystems using multiple internal SCSI buses and disk arrays. This technique speeds up the total data rate of the storage unit.

The use of bit-rate reduction techniques (MPEG, JPEG and others) also can greatly reduce the system bandwidth needed to achieve the desired quality and capacity of video storage. (See box at right.)

Some optical and hard-disk server systems offer a choice of compression algorithms allowing the user to tailor the storage requirements of the system to a specific application or desired video quality level. However, the laws of physics still apply and you don't get something for nothing. The trade-off is usually image integrity for system storage capacity.

The computer industry has written about the use of servers, but it's only been in the last couple of years that serious video applications have become common.

Systems integration and control is another important consideration. Most servers are controlled by external devices via an RS-422 or Ethernet port. These protocols are also used to link the internal system control computer to individual storage units, video data routers and I/O subsystems.

However, broadcast-quality video typically requires digital bandwidth much greater than the 10Mb/s that Ethernet can deliver. This usually requires a higher-speed data interchange technology, such as SCSI, FDDI or ATM, to internally move the video file data between storage subsystems and I/O units. Although 100BaseT or fast Ethernet (100Mbp/s) is available, it's not yet widely used for servers.

Actual system control of a server generally involves the use of a reliable multitasking operating system, such as UNIX. The I/O subsystems handle the input and output of video (and audio) with respect to the server and usually any compression techniques present in the server are applied at this stage.

Depending upon the target application, the server may interface to external equipment via serial digital, analog component or analog composite video. In the case of servers designed to function in the total digital studio environment, the server I/O may use FDDI, ATM or some other high-bandwidth network data standard. Most servers can be configured to provide one type of I/O now and be changed to another in the future. This means that you can implement an analog interface today and modify it to serial digital later if needed. Because this may not be an inexpensive option, check it out with your prospective vendors.

Networked systems

It is important to remember that the orderly storage and retrieval of video program material usually requires more than just video storage. A capable file management system is essential to the successful use of any server. Some servers are able to handle file management internally, while others are designed to be little more than devices driven by an external controller or automation system. Some manufacturers use the open media framework (OMF) standard for video file format and organization, but plenty of proprietary systems exist.

In short, although there are many solutions to the problem of organized video mass storage, each solution must be unique to the application. Don't buy an apple if your application really needs an orange. ■

Philip J. Hejtmanek is the director of technology, SIU Broadcasting Service, Southern Illinois University, Carbondale, IL.

Editor's note: The articles that follow were provided by manufacturers of video servers and represent the viewpoint of the respective authors.

For additional information on server manufacturers, see "Video Servers" on p. 79 of the 1996 BE Buyers Guide.

A SCSI primer

SCSI (pronounced "ska-zee" stands for Small Computer Systems Interface. There are two basic SCSI standards: SCSI-1 and SCSI-2. SCSI-1 is currently one of the most popular computer interfaces for peripherals, but SCSI-2 offers backward compatibility and higher bandwidths.

The key feature is high data transfer rate. The standards also offer a common command set, cabling configuration handling up to eight devices and a simple disconnect/reconnect control feature.

- **SCSI-1**

The interface relies on a 50-pin Centronics connector, 8-bit data path, 18 signal lines of which nine are data and nine are control. Both single-ended and differential configurations are available, providing synchronous and asynchronous data transfers.

- **SCSI-2**

This interface uses a 50-pin micro-D connector, providing an 8-, 16- or 32-bit data path. It can be used single-ended or in a differential configuration. It provides synchronous and asynchronous transfers. SCSI-2 is backward compatible with SCSI-1 circuits.

- **Fast SCSI**

This standard doubles the data rate to 10MB/s using an 8-bit bus.

- **Wide SCSI**

Wide SCSI allows 16- or 32-bit data transfers. When combined with fast SCSI, sustained data rates of up to 40MB/s can be achieved.

- **System concepts**

While SCSI interfaces are relatively easy to handle, several things must be kept in mind. First, use the same high-quality cable throughout the system. Second, avoid impedance mismatches because they cause noise on the bus. ■

Editor's note: This information was prepared from an application note supplied by Abekas Video.

Additional information on SCSI interfaces is available from Scitex Digital Video (formerly Abekas). Ask for the SCSI Primer or circle (152) on Action Card.

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The BTS MediaPool is a highly configurable server system providing a wide range of options in storage capacity and I/O channels.

BTS Media Pool

By Charlie Bernstein

The BTS Media Pool video server combines off-the-shelf components and dedicated hardware that has made it the state-of-the-art in video servers. It is a scalable multichannel system that provides the highest quality video and audio for a facility. Because it is a modular system, it can be built in various configurations to meet any specific broadcast needs.

The server uses multiple arrays of hard disks to provide high bandwidth and high storage capacity. It also provides modular scalable I/O channels. A bare-bones Media Pool system can start with a single I/O module and can be expanded to eight channels.

Systems purchased today can be upgraded with additional channels in the future. Additional drives and arrays can be added to the system to meet a facility's storage needs.

Media Pool basics

The Media Pool is divided into four basic subsystems. The basic system configuration is shown in Figure 1.

1. The storage subsystem is a shared pool of video/audio/time-code information accessible to all channels in the system.
2. The video transfer subsystem provides high-speed switching between various storage arrays, and I/O modules enabling the system to provide up to full-bandwidth video on multiple channels simultaneously.
3. The input/output subsystem provides individual access to video files, as well as control of streaming video data.
4. The control subsystem allows for system configuration, media file database tracking and support for embedded applications.

Storage subsystem

Hard-disk storage systems have evolved quickly over the past few years. Increased disk capacity and the ability to connect multiple drives as a single addressable storage system or array has greatly increased the total capacity of storage via disk. These advances have made video server technology viable today.

There are various options to interconnecting drives. Among the most popular and widely used approaches is the redundant array of inexpensive disks (RAID). RAID is a computer industry standard for the connection of multiple drives. It offers various levels of data protection. The Media Pool uses RAID level 3, which provides support for parity protection of data and provides for quick access to media data. It uses an additional hard disk to store parity information for the disk array. RAID 3 can support a single disk failure with no data loss.

To maintain the bandwidth required to sustain a professional serial digital component bitstream, video files must be spread over more than one disk. All disk drives used today are SCSI-based drives. A SCSI system has a maximum data transfer rate per bus of 20MB/s. Yet, a single disk drive today can sustain only about 3MB/s to 5MB/s depending on how the data is stored.

This means that multiple SCSI hard disks and a SCSI bus are required to provide the needed (20MB/s) transfer rate. A full 10-bit digital video signal with audio and time code takes 270MB/s or 33.75MB/s. Even multiple drives on a single bus cannot sustain the bandwidth required for full-bandwidth video.

The Media Pool system relies on multiple buses and arrays to provide and sustain high-video bandwidth to all ports. The server supports up to 42 high-capacity drives per array. With support for multiple arrays, it is capable of storing hundreds of hours of compressed video in a single system.

Compression

The Media Pool video server supports user-selectable variable compression from full-bandwidth video to 30:1 compression. It uses a Motion JPEG compression mezzanine board to support compression. The compression mezzanine card can be replaced in the future to support other compression algorithms, such as the MPEG 4:2:2 standard.

Motion JPEG compresses video on a frame-by-frame basis, allowing the system to provide limited editing capabilities not currently supported with MPEG compression.

Video transfer subsystem

The Media Pool server uses separate high-speed links to transfer data from storage arrays to the I/O modules. These links are switched rapidly to allow the system to provide full-bandwidth digital serial component

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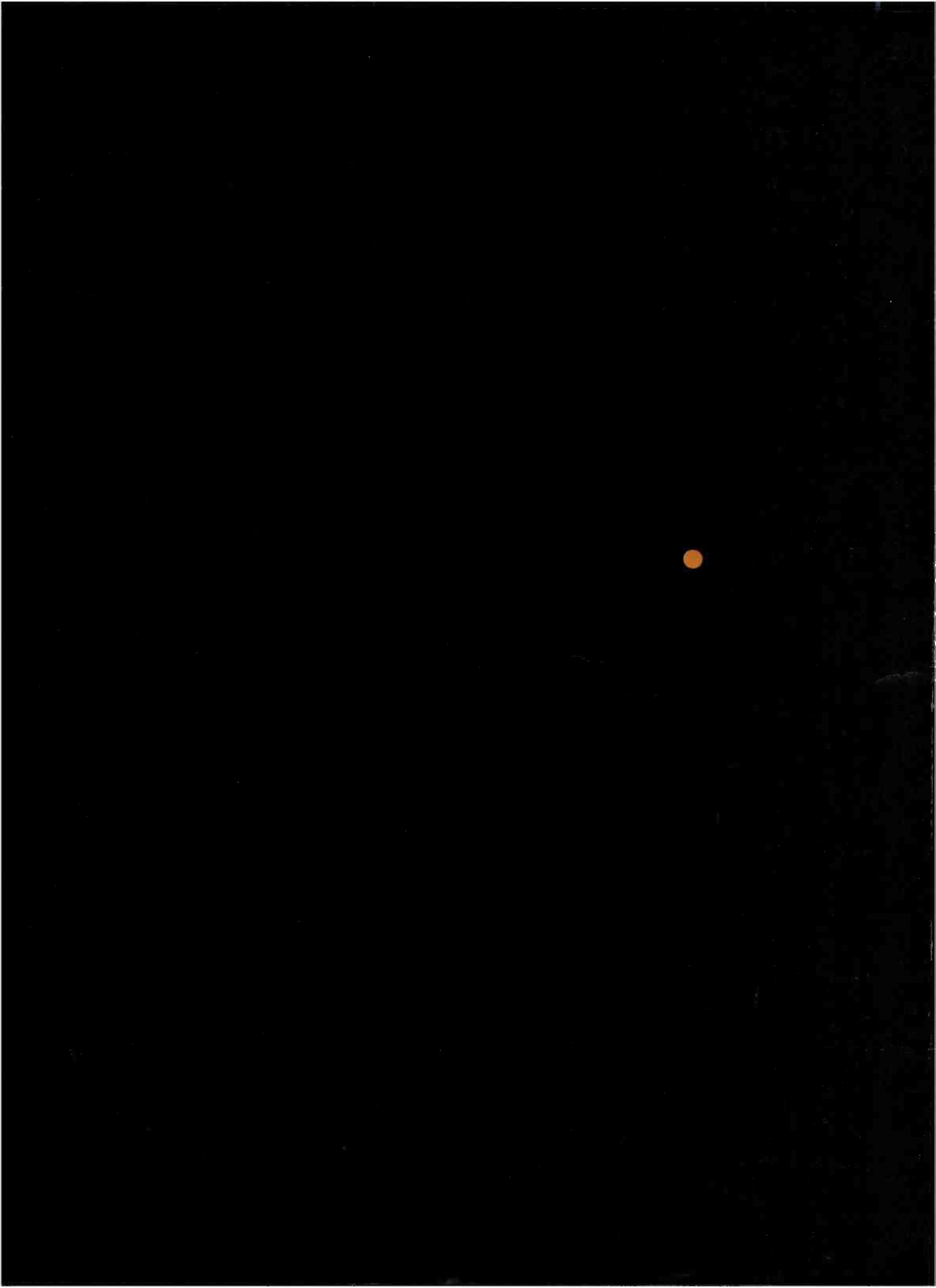

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First Compressions Count

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video for each I/O. The ability to provide this bandwidth offers various architectural options including full-bandwidth output for high-quality video applications, system modularity, bandwidth allocation management and variable compression.

The bandwidth system can be broken into smaller segments to allow for increased system modularity. By providing bandwidth allocation management software and variable compression, the storage system can now be leveraged by multiple I/O channels.

For example, if a user needs two full-bandwidth channels, the Media Pool can be configured as shown in Figure 2. The two arrays can support two full-bandwidth channels as configured.

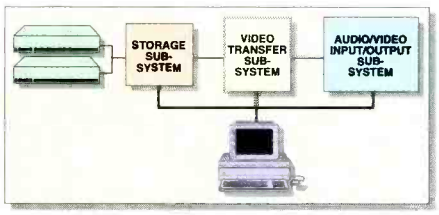

Figure 1. The basic MediaPool system incorporates four components: storage, I/O, video transfer subsystem and control subsystem.

Figure 3 shows how the system can be configured with more I/Os than arrays. In this case, the total bandwidth of the combined arrays is divided among the four channels. The full-bandwidth signal is compressed (in this case 2:1) and striped across both arrays. High-speed switching is built into the array and I/O modules for systems up to four channels or four arrays. For larger systems, high-speed switching is provided by the BTS proprietary Data Transport Communicator.

Because the system is modular, it can be configured in any combination of channels and arrays to meet any user's needs. This approach also allows customers to expand their systems in the future.

Input/output subsystem

The Media Pool I/O subsystem provides all of the control and I/O ports required for broadcast applications. It supports CCIR-656 serial digital video input and output and two AES/EBU digital audio stereo channels. The server supports house time code and general-purpose inputs (GPIs) and outputs for master control, and a fast-wide SCSI interface for data transfer to storage libraries. The board also supports RS-422 ports for control via the Beta control protocol and the video disk control protocol for automation system support.

Control subsystem

The control subsystem uses a Unix-based workstation running X-Windows. Unix was chosen because it is among the most reliable operating systems available. The controller is responsible for initiating system booting, system configurations, compression level set-

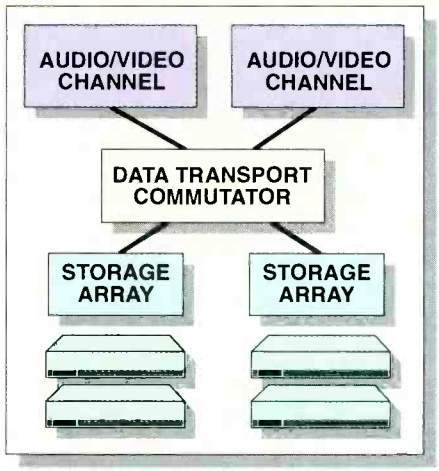

Figure 2. In this configuration, the MediaPool is configured to provide two full-bandwidth output channels.

ting, system monitoring and media file database administrations. It also contains software applications for system administration, commercial insertion and record/playback.

The key system interface for the system administrator and users is an X-Windows-based software program called Software Package for Logical Administration of System Hardware (SPLASH). SPLASH allows a systems administrator to create a Media Pool *instance*, or a single-channel configuration. Instances can specify compression levels, number of audio channels, GPI settings and choose specific I/O connects and control ports. The instance scheme allows for flexible configuration management and usage of the data pool.

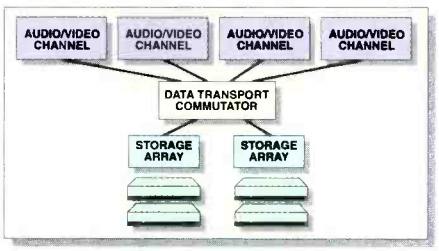

Figure 3. As more I/Os are needed, the system bandwidth can be divided among them. Shown here is a 4-channel system.

The stream record/playback application controls the recording and playout of material. Stream supports typical VTR commands, such as play, record, cue, review, stop and pause. Stream includes software to create spots from source material, support variable compression on records, set cue points and support for GPIs and E-E operation.

DiskCart is commercial insertion software that supports the creation, editing and importing of playlists from traffic systems. It generates an as-played log and allows for GPIs/GPOs for interaction with master control and provides support for various types of external triggers. ■

Charlie Bernstein is senior product manager, Video Server Products, BTS Broadcast Television Systems, Salt Lake City.

Hybrid solution at HGTV

By John Ajamie

The Home & Garden Television Network (HGTV) had the opportunity to incorporate some of the latest technology when building its new facility. Because the industry is moving from a reliance on tape to video file servers and a tapeless environment, we decided to take advantage of this new technology. However, the decision to do so was much easier than deciding what operational features we needed.

However, the decision (to use a server) was much easier than deciding what operational features we needed.

Developing the wish list

In the early days of planning we asked ourselves many questions. While the solutions provided by HD storage were tempting, when we were looking at the technology, there were no proven systems yet in place. Any decision had to provide current and long-term solutions to the network's storage and playback requirements. The HGTV staff considered among others, the following issues:

- What would be the cost of this technology vs. traditional tape machines?
- How much total storage time would be required?
- Was multichannel operation required?
- What about redundancy? Was any needed, and if so how much?
- Were there any future applications beyond the network's environment that this technology could support?
- Could system storage capacity be easily expanded as the network's need grew?
- If the selected system used compression, what amount would be acceptable?

These issues helped form the

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framework for evaluating the competitive systems, and making the final decision to go with the Media Pool. Here is how the system is configured.

Facility needs

The network playback functions required a redundant system. We couldn't put all of our eggs into one basket. Should the primary source fail, a backup had to be available. The options were to either use two cart machines or one cart machine and a file server. A 2-cart machine automation system would limit us to tape. We finally decided that splitting the resources would give us the needed redundancy while moving us toward a tapeless environment.

The graphics department needed storage for updating promotional packages, which is traditionally done on tape. The post-production department needed to be able to store and update daily promotional spots by using the same template, a perfect application for a file server.

The final plan will allow us to share the file server with all three departments: post-production, graphics and network operations.

These storage needs drove us back to the issues of quality and storage capacity. The compression schemes on many file servers are fixed. Yet, we felt that a variable compression approach would be better. This would also allow us to control the amount of storage needed. We also had to keep in mind that this file server had to complement our existing hardware.

The final plan allowed us to share the file server with all three departments: post-production, graphics and network operations. This also permitted us to move video from one department to the other without going back to tape.

Our configuration

The final system will be comprised of several key components. The Odetics TCS-90 cart machine will be controlled by an automation software for program playback. The BTS Media Pool file server handles the playback of all commercial and promotional spots.

We purchased 224 minutes of uncompressed video storage and four channels to be shared among the three departments. Two of the I/O channels are assigned to on-air at a 4:1 compression level and can access the same file and play back commercials simultaneously. This gives us the redundancy needed should a channel fail. We determined that a 9:1 compression level is equivalent to Beta-SP quality.

Our post-production department is assigned one I/O channel operating at a 2:1 compression level. This level was chosen because it is the same as a digital Beta format.

The graphics department has one I/O channel of uncompressed video due to the demanding nature of computer-generated graphics. The file server will be used in conjunction with a digital graphics workstation as video is recorded back and forth from the Media Pool to the workstation multiple times for layering.

The graphics and post-production departments can access the Media Pool through separate control panels via Ethernet LAN and have a 9-pin RS-422 control of their assigned I/O channel. Once the system is fully configured, network operations can retrieve these files and play it back to air without ever touching tape.

The Home & Garden Television network became a beta site for the BTS Media Pool service shown above. Combining the video server with a robotic tape system, provided the network with on-air reliability, operational flexibility and the ability to adapt as new features and technology become available.

The solution

The shared resource, scalable storage and variable compression that the BTS Media Pool offers answered our questions posed when we first began our search. Scalable storage allows the Media Pool to expand as the network needs grow and variable compression gives us the quality appropriate for each task.

Sharing this resource minimized the need for additional VTRs in graphics and post-production. Network operations effectively reduced the maintenance time and mechanical wear on our cart machine.

The solution of tape plus server technology afforded HGTV the technological solutions we needed. By sharing the server with three departments we were able to implement state-of-the-art production and playback capability, without locking us into a tape-based era. This approach also ensured that we could move toward our goal of a tapeless environment. ■

John Ajamie is director of network operations & duplications, Home & Garden Television Network, Knoxville, TN.

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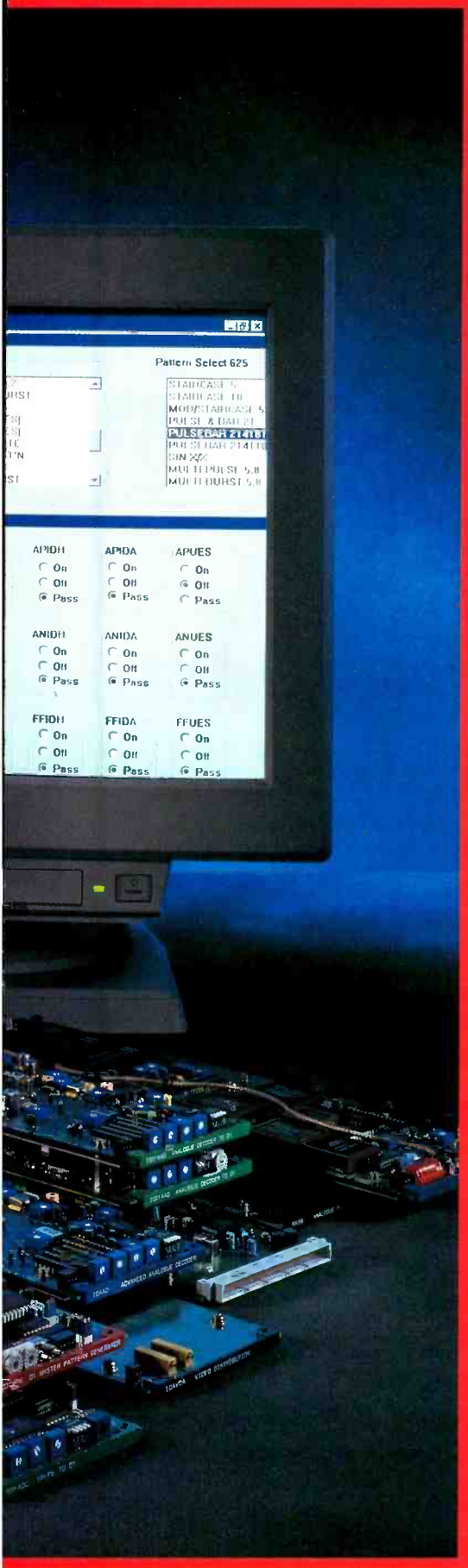

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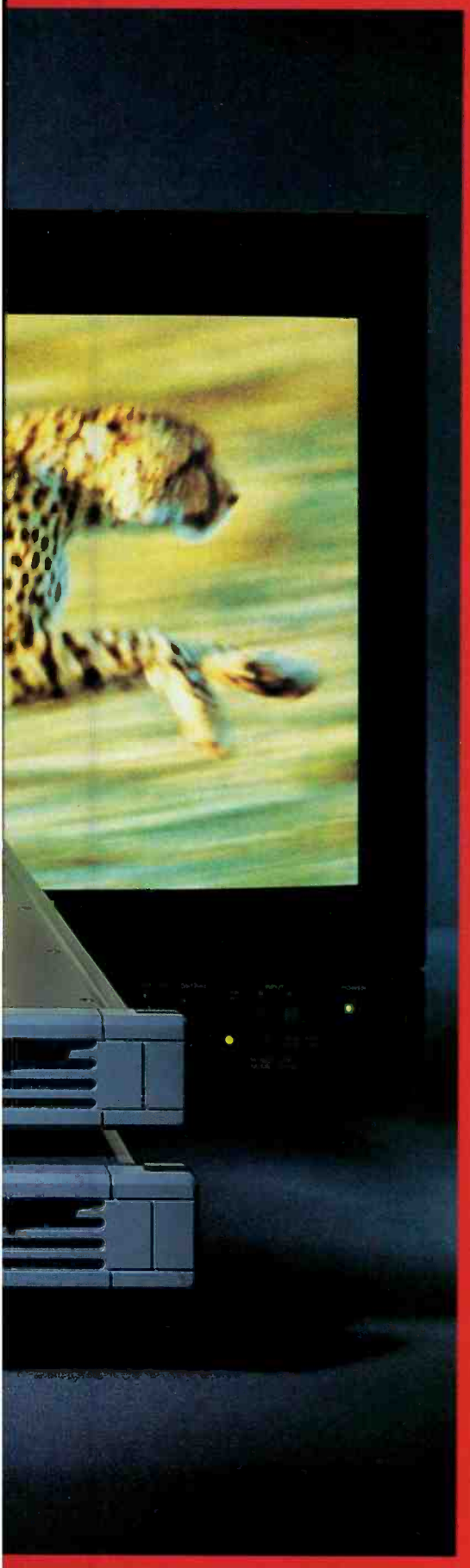

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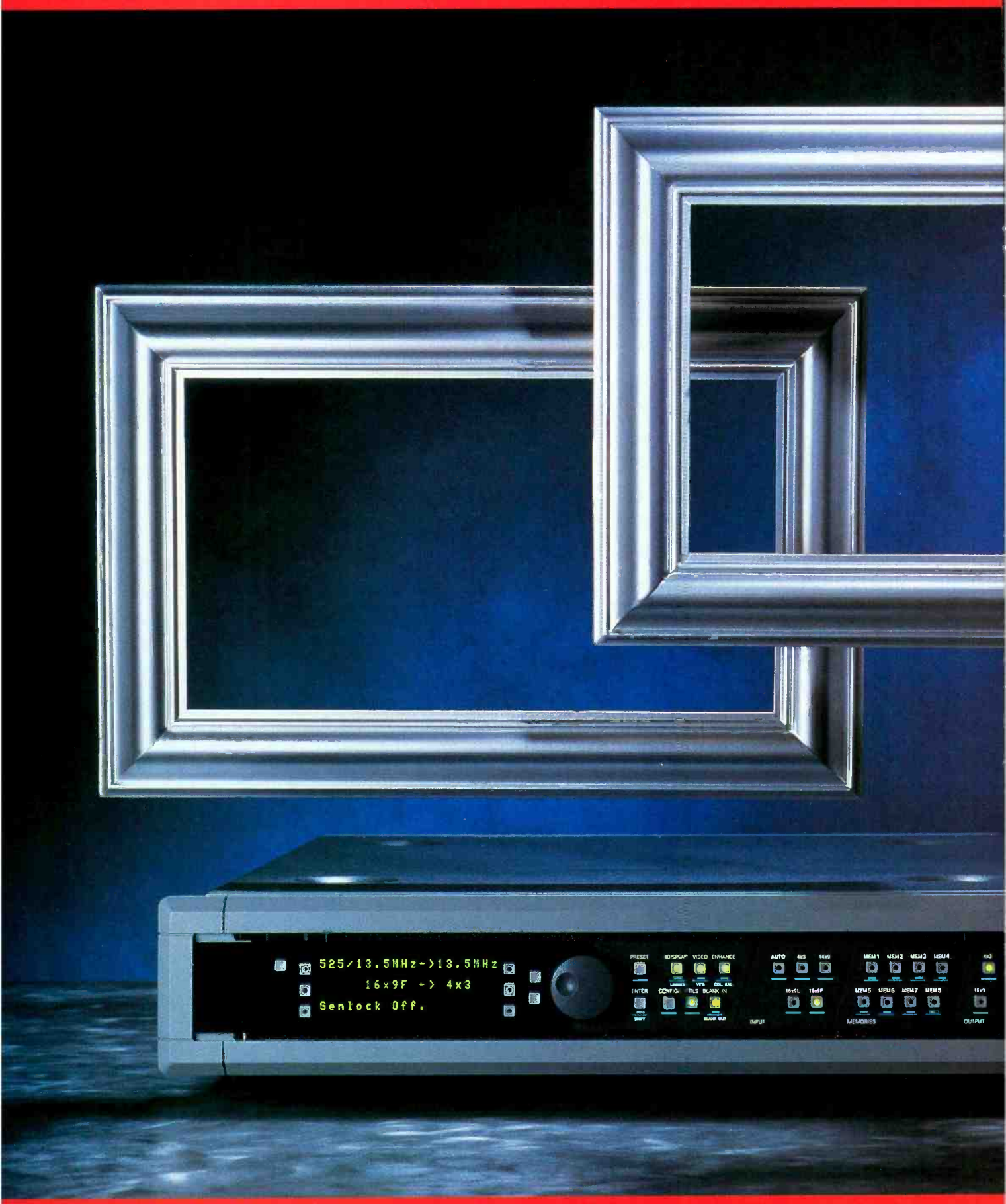

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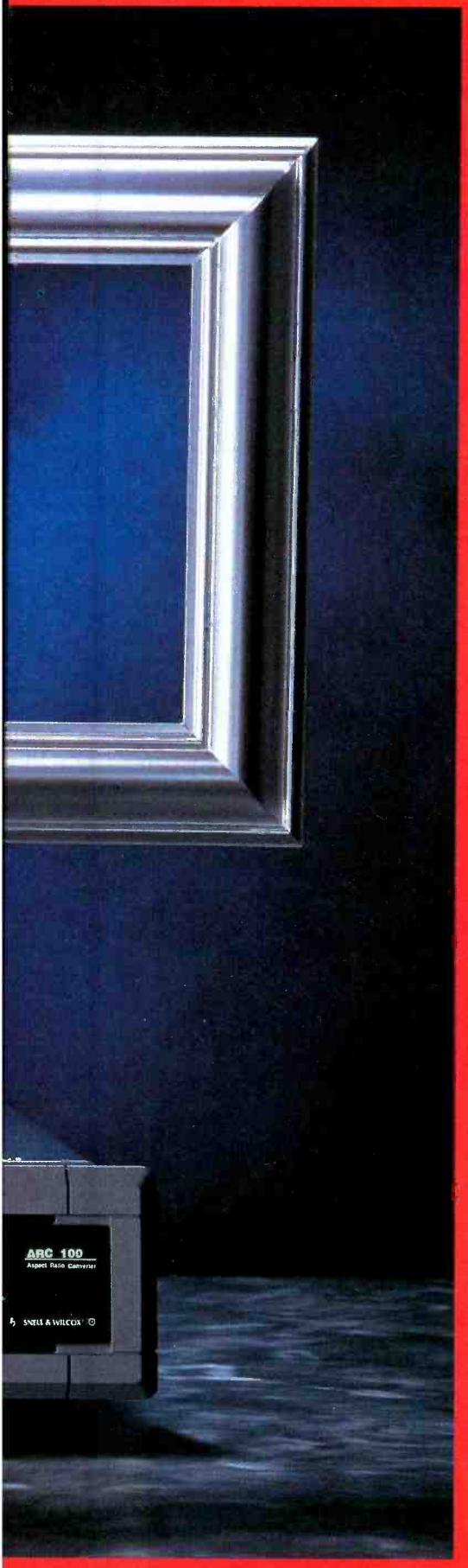

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Optical storage systems like this one provide low-cost, low-maintenance and highly reliable operation. For archival applications, optical technology is an efficient solution.

Pioneer's optical server

By Richard Bauarschi

Providing server features need not be limited to hard-disk technology. Optical storage systems are increasingly being seen as an alternative to the single-point hard-disk approach or dual path of tape and hard-disk solution. While no one would fault the many advantages of hard-disk storage, there is one major drawback — the media is captive. If something goes wrong, the data can be lost. With videotape and optical discs, on the other hand, the recording medium is removable. It can be quickly pulled from one machine and transferred should problems develop with the playback system.

Optical disc systems

There are several optical disc processes. The phase-change and magneto-optical (MO) systems use lasers to apply heat to a thin layer of rare-earth transition metals. In MO systems, a laser heats a tiny patch of the disc to a temperature called the curie point (about 200°C). At that point, a relatively tiny magnetic field can change the magnet polarity of the heated area to record data. At playback, polarized light is beamed at the magnetically polarized surface. The phase angle of the reflected light varies according to the surface magnetic polorization, thereby accurately reproducing the input datastream.

In the phase-change system, variations in the power of the heating laser cause the metal to go to either an amorphic or crystalline state. The scanning laser will then either be defracted or reflected, representing the binary states of the input data.

Both of these systems use metal, which is a good conductor of heat. Laser spot size and duration must be carefully controlled to avoid disturbing the neighboring data, effectively limiting the track pitch, and therefore, capacity.

Non-metallic optical recording systems are also available. These can be printed systems, such as CDs and CD-ROMs or they can be dye systems. In a dye system, laser light is pulsed onto a thin spin-coated layer of organic dye. The heat changes the dye's surface characteristic, forming a pit. A scanning laser will be reflected when it contacts a pristine surface area and defracted when it strikes a pitted area. The dye is not a good heat conductor and, therefore, pit spacing and track pitch can be much tighter. A double-sided 12-inch Digital LD can hold 19GBs of information, much more than the amount that can be stored on MO or phase-change discs.

Dye-based discs are write-once, read-many (WORM) devices. For many applications, such as archives and on-line libraries for video servers, this can be advantageous. It provides intrinsic write-protection and unlimited random-access playback.

The optical advantage

One significant feature of optical storage is that it uses few moving parts. Actuators move the optical heads across the disc while a spindle motor rotates the disc at the proper velocity. Maintenance consists primarily of keeping the unit dust-free. The media is sealed between polycarbonate discs, and because it is touched only by a beam of light, it is not affected by frequent use.

Media costs over the life of a system are a key factor in determining the overall system price. The most expensive of the three media used in storage systems are the hard-disk drives. On the other hand, they are purchased only once and used until they fail. (See Table 1.)

The least-expensive media is videotape, but it also has the shortest life. Digital LDs

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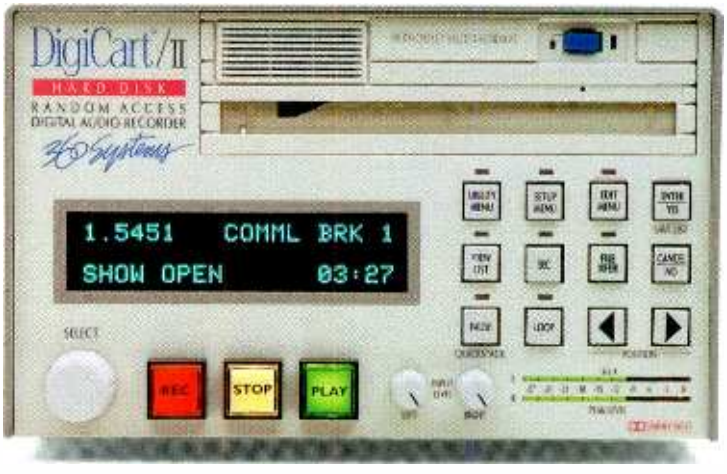

DigiCart/II holds 10,000 cuts, records in linear or with Dolby AC-2 data compression, allows precise edits, and features removable media for archiving, backups and transfers.

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cost more than videotape, but they can be used heavily without degradation.

Media cost is only half of the story, however. Because the initial capital investment may be significant, the equipment must be usable over several years. Therefore, consider what may happen to media and hardware costs during the lifetime of the purchased storage system.

The price of hard-disk drives is descending approximately according to Moore's Law. This computer-industry axiom states that the amount of electronic memory you can get for a certain price doubles every 18 months. By corollary, prices for a fixed hard-disk storage will halve in the same period. However, there will be a limit to how far HDD prices can drop. Thereafter, it is likely that although HDD capacities will increase prices will remain constant.

	DIGITAL LD	HD	VIDEOTAPE
GENERAL ATTRIBUTES:			
Recording medium	Organic dye	Magnetic coating	Magnetic coating
Substrate	Sealed poly-carbonate sandwich	Flat metal disk(s)	Flexible tape
Method of recording/playback	680nm laser (no contact with disc surface)	MR or thin-film head (hovers close to disk surface)	Spinning video head penetrates moving tape
Removeable	Yes	No	Yes
Rewritable	No	Yes	Yes
RELIABILITIES:			
Single point failure	No	Single disk-yes RAID-maybe	No
MTBF (Equipment)	30 years	5 years	Depends on maintenance
MTBF (Media)	Unlimited	Same as above	500-600 passes
Preventive Maintenance	Easy	No can do	Constant
COSTS:			
Cost of recorder	Moderate	Moderate	Moderate/high
Cost of media	High	Very high	Low
Modular/ Expandable	Best with robotics	Single disk-varies with disk sizes Raid-up-grade may be complicated	Yes-robotics recommended for large applications
Special environment	No	No	Yes

Table 1. Comparison of attributes of three video storage technologies: videotape, hard disks and optical disc. No one solution is best for every application.

Modular expansion

Few applications remain constant in terms of capacity. As new features or users are added additional storage is often needed. Compare the different topologies.

Videotape is modular. Tape machines can be added or subtracted as required. All that is needed is to adjust the work schedule to provide personnel to keep the machines loaded and repaired. Hard-disk drive storage can be harder to step up or down in volume. Changing array sizes may require reloading and re-striping the array.

For large storage systems, access to the media can be enhanced by robotics. This applies to tape and optical disc systems. A Digital LD system is most efficient when used as part of a robotic storage system. A system of 225 discs and two drives can store almost 5TBs. At this level, the cost per GB is much lower than that of hard disks and approaches videotape.

Consider the total picture

Choosing a storage medium may not be as straightforward as it first appears. Although hard-disk technology is well known, it's expensive compared to tape. On the other hand, tape-based storage is maintenance-intensive and may provide limited life of the material. Digital LD storage is hard to beat if the application centers on archive-type needs.

Archives are meant to be read, not written. The most successful applications of this technology will likely be those that combine the advantages of Digital LD with the strengths of tape and hard-drive systems. ■

Richard Bauarschi is director of broadcast and professional marketing for Pioneer New Media Technologies, Long Beach, CA.

The Sony VideoStore

Based on RAID 3 technology, the Sony VideoStore multichannel video file server combines instant random access, large storage capacity and high-quality MPEG-2 (MP@ML) compressed video in an integrated, fault-tolerant, multichannel video transmission system.

By Jerry Berger

Based on RAID 3 technology, the Sony VideoStore multichannel video file server combines instant random access to all stored data, large storage capacity and high-quality MPEG-2 (MP@ML) compressed video in an integrated, fault-tolerant, multichannel video transmission system. The system relies on a cost-effective and centralized design (rather than the channel-buffer design). This way, any media may play to any output at any time and be revised up to the last second prior to air. Major elements of the system architecture include:

• The Media Control Unit (MCU) contains all of the control electronics, CPU as well as communications and bus architecture. Up to 12 independent and discrete output channels per MCU may be installed. Multiple MCUs can be linked together with an optional Clip Exchange Board resulting in effortless library management of multiple VideoStore systems. Clips only need to be encoded once and the Clip Exchange op-

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WHAT WE FEEL, WE REMEMBER.

Alaska – 1989

Soviet Union – 1989

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SONY

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tion facilitates the distribution of the encoded data to/from multiple MCUs.

The MCU provides the benefits of Sony's RAID 3 Predictive Maintenance, hot swappability and non-disruptive faulting even though there are no HDDs in this unit. In addition, the MCU supports remote VideoStore systems diagnosis through a dedicated RS-232C port.

• Media Units (MU) can be easily and economically expanded to accommodate up to seven MUs for added storage capacity. Each MU is comprised of six high-performance hard-disk drives in a 5+1 RAID 3 configuration. Each HDD either stores 2.1GB or 4.2GB of information, effecting a storage capacity of 8.5 hours per Media Unit (equal to more than 1,000 30-second commercials).

A system equipped with seven media units can, therefore, provide instantaneous access to more than 60 hours of full-motion video information or more than 7,600 commercials. Off-the-shelf drives can easily be interchanged as hard-disk storage technology evolves, thereby increasing storage capacity exponentially.

In addition to the features of Predictive Maintenance, non-disruptive faulting and hot swappability of almost all internal components as in the Media Control Unit, the Media Unit also provides for automatic (without operator intervention) data rebuild for any lost HDD in the VideoStore System upon insertion of a compatible replacement drive.

• MPEG 2 decoders. The system can be configured with a 2-channel video output board designed for vertical switching applications, such as in cable commercial insertion. In addition, a single-channel gen-lockable board is offered for more sophisticated integration into broadcast environments. Both decoder boards have analog composite or component outputs allowing for easy integration into existing facilities.

• Wide area network interface. The bitstream supports Ethernet TCP/IP interfaces to various wide area networks with the capability to distribute an encoded MPEG-2 bitstream to multiple VideoStore systems.

The device's four levels of fault tolerance are:

1. Predictive Maintenance alerts the user of potential component failures prior to actual failure.
2. The ability to suffer multiple single points of failure and continue to perform without any impact to performance.
3. Hot swappability of not only the system's RAID hard-disk drives and power supplies, but several of the MCU's components as well.
4. Automatic data reconstruction upon replacement of a failed hard-disk drive.

Bitstream MPEG-2 encoding system

Video encoding is accomplished by the bitstream encoder using Sony's MPEG-2 (Main Profile@Main Level) compatible algorithms. This system is designed to produce high-quality pictures due in part to a wide window of motion estimation and compensation. Also included in the MPEG-2 encoder system is a built-in frame synchronizer to enable acceptance of non-synchronous feeds, such as satellite transmissions or non-time-base corrected videotape sources. Additionally, the encoder provides editor-like VTR machine control of source tape decks.

The system incorporates an integral decoder that provides for instant quality assurance and verification. The system contains multiple-format video, audio, bitstream and control interfaces. Through Sony's control protocol, systems integrators can use any PC or control platform to control the encoder system. Users may select either a data rate of 5Mb/s or 10Mb/s with either the standard motion-estimation window or an optional expansion motion-estimation expansion board.

Closed-captioning is supported by first encoding the closed-caption data along with its associated video, storing that data with the associated clip and then reinserting the data upon playout. Similarly, the clip identification is encoded along with the video and decoded upon playout for absolute as-run verification. In addition to the Predictive Maintenance features described earlier, the system supports remote VideoStore system diagnosis through a dedicated RS-232C port. ■

Jerry Berger is manager, video file server technology, Business & Professional Products Group, Sony Electronics, Montvale, NJ.

Vela Research video server

Because of its simple modular design, the Vela Research video server is targeted at multiple channel playout applications.

By Paul Mears

The Vela Research video server is based upon a 486/33 CPU in an EISA backplane. The 33MB/s 14-slot EISA backplane provides enough bandwidth and fanout to support 10 decoders per chassis. The video server's operating system is a real-time UNIX kernel, which occupies less than 10MB of disk space and can operate in less than 8MB of RAM. The kernel architecture supports POSIX multithreading and open architecture networking stacks, such as TCP/IP.

Each server can store up to 14 hours of video in MPEG-1 or MPEG-2 format at CCIR-601 resolutions at a 4Mb/s overall data rate or about nine hours at a 6Mb/s overall data rate. The data is stored in a

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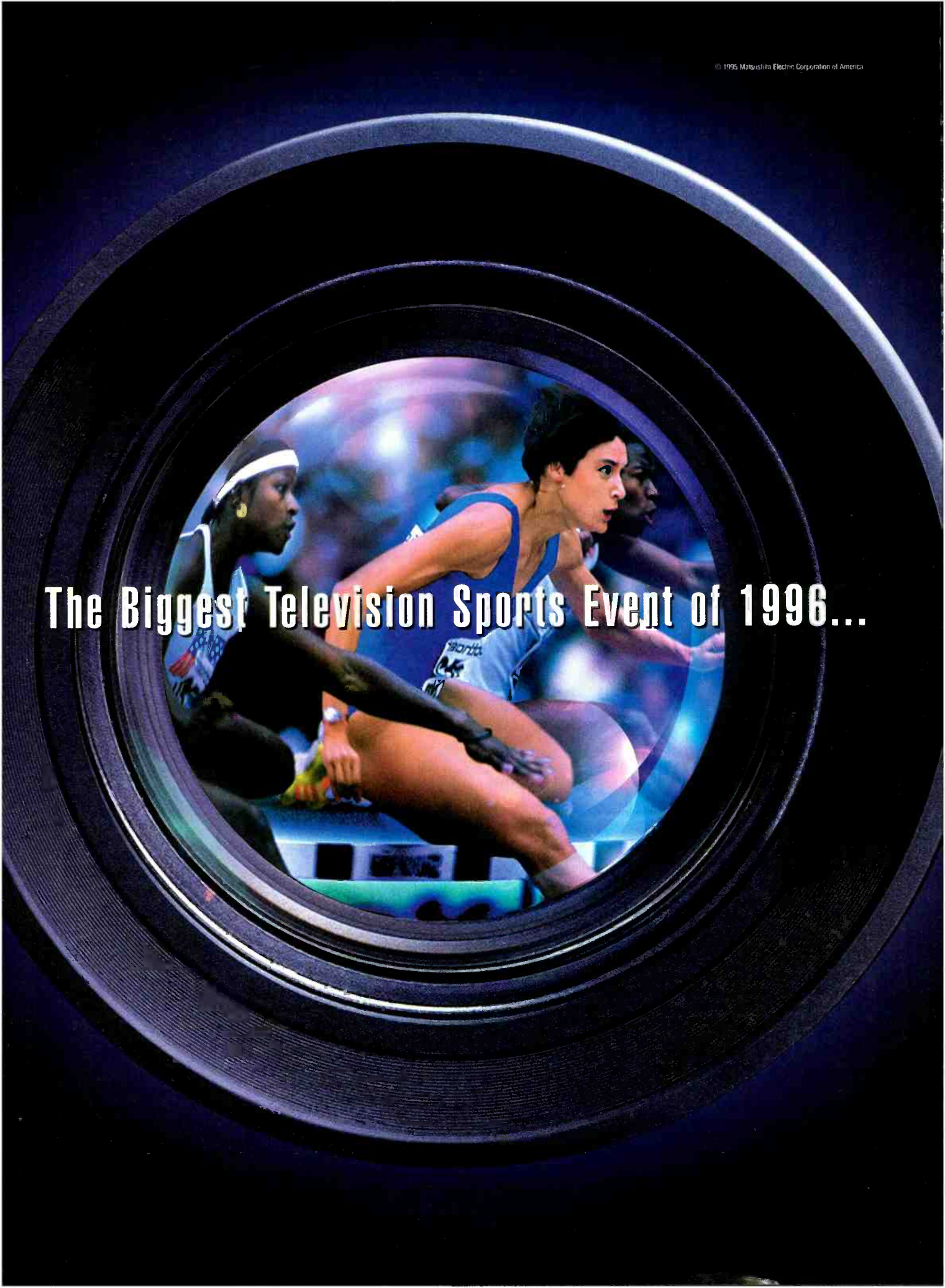

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RAID 5 disk array for high data throughput, high capacity and fault-tolerance performance. Should a drive fail, it can be easily resolved via a hot spare in the chassis. Data is then rebuilt on a hot spare drive in the background during the playback process.

The failed drive can then be replaced at a later date (it essentially becomes the new hot spare drive). Thermal recalibration, which is a major issue for video storage, is effectively eliminated through careful drive and array controller design.

Material is stored on the disk array as a *raw* device; the disk has no file system per se. File (video) management is accomplished via a local database on the video server, which keeps track of all file attributes.

Each server can support up to 10 simultaneous analog video outputs. Each video output is driven by a Vela Research MPEG decoder, which provides high-quality NTSC video and balanced CD-quality stereo audio. A gen-lock input and support for reconstruction of closed-captioning information from the user data fields of an MPEG stream are also provided.

The system includes a fault-monitoring device called a *System Monitor Unit* (SMU), which constantly monitors operational parameters, such as internal temperatures, voltage levels, fan speeds and others. These parameters are queried by the *Site Manager* where alarms and faults are delivered by the system's GUI for operator notification.

Site Manager and scheduling software

The Site Manager is a UNIX workstation used for managing and controlling one or many video servers locally or remotely. The Site Manager implements an easy-to-use X-windows based GUI for presentation of alarm and operational information. The operational system is also used for scheduling and control of video playback through a scheduling interface. This scheduling interface allows a user to set up schedules for multiple channel playback for multiple video servers either over a time window or as a continuous playback to completion.

The Site Manager accomplishes all scheduling and control via an Ethernet interface using a protocol that runs on top of TCP/IP. The manager system is a pure network client, meaning it does not manage any data for any of the video servers. A video server can also run independent of a Site Manager.

The video server can also be monitored via traditional off-the-shelf network, such as HP-OpenView and SunNet Manager. A full MIB-2 SNMP agent exists on the video server to ensure compliance with existing network management systems that may exist at customer locations.

The video server has been designed for acceptance of either local or remote download data. A high-speed/high-capacity tape drive can be installed locally on the video server or a high-speed/high-capacity tape drive can be shared by multiple video servers for network downloads. Currently, Site Managers and video servers are interconnected via standard 10Mb/s Ethernet. Future high-speed network interfaces supported will include IP over ATM and ATM/AAL5 on both the Site Manager and the video server. ■

Paul Mears is vice president of technical research with Vela Research, St. Petersburg, FL.

AVID Technology's DNG MediaServer

NewsCutter is a server-based editing system that allows multiple users to access and edit the same material simultaneously, each for different applications.

By Jim Boutin

Avid Technology's Digital Newsgathering System (DNG) system is a multi-user news production system that connects non-linear video and audio recording, editing and playback devices to a high-powered file server. Based on a flexible client/server architecture and the latest fiber-optic networking technology, the DNG system is designed to increase production speed, efficiency and reliability by providing shared simultaneous access to a central library of disk-based media.

The DNG system has three key components: the MediaServer (file server); AvidNet, an ATM networking system; and the non-linear recording, editing and playback systems. Combined, they provide an integrated solution for broadcast applications.

In this configuration, the MediaServer facilitates file sharing and management activities and the clients perform the actual production tasks. The Avid Media Recorder system records electronic feeds directly to the central library disk drives, NewsCutter edits audio and video and AirPlay plays the

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media out to air. Because the clients can function independently of the server, this architecture provides improved operational flexibility. For example, broadcasters can use NewsCutter to edit video on the server, locally on the client or on a mixture of both.

MediaServer

The MediaServer is the heart of the DNG news production system. Based on an SGI Challenge series server and the IRIX UNIX-based operating system, the system provides simultaneous, multi-user access to a common library of audio and video. With the SGI server as its computer base, the file management software performs all of the file and network management tasks.

Because the system functions like an extension to the storage of an individual workstation, users can share audio and video files. Incoming feeds can be recorded directly to the server's central library. Even while it's still recording, editors can begin their work, each accessing the same pieces of media if needed. Currently, the system supports up to 12 clients, any eight of which can be actively linked to the server at any point in time.

The MediaServer supports RAID 3 on-line storage, scalable from 16 to 224 hours. The system is able to support simultaneous multi-user access to files because the RAID 3 storage system is striped *wide and deep*. Each individual RAID 3 subsystem is internally striped deep into four drives with the fifth drive of the array used for parity. The server's software provides the second dimension of striping by spreading the data wide across multiple individual RAID subsystems. This combination of wide and deep striping produces a cumulative data rate well in excess of that achievable by any single drive or drive array. At the server level, striping also facilitates faster I/O because transfers are handled by four I/O operations at once.

Because the system's five disk drives store the data of four drives, the system can easily recover data in the case of a drive failure. A drive rebuild can go on in the background as users continue to work on the system — users will not see any loss of functionality, but will be notified if a drive is lost.

Networking

AvidNet uses two networking technologies to link the production clients to the server: ATM networking technology using fiber and Ethernet networking technology using copper wire. (See Figure 1.)

The ATM network is called MediaTransport and handles the transfer of all audio and video files. MediaTransport provides high-speed, low-latency data transfer over a dedicated link.

The Ethernet implementation is called the Database Network and handles the transfer of all bin information. Bins are organizational tools that define master audio and video clips, story sequences, graphics and effects. Rather than holding the actual media, the bin contains information about in and out points, the order of clips in a single story, the types of transitions between clips, etc. This approach ensures that media is efficiently managed and stored. While the actual media files are transferred over the MediaTransport, the clients and server use the Database Network and Apple Talk protocol to communicate this bin information.

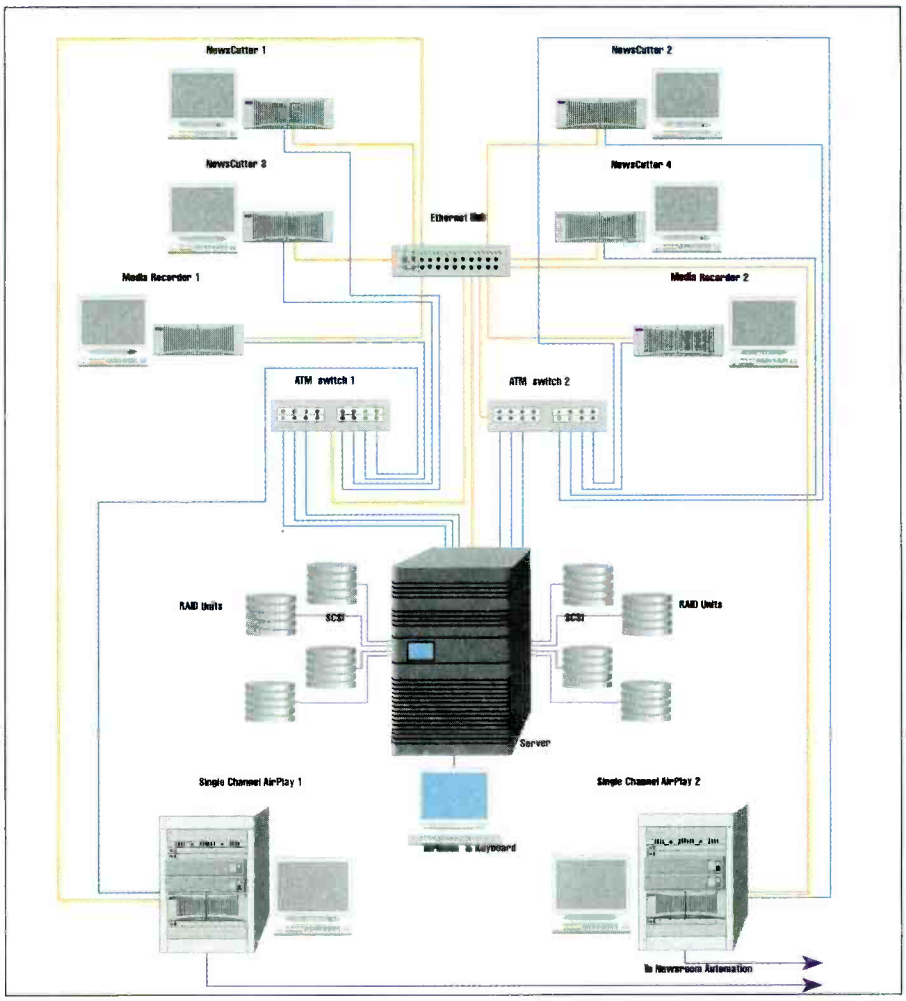


Figure 1. The Avid MediaServer system relies on two interconnection paths. One, called MediaTransport, relies on fiber to transport the actual audio and video. The parallel path, called Database Network, handles the transfer of all bin (video clip) information.

In an 8-workstation system, the network uses two ATM switches to manage connections to the server. The server and workstations contain ATM network boards, which provide redundant operation. Should a subsystem fail, only part of the network will go down.

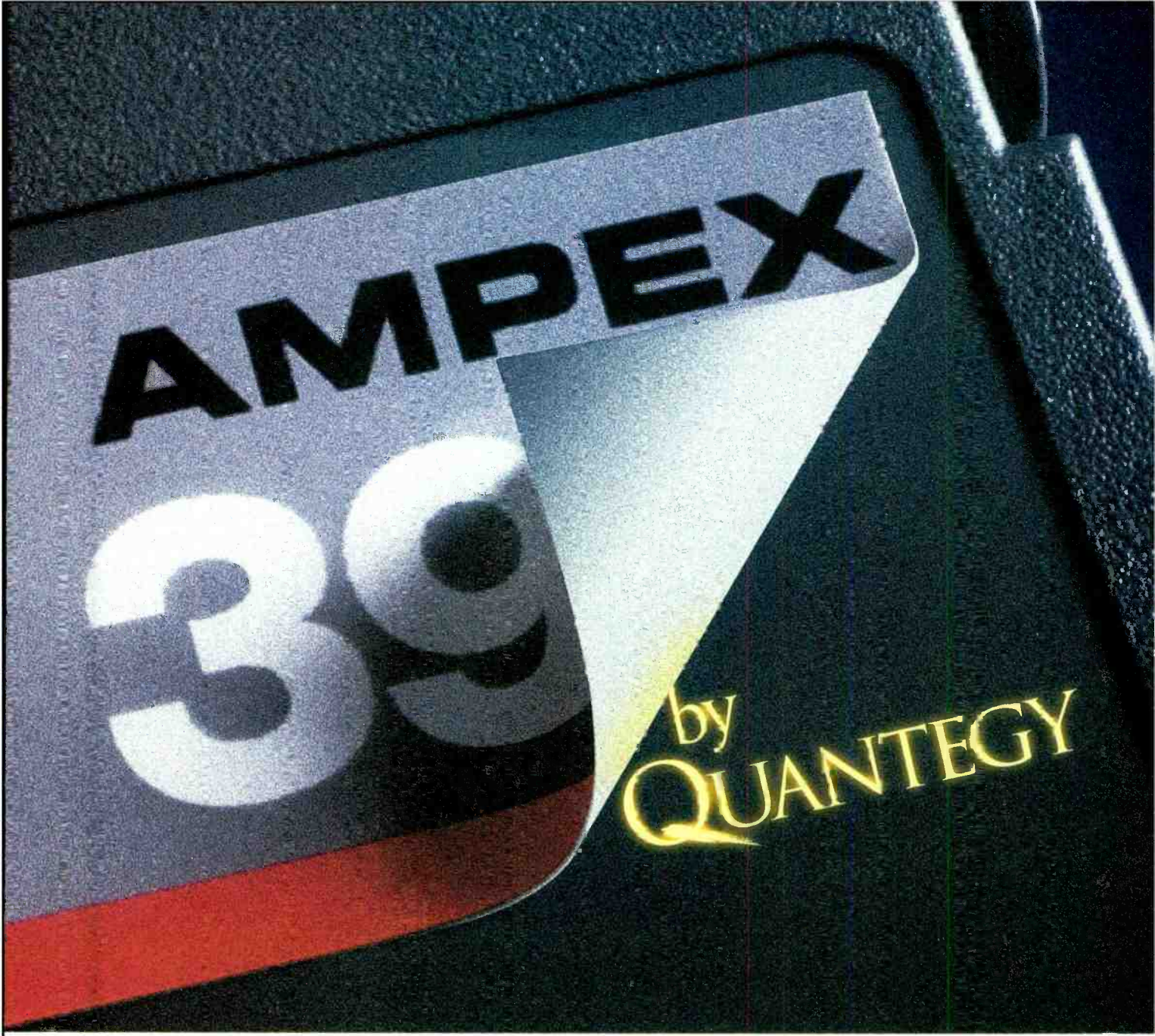
The disk-based clients of the DNG system include the NewsCutter news editing system, the AirPlay playback server and the Media Recorder virtual VCR. These clients request and receive services (access to the central library) from the MediaServer, which uses a combination of bandwidth assignments and priority levels to determine which clients can use the server at any given time. The AirPlay clients, for example, have priority because they play back continuously and cannot be interruped.

During the recording process, incoming analog audio and video are converted to digital, and the video is compressed with JPEG compression at each workstation. The digital media is passed across the CPU's data bus to the ATM card at an average data rate just under 30Mb/s for video with four channels of audio. The digital video and audio travels via the fiber-optic cable into the ATM switch, which routes it to the server. The data enters the server through its ATM card, passes across the server's data bus into the drive controller and onto its disk drives. During playback the process reverses.

Uncompressed audio and compressed video data flow from the server's drives through the server into the switcher and then on to the workstation, which uncompresses it and converts it back to analog video and audio.

The Avid DNG system is in use at a number of broadcast facilities worldwide, including U.S.-based KHNL in Honolulu, NorthWest Cable News in Seattle and CNN's Financial Network in New York. ■

Jim Boutin is director of Field Sales Support, Avid Technology's Broadcast Division, Tewksbury, MA.



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Circle (34) on Action Card

Hewlett-Packard's newest generation digital Broadcast Video Server is expandable to up to six channels and 50 hours of storage to accommodate a variety of station needs. The server starts at $100,000.

Hewlett-Packard's video server

By Louise Bucher

Since NAB 1994, there has been an evolution in the way broadcasters investigate the wide range of video servers available. The investigation has grown increasingly in its level of sophistication from open curiosity to critical evaluation. At NAB 1996, broadcasters will evaluate the different vendors' server products not just from the perspective of technical specifications, but with an eye to how well the server will provide them with a short solution and the potential for long-term expandability and growth. The solution to how well a particular server will meet the needs of the user lies in its architecture or design.

Hewlett-Packard's (HP) video server architecture is the common core among its product offerings beginning with the first spot insertion system introduced in 1994. The architecture has evolved since then, allowing HP to introduce two generations of servers offering high quality, reliable video server systems for spot insertion, as well as networked solutions including time delay and multichannel broadcast applications.

Hewlett-Packard's third and newest generation of servers supports six fully independent channels, increased file transfer features and high-speed data networks for interoperability. One constant amid the evolution of server architecture is that each new generation of products shares the same application protocol, allowing each to operate simultaneously and side-by-side with previous systems under the same applications.

System architecture

Hewlett-Packard's newest generation of video server has been designed for longevity and the preservation of a customer's initial investment. The server will provide broadcasters with a system that is superior in four key areas: networking, scalability, reliability and price.

This is done with a modular hardware design for easy upgradeability, a distributed network design allowing the system to deliver tomorrow's system performance today, and a platform based upon open systems and industry standards.

The broadcast video server consists of a control system in which the encoding, decoding, CPU and networking cards are modular plug-ins, allowing them to be added or upgraded as needed. At the same time, the scalability of the server minimizes the overall system cost per channel. The file system is format-independent: its management of data is the same, regardless of compression standard or data format. This flexibility allows the system to be effectively used during the transitional period as broadcasters move from NTSC to ATV applications.

Key factors in this capability include increased bandwidth and channel capacity and improved data-processing efficiency through the pairing of a powerful I/O engine with the removal of the system CPU from the video data path. Video data transactions use 64-bit processing, with data being transferred in a single, efficient pass from the disk array to the appropriate processing (encoder, decoder or network) card. (See Figure 1.)

The system uses MPEG-2 video compression because of its high quality and the corresponding storage cost efficiencies it offers. At the same time, system costs are driven down because MPEG data files re-

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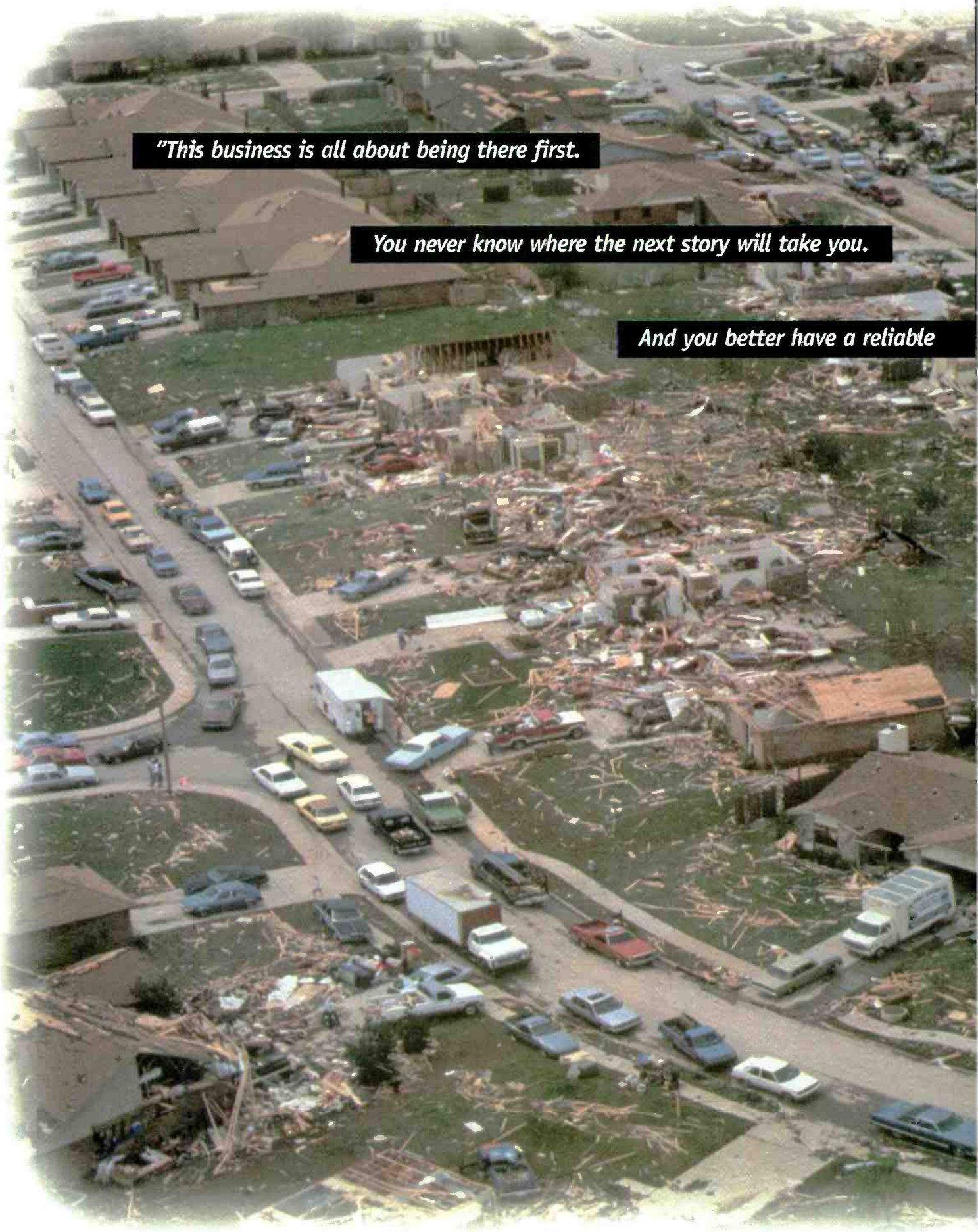
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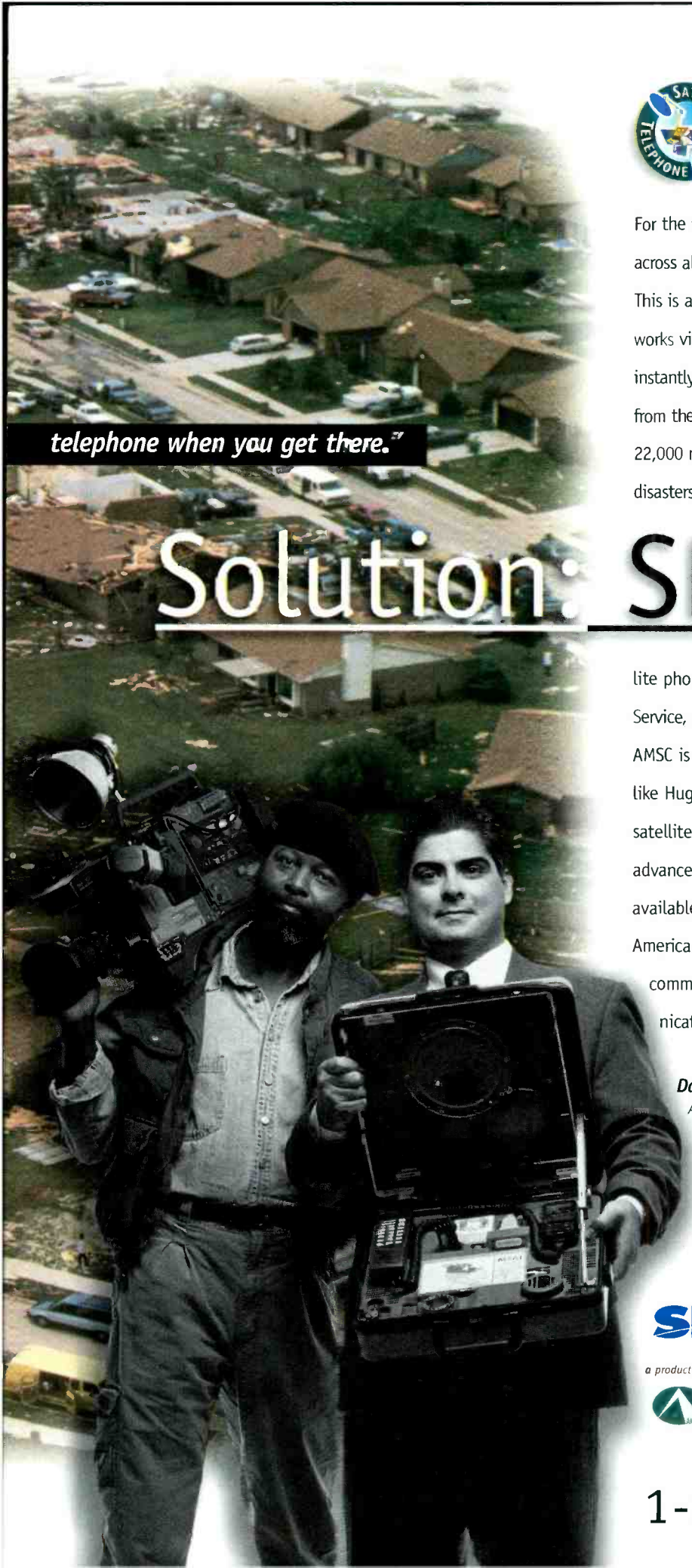

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quire three to five times less disk space and networking bandwidth than comparable JPEG solutions. And, because MPEG is an interoperable standard, it allows products from different suppliers to connect together to form true server solutions. This interoperability will become increasingly important as servers move from widespread use for spot insertion in the on-air environment to use in programming, news generation and editing.

Networking solutions

The company believes that Fibrechannel will be the standard for networking video servers within broadcast facilities. Fibrechannel is a networking solution that is available and provides greater bandwidth (1Gb/s) than ATM and many proprietary system networks. (See Figure 2.)

Using low-level building blocks of industry-standard networking technology, the HP system provides an integrated solution specifically targeted for broadcast applications. The system is based on a distributed server approach. While a base server system has six channels, the design can be readily expanded by networking multiple server systems together (clustered networking) over the server's Fibrechannel ring.

The open platform, networked approach allows the system to incorporate servers of many vintages and manufacturers.

The open-platform, networked approach allows the system to incorporate servers of many vintages and manufacturers. The modularity of the HP server allows it to be packaged as a main data server, on-air or news client or a stand-alone device.

ATM will be the standard for networking outside of the broadcast facility. It is a technology used in HP's interactive media servers. This provides a synergy between broadband and broadcast applications. Other digital distribution protocols are satisfactory for point-to-point networking, but because ATM is a switched, packetized protocol, it allows distribution from a single point to several end points of receipt.

This will be particularly advantageous as broadcast groups or networks distribute common information to station affiliates. The interconnectivity of ATM allows data to be distributed over public facilities, allowing broadcasters to dial in and take advantage of worldwide networks currently being put into place.

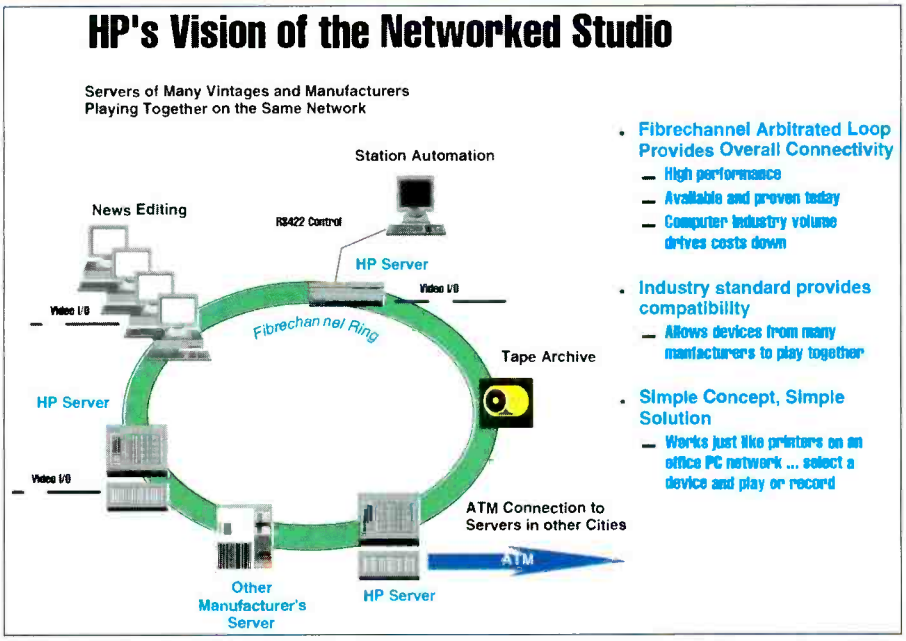

Figure 1. The HP server relies on a modular design as shown here. This scheme provides flexible configuration, RAID level 5 security and allows for low-cost expansion as a facility's needs change.

Expandability and reliability at a surprisingly low cost

In keeping with the development of an expandable architecture, HP's newest generation of broadcast video servers offers inexpensive, expandable storage (from eight to 48 hours) and a high-speed link to a StorageTek Near-Line archive. On-line disk arrays are hot swappable and protected with RAID level 5 redundancy. System operation is protected by hot-swappable power supplies and redundant system fans, while a distributed network eliminates the possibility of loss of operation due to the failure of a single unit. Data is also backed up through the distributed network and secondary data tape storage for complete redundancy. In addition, the continued large-scale integration of our data I/O engine, coupled with ongoing decreases in MPEG encoder costs has enabled a dramatically lower system cost.

Louise Bucher is technical business development manager, Broadcast Video Server Systems, Hewlett-Packard company, Santa Clara, CA.

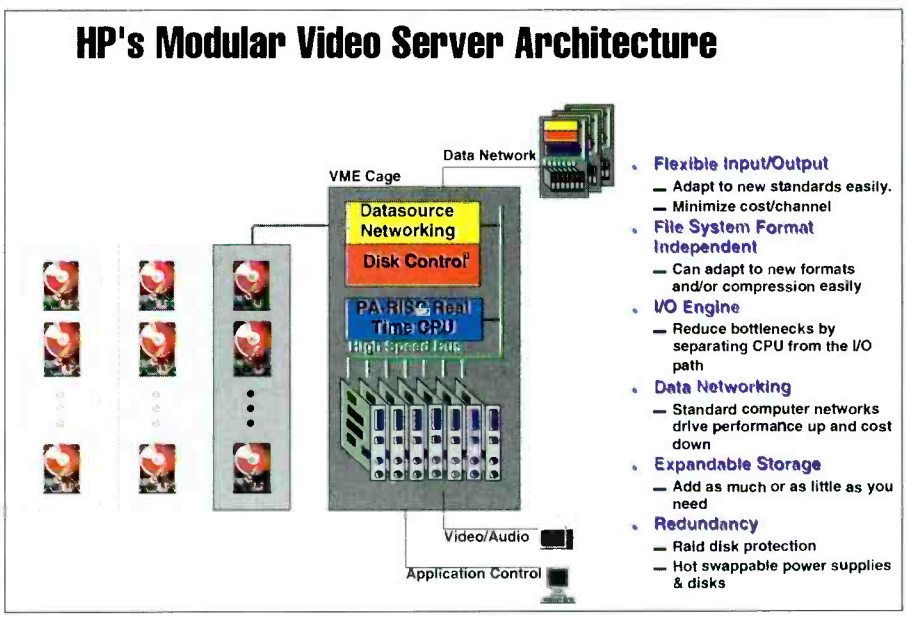

Figure 2. The HP server uses a Fibrechannel ring to interconnect the workstations and ATM for connection to external telecommunications links.

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The Micropolis video server relies on disk-centric design, which improves disk bandwidth by allowing the array to handle video while the CPU focuses on control and routing functions.

Micropolis

By Gerry Pineau

Disk-centric vs. CPU-centric architecture: Disk-centric architecture represents a paradigm shift in server architecture and a revolution in server and storage technology.

In traditional file server architecture, the processor controls the storage and information gateways, thus it is inherently CPU-centric. Drawbacks include reliance on the CPU's processing power to packetize and route data, the need for large amounts of memory and limited system bus bandwidth.

Alternatively, is the disk-centric model where disk arrays are directly connected to the video delivery infrastructure, whether analog or digital. The CPU merely acts as a traffic controller allowing the drives to handle the delivery of video with minimal CPU interaction. A significant additional benefit of disk-centric media architecture is that it can be massively paralleled (using an

array of arrays), thereby providing simultaneous access to potentially thousands of users, and in some cases, to the same data, with just a few processors.

AV Server architecture and configuration

All audio/video servers of the Micropolis AV Server series share the same architecture. The core of the AV Server is the RAIDION VOD array controller equipped with video-specific RAID firmware. The disk drives reside at one end of the array controller, ranging in number from three to 28 and in capacity from 2GB, 4GB, 9GB or higher as new disk generations become available.

On the other end, a fast/wide SCSI adapter communicates with 4-channel MPEG-2 audio/video decoders capable of providing analog composite video and stereo audio output.

With a single audio/video file striped across the array, up to 32 users are permitted simultaneous access, at a response time typically of less than two seconds, to any of the audio/video data stored on the disk array. The system provides output of up to 32 individual analog NTSC audio/video channels, but may be expanded to 64, 96, 128 or more users by adding more AV servers and controlling them from a common control PC.

The standard hardware configuration consists of one array of seven 9GB disk drives connected to the RAIDION VOD array controller, an internal control PC, and up to eight of the 4-channel MPEG-2 audio/video decoders. Here are some of the features and server building blocks.

Disk-centric vs. CPU-centric architecture: Disk-centric architecture represents a paradigm shift in server architecture and a revolution in server and storage technology.

- Disk drives: The drive design is expandable up to 28 9GB drives providing up to 160 hours of storage. The system typically stores 40 hours of video at a data rate of 3Mb/s SIF or half D-1 resolution depending on the encoder, with higher data rates of up to 12Mb/s for full D-1 resolution.
- Array controller: The array controller uses a single fast/wide SCSI port to interface with the control PC and the 4-channel MPEG-2 audio/video decoders, and four narrow SCSI ports to interface with the disk drives. The array controller operates in a RAID 5 enhanced mode featuring concurrent parity. That is, no performance loss will result in the event of a drive failure or during a rebuild period, and data integrity is guaranteed. Parity information is striped across the array with the audio/video files.
- Internal control PC: The server control PC, controlling traffic between the array controller and the 4-channel MPEG audio/video decoder, maintains the file system and imports video. The PC contains I/O expansion cards for control of the IDE and floppy drives, a VGA monitor, dual serial ports and a parallel printer port.
- Decoder card: The 4-channel MPEG audio/video decoder card reads the MPEG-2 data into its internal buffers and writes the data to the output audio and video decod-

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Video servers

er boards. SCSI firmware controls the decoder card and provides the functionality needed to receive and respond to commands from the control PC, to issue commands to the array controller, to read data from the drive array and to manage the buffered datastream for each of the MPEG-2 channels.

• Decoder boards: The AV server decoder card uses CL9100 MPEG audio and video output decoder boards, four of which reside on each decoder card as daughter cards. These output decoder boards have separate audio and video decoders that feed either MPEG-1 or MPEG-2 data at data rates of 1.5Mb/s to 12Mb/s. Output of the datastreams can be produced in composite NTSC or PAL format. A gen-lock feature on the MPEG decoder board allows the output to be accurately timed with other video sources.

• Control PC software: The internal control PC software developed by Micropolis provides complete functionality for controlling all components of the system, including management of the file system and issuance of commands to the decoder cards that manage the datastreams during playback of a movie. The PC software also controls the uploading of new material from an external device during system operation. Communication with the external user system is accomplished for networks via Ethernet or Token Ring or serially via RS-232, using VideoNet software, a Micropolis-developed protocol. ■

Gerry Pineau is manager, server engineering, Micropolis, Chatsworth, CA.

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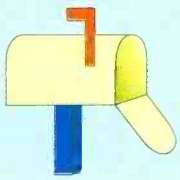

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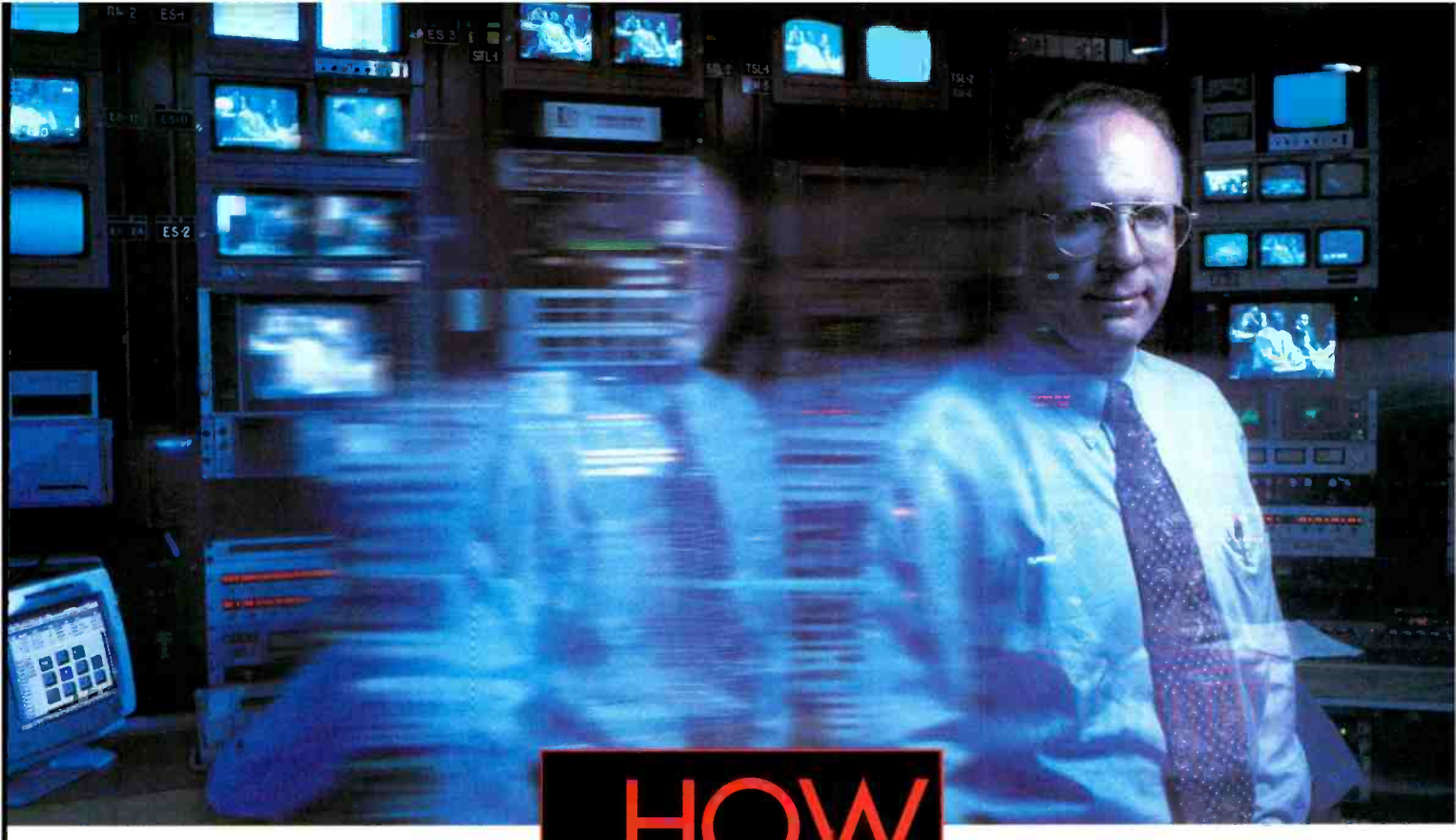

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IF you want to make the move from tape to disk, Ira Goldstone has a few quick words of advice:

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A: *Carefully.*

Q: Right. So did you choose the Louth ADC-100 automation system to bridge to disk or give you future flexibility?

A: *Yes.*

Q: Meaning you liked Louth's ability to control all types of different devices?

A: *Yes.*

Q: And you weren't worried about any problems with proprietary automation software or choosing any disk vendor you wanted?

A: *No*

Q: So if you were to give advice on how to make the transition to disk, without worrying about where your station goes in the future, what would it be?

A: *Louth.*

Q: And what about the multi-casting environment?

A: *Louth.*

Q: Of course, you'd still need a media management and traffic interface system to tie it together. Any final words of advice?

A: *Louth.*

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Circle (31) on Action Card

By Steve Epstein, technical editor

Video compression 101

Considerable math and science can go into compressing a video bitstream.

The image on the left was scanned at 300dpi, creating a file of 4,435,006 bytes. The top image is a JPEG-compressed version, file size is 388,800 bytes. Photo by Mary Masterson.

The Bottom Line:

Video compression has been around since the early days of NTSC. Today's compression algorithms are capable of reducing signal bandwidth requirements far beyond the capabilities of early methods. Unfortunately, these same technologies can be pushed far enough to destroy image integrity. Future broadcast technologies will almost certainly use image compression in one form or another. A basic understanding of compression, and the trade-offs involved, can be critical to the selection of the appropriate compression system for your needs. $

Compression techniques have been in use for years — interlaced scanning and bandwidth reduction are among them. We are so used to some compression systems that we no longer question them. For example, film resolution is quite high in the spatial domain, however, temporally the medium is compressed because there are typically only 24 or 25 samples per second. Methods that reduce the amount of data gathered reduce data-management needs but also set a precise limit on the maximum output quality.

Today, lossless compression techniques based on statistical analysis, such as run length and entropy encoding, have found widespread acceptance. These statistical techniques are reversible if done properly and can generally reduce the amount of data by 50%. Perceptual coding is also being used to take advantage of the limits of human perception, reducing data by removing what is not perceived and keeping what is.

Properly implemented, compression algorithms may not *appear* to cause image degradation because we simply fail to notice the discarded information. Studies have shown that we are far more sensitive to changes in luminance levels than to similar changes in chroma levels. This fact is reflected in the reduced bandwidth given color information NTSC and 4:2:2 systems.

Data lost through perceptual coding can be quantified, but typically is not perceivable by the average viewer. When properly combined, these techniques can significant-

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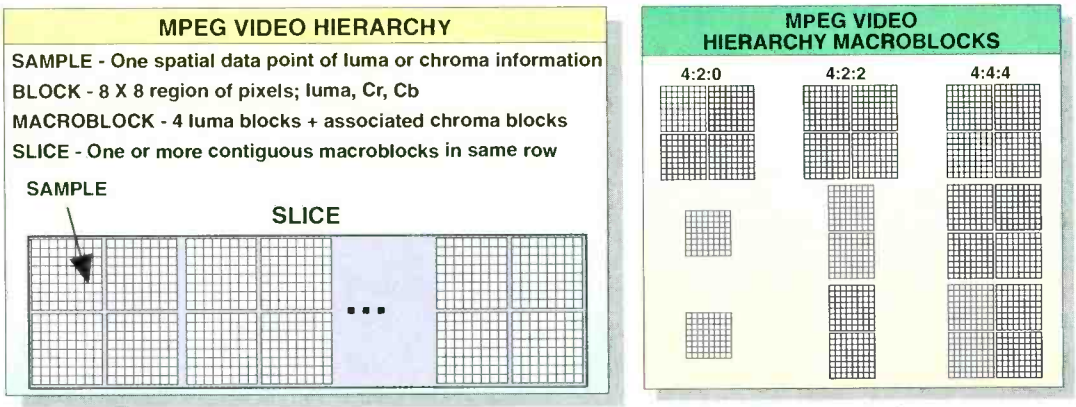

Figure 1. The MPEG video hierarchy specifies samples, blocks, macroblocks and slices. The amount of information contained in a macroblock can vary based on chroma sampling.

ly reduce bandwidth requirements without serious apparent image degradation. However, the combined effects of these techniques are not reversible. If used improperly, they run the risk of causing serious image defects as well as unforeseen problems at some subsequent point in the distribution chain.

Basics

For many, the first question is: "Why do we need compression?" The simplest answer is that there is too much data to move and store efficiently. Attempting to record portions of the real world on finite recording media requires compromises. Again, using film as an example, each image contains considerable information, but with only 24fps, quite a bit can happen between frames. This can be remedied by increasing the frame rate, however, doubling the number of images per second doubles the amount of film stock required. This becomes expensive quickly and is not necessary in most instances, due to the forgiving nature of the human visual system.

Today's video systems are capable of the equivalent of fairly high data rates. For instance, 8-bit NTSC requires a data rate of approximately 115Mb/s, while 525 component digital requires 270Mb/s. Proposed ATV data rates are 1,200Mb/s, however, current proposed transmission schemes are only designed to transmit approximately 20Mb/s. Transmitting ATV signals will require a compression of 60:1. Using the same 60:1 compression on 525 serial digital yields a data rate of 4.5Mb/s, which would allow four or more program channels to be transmitted within a 6MHz channel. Four basic methods are used to compress images: information reduction, lossless compression, spatial compression and temporal compression.

Information reduction can be accomplished by such techniques as interlace, reducing the sampling rate and/or reducing the number of bits used in quantization. Another technique is image decimation, where every other pixel is removed using filtering techniques. Depending on the ap-

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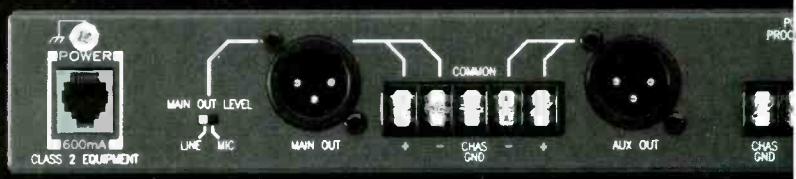

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plication, the entire pixel or just the chrominance information may be removed.

In essence, this is what happens when 4:4:4 is subsampled to 4:2:2. If necessary, interpolators can be used to restore the entire image during playback. However, if a decimated image was recompressed, and the codec kept the interpolated pixels and discarded the remaining original pixels, image integrity could be destroyed after several compression/decompression cycles.

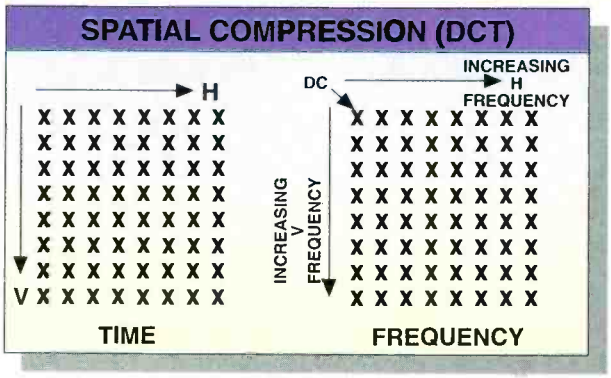

Figure 2. For spatial compression, the discrete cosine transform (DCT) is used to convert time-based data to frequency-based data.

Beyond these techniques, proper signal handling can be an effective tool when compressing an image. Crisp, clean signals compress far better than noisy images. Starting with the highest-quality signals will produce the best results in terms of compression ratios obtained and final image quality.

One of the first steps is to properly filter the signal, removing unwanted frequencies that can result in aliasing. Noise should be minimized because it prevents signals from compressing properly. Noise can distort the image, making identical areas appear different. Additionally, bits used to compress noise cannot be used to compress picture content. It's not just a few bits either, a disproportionate number of bits are required to compress noisy images. By definition, noise is random, and compression systems that work by removing redundancy fail to work when the image is full of random noise.

Lossless compression is next, although many times, lossless techniques are applied at the end of the process. Lossless compression is the equivalent of PKZIP and is completely reversible. However, the amount of compression obtained is usually inadequate for use by itself. Statistical coding methods, such as run length and entropy (variable-length) encoding are applied to the data.

Typically, data is formatted in a manner that results in long strings of equivalent numbers (usually zeros) and then run-length encoded. Entropy encoding assigns the shortest symbols to data strings that occur most often. Data that occurs less often is assigned longer symbols.

Morse Code is an example of entropy encoding, frequently transmitted letters, such as "e," "t" and "s" are assigned short codes. Because of this, Morse Code is approximately 25% more efficient than if the codes were assigned at random. By analyzing the data before symbol assignment, entropy encoding can take advantage of redundant data.

Normally, a table is included with the compressed file to provide look-up information as to what data is assigned to which symbols. Depending on the actual data at hand, this technique may result in a compressed file larger than the original (because of the table), in which case, most algorithms default back to the original file. Some systems have predefined tables that do not

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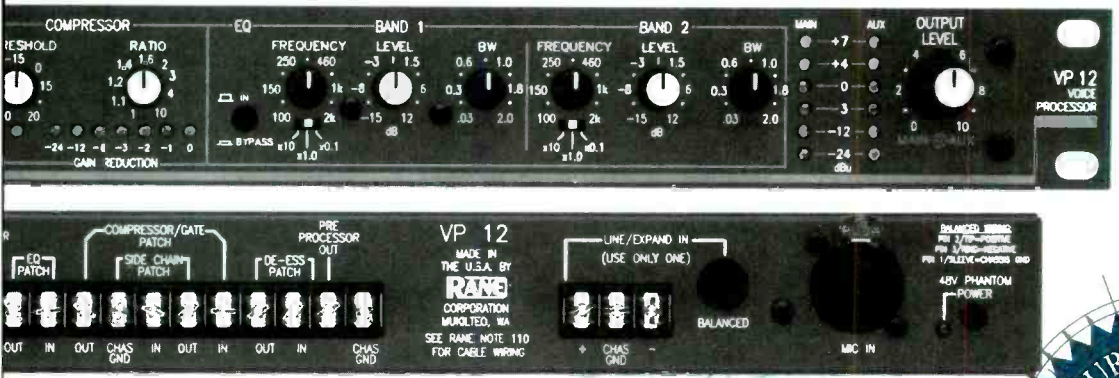

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need to be transmitted with the file, however, because the tables are somewhat generic, they do not work as well as file-specific tables.

Spatial compression is used to reduce the data needed to transmit static images. The JPEG algorithm is a common example of this type of compression. Frequency domain techniques, such as the Discrete Cosine Transform (DCT), are used to transform the image from the spatial domain to the frequency domain. Through careful choice of coefficients, the algorithms can be tuned to the desired response.

Temporal compression is used in conjunction with spatial compression. It is assumed that for a series of images, like those obtained from film or TV cameras, that a particular image is similar to adjacent images. For continuous recordings, this assumption is true, however, for edited footage, or when the recorder is stopped for a length of time, problems can arise.

Temporal compression is ideal for sending static images. A spatially compressed image is sent along with information on the amount of "hold" time required. Because of the possibility of errors that can propagate through the image, some form of periodic image refresh is necessary. For most implementations of MPEG-2, at least two "refresh" images are sent every second.

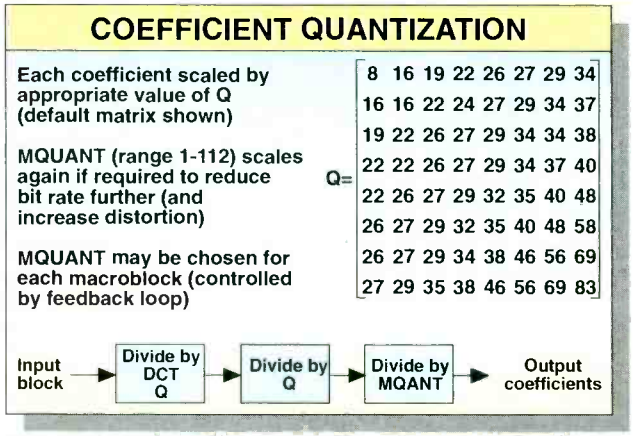

Figure 3. Each DCT coefficient is scaled by an appropriate value of Q. The default matrix is shown, but Q values can be tuned if desired. MQUANT may be controlled using feedback from the operator or buffer/datastream requirements.

Spatial compression

Most DCT-based algorithms divide the image into a series of blocks. (See Figure 1.) Blocks consist of 8x8 groups of samples. Compression systems generally process component video only, decoding composite video internally. Samples are defined as one spatial data point of luma or chroma information. Macroblocks consist of four luma blocks and their associated chroma blocks. One or more contiguous macroblocks in the same row are considered a slice.

Each block is transformed from the time domain to the frequency domain using the DCT. The DCT process is virtually lossless and results in a single DC coefficient that is placed in the upper left corner of the 8x8 matrix, along with 63 coefficients representing the frequencies found in the 8x8 block. (See Figure 2.)

Next, the coefficients are quantized, which results in lost information. Much of the information lost is based on how the algorithm is tuned. Additional information is lost based on a variable that scales the quantized array based on output data rate requirements. Once scaled, the coefficients are scanned and then entropy and run-length encoded.

It should be pointed out that the MPEG specification only determines how an image is decoded. Because of this, encoders need only produce an MPEG-compliant datastream, allowing future MPEG-compliant datastreams to be decoded using existing hardware.

Temporal compression

Temporal compression takes advantage of similarities between a group of related images. Three types of frames exist in temporally compressed streams. The first (and usually last) frame is an *intra* ("I") frame. "I" frames are spatially compressed and provide a starting point for the algorithm.

Predicted ("P") frames are next. These are assembled by finding similar blocks in a previous I frame and providing a motion vector to indicate the block's new position.

Bidirectional ("B") frames use adjacent I and P frames to compute macroblock locations. A group of pictures (GOP) may contain all three types of frames in any order, as long as the output stream can be properly decoded.

To accomplish MPEG compression, the system must first generate the necessary I frames for each GOP, then P and B frames are computed. The results are run-length and variable-length encoded. Typically, the data must be placed into some type of ongoing datastream. For this, the data is packetized and packet headers are added. Packets are multiplexed with other information (e.g. audio and data) into a buffer.

Based on how full the buffer is, quantizer scaling is adjusted. As the buffer fills, the

Continued on page 116

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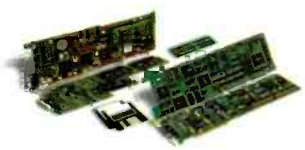

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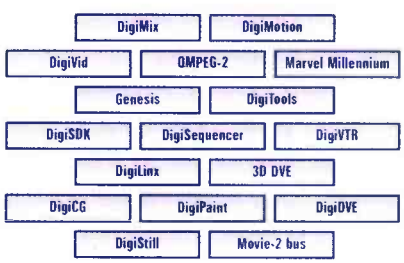

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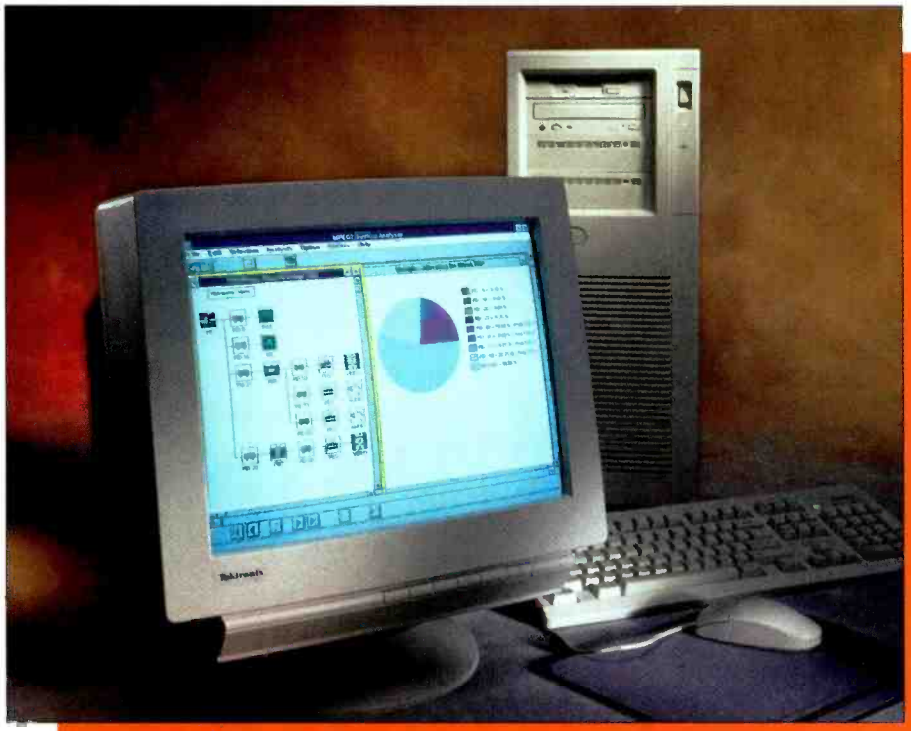
By David K. Fibush



The Tektronix MTS 100 can be used to generate and test MPEG-2 transport streams.

The Bottom Line:

As computers become commonplace, so too are compressed datastreams. Equipment that tests these streams must be capable not only of providing some form of readout but also of analyzing the various layers under test. The process is more complicated than it first appears, and it requires considerable expertise, as well as sophisticated equipment. Preparing for this fundamental change in the way systems are tested will smooth the transition to ATV. $

Testing MPEG-compressed signals

To fully test compressed datastreams requires a thorough understanding of the various layers involved.

Editor's note: If you examine the above photo closely, you will see a fundamental change in test equipment. Just as the equipment has changed, so too must the methods used. As compressed digital video datastreams move closer to the mainstream, engineers will be required to troubleshoot these packetized streams. The equipment required is different from traditional test equipment, and so are the troubleshooting methods required. To adequately understand and troubleshoot these new "data-based" systems will require some shifts in the thought processes involved. The following article sheds some light on these new processes. What may at first seem extraordinarily complex will begin to appear as a natural evolution of the troubleshooting process as these concepts are defined. Some who have worked with digital may already be familiar with these concepts, however, rest assured that as today's analog equipment is replaced with digital, engineers that wish to remain current will be required to adapt to these new technologies.

Over the half century of widespread television use, there has been a relatively simple model for analyzing video systems and providing test methods. Testing is performed at one interconnection generally carrying a composite PAL or NTSC signal. A single measurement instrument can analyze the operational aspects, such as signal level or color balance and the data formatting (sync pulses). This analysis of the signal quality through the transmission path using a suite of test signals does an adequate job of characterizing resulting picture quality. For in-studio transmission of signals on copper or fiber, a separate piece of test equipment is used to ensure the continuity of the physical layer (cabling and connectors). Long-range transmission is by amplitude or frequency modulation on a carrier, however, the channel characteristics of the video are still determined by analog measurements, such as those specified in ANSI T1.502.

With the advent of digital television over the past 15 years, a more complex system and set of functional layers has been used as shown in Figure 1. The analog signal is converted to digital in accordance with a sampling standard, such as Recommendation ITU-R BT.601. Formatting and studio interconnection of the digitized signal follow a related standard, Recommendation ITU-R BT.656, leading to an extension in the functional layers and the variety of tests to be performed. For operational purposes,

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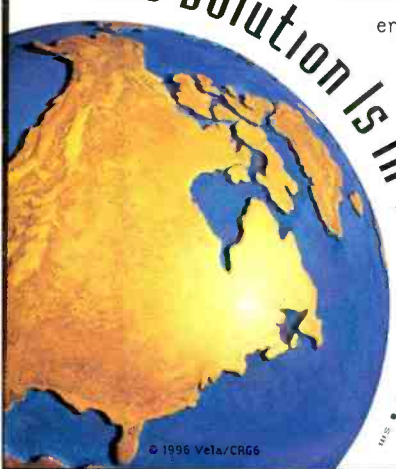

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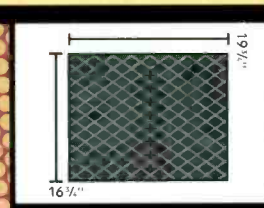

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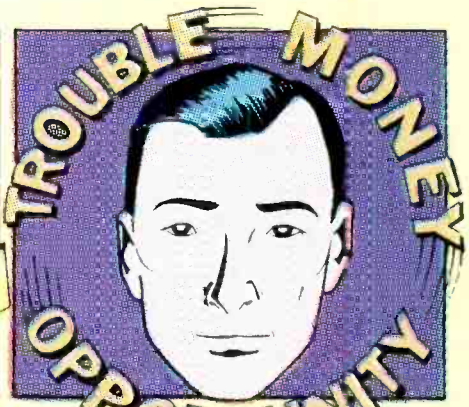
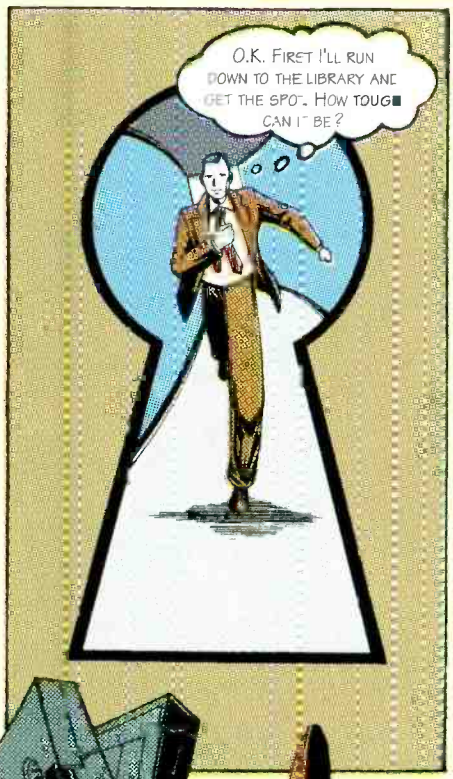
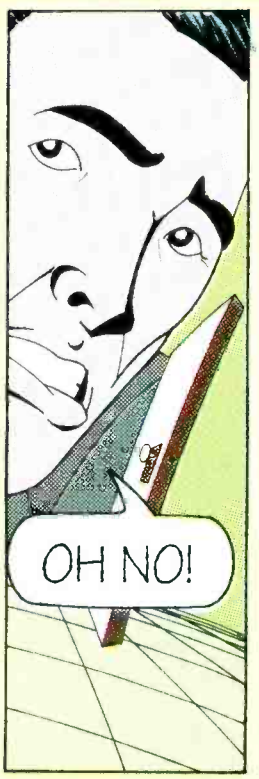
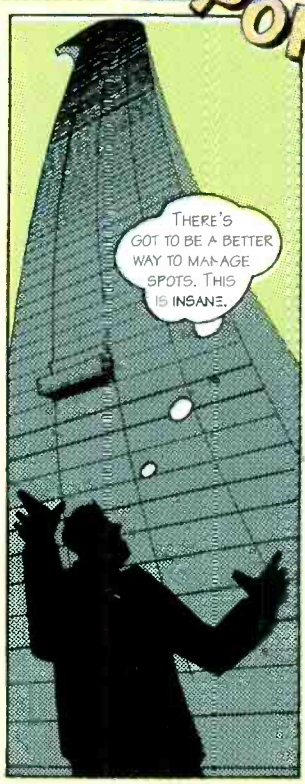
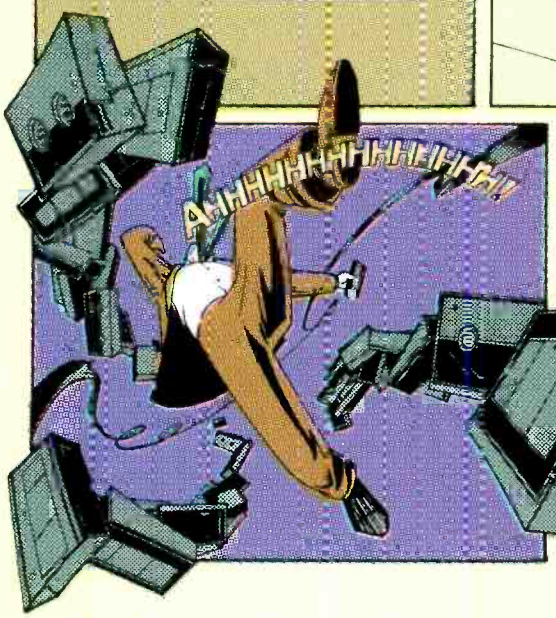


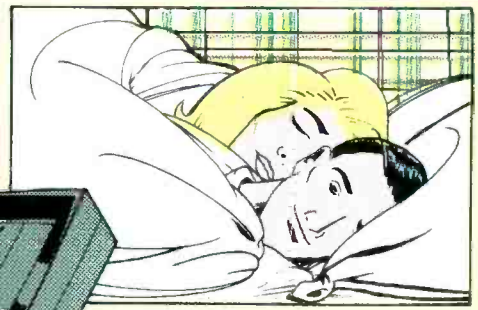






FINALLY CANAVAN LOCATES THE CASSETTE.





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SEAMLESS DIGITAL VIDEO INTEGRATION IN AN ANALOG WORLD

Developing and establishing maintenance and test programs for today's multi-format, sophisticated broadcast and post production facilities are becoming tasks of enormous importance. In a world full of transition considerations, implementation nightmares and multi-format conversion compatibility concerns, moving from an analog facility to the digital domain is an engineering challenge that cannot be easily dismissed. Technology changes and obsolescence considerations add to the overall scheme, making the job of running an effective broadcast and post production facility a true challenge. On top of all this, we are asking our engineering and operations staff to keep working at top speed — to never miss a beat — while they learn the new digital video transmission standards. The differences in testing philosophy between digital and analog systems are vast. Bridging the gap between analog and digital systems, and successfully integrating digital islands within an analog world, has been a costly and cumbersome task until now ...

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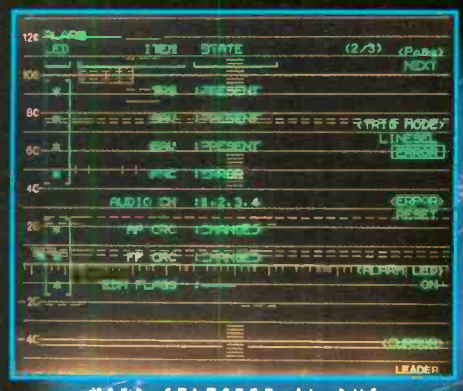

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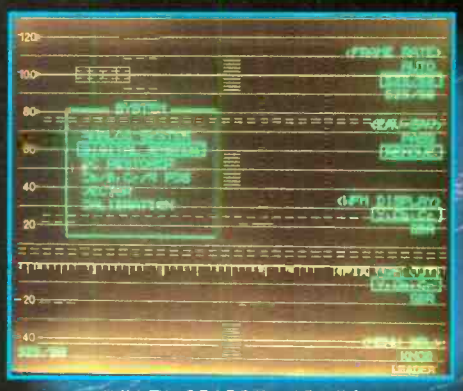

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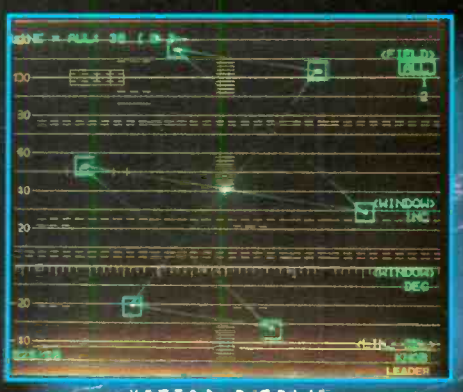

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the monitoring of analog video signal properties is still key; however, this signal must be processed from the digital data.

Where testing of the analog signal required only that various parameters be measured on a single waveform, digital testing requires analysis of the digital waveform, digital data formatting and digital signal coding in addition to the resulting analog signal. Although all of these measurements can be performed with a signal instrument, there is significant processing between each pair of layers with different analysis methods for each layer.

Prior to the advent of digital compression techniques, transmission of this higher-quality signal was handled by conversion (and compression) back to the composite analog domain. The analog-to-digital and digital-to-analog conversion does introduce some signal quality degradation beyond that of the basic NTSC or PAL analog signal. ANSI T1.502 is presently being updated to add appropriate signal quality tests to account for these conversions.

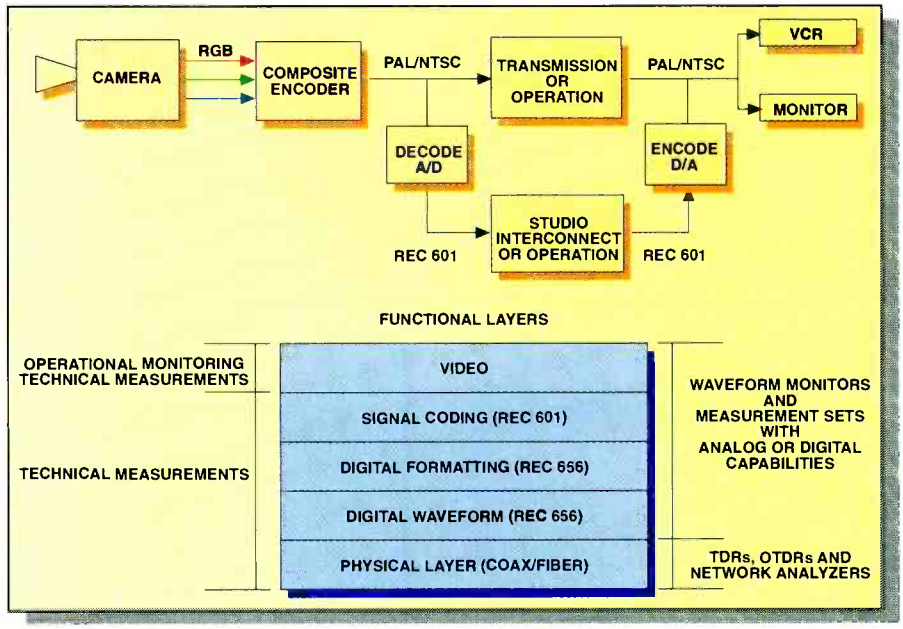


Figure 1. Block diagram of a typical uncompressed video system, along with a depiction of the layers involved and the test equipment used.

Digital testing requires analysis of the digital waveform, digital data formatting and digital signal coding in addition to the resulting analog signal.

The convergence of television and telecommunications has greatly expanded the number and varieties of layers to be considered for test and measurement applications. This results in a much larger set of technologies to be understood by the TV engineer and the communications engineer.

MPEG-2 TV/transmission system

An overview of compressed TV processing and transmission is shown in Figure 2. Television nominally consists of audio and video; however, the system shown includes data and control signals and so may be thought of as a multimedia system. Only single-direction transmission is shown. Interactive operation requires some or all of the elements to be available in the reverse direction. A multiplicity of methods are depicted, particularly in transmission, making this diagram an overview of many types of applications. MPEG-2 is used because of the variety of datastreams already defined, and because it provides for inclusion of other data at the system level.

For completeness, analog TV inputs to the system are shown, although many facilities are likely to be primarily digital. Video and audio are transformed to standard digital formats by analog-to-digital converters. Digital audio is generally directly accepted by the audio coder, whereas digital video is more likely to require preprocessing. MPEG-2 compression requires component video, therefore, composite inputs must be decoded. The decoders are often included in MPEG-2 encoder/compression products.

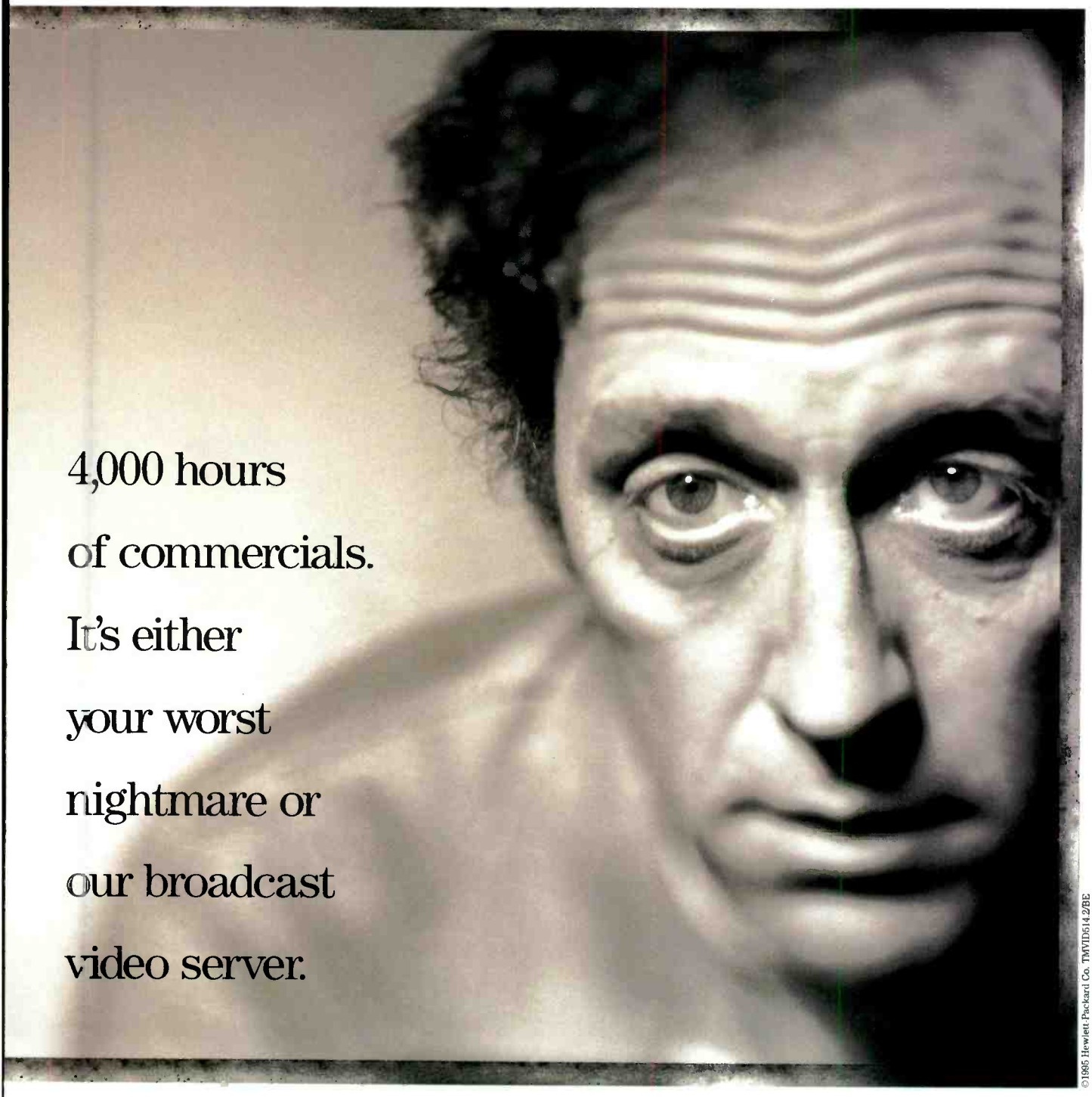
There are separate MPEG-2 standards documents covering video decoding, audio decoding and system data formatting. Digital data from each of the coders and other sources is first formed into packetized elementary stream (PES) packets and then multiplexed and reformatted into an MPEG-2 transport stream. The transport stream is different from an MPEG-2 program stream and uses fixed-length packets. It may carry information on a multiplicity of programs.

The "other similar channels" are other program sources that could be included in the transport stream. Each program source would likely include multiple audio sources and possibly multiple video, data and control sources. The transport stream with its fixed-length packets of 188 bytes each is specifically designed for long-range transmission.

Today, a large number of computer and telecommunications standard interconnect methods are being used to move packetized data within and between facilities. Because of the characteristics of media-based recording, particularly tape, special formatting, channel coding and error protection are built in to recorders. This makes recording and playback look like an error-free process. Traditional wire or fiber telecommunications channels have relatively low error rates; however, some optional error protection may be required to meet the error-free criterion. ATM, which is a packetized protocol riding on various transport layers, may even be considered for interconnection within facilities. Radio frequency communication has its own channel-coding methods and always includes error protection.

The convergence of television and telecommunications has greatly expanded the number and varieties of layers to be considered for test and measurement applications.

The decode end of the process is basically a reverse of the encoding. Following the transport stream demultiplexing and signal decompression, set-top output processing might be the conversion of 24Hz progressive scanned film to a higher frame rate for viewing. Pan-and-scan data transmitted with the picture could be used to convert 16x9 or 2x1 images for viewing on the available display, taking into account its particular aspect ratio.



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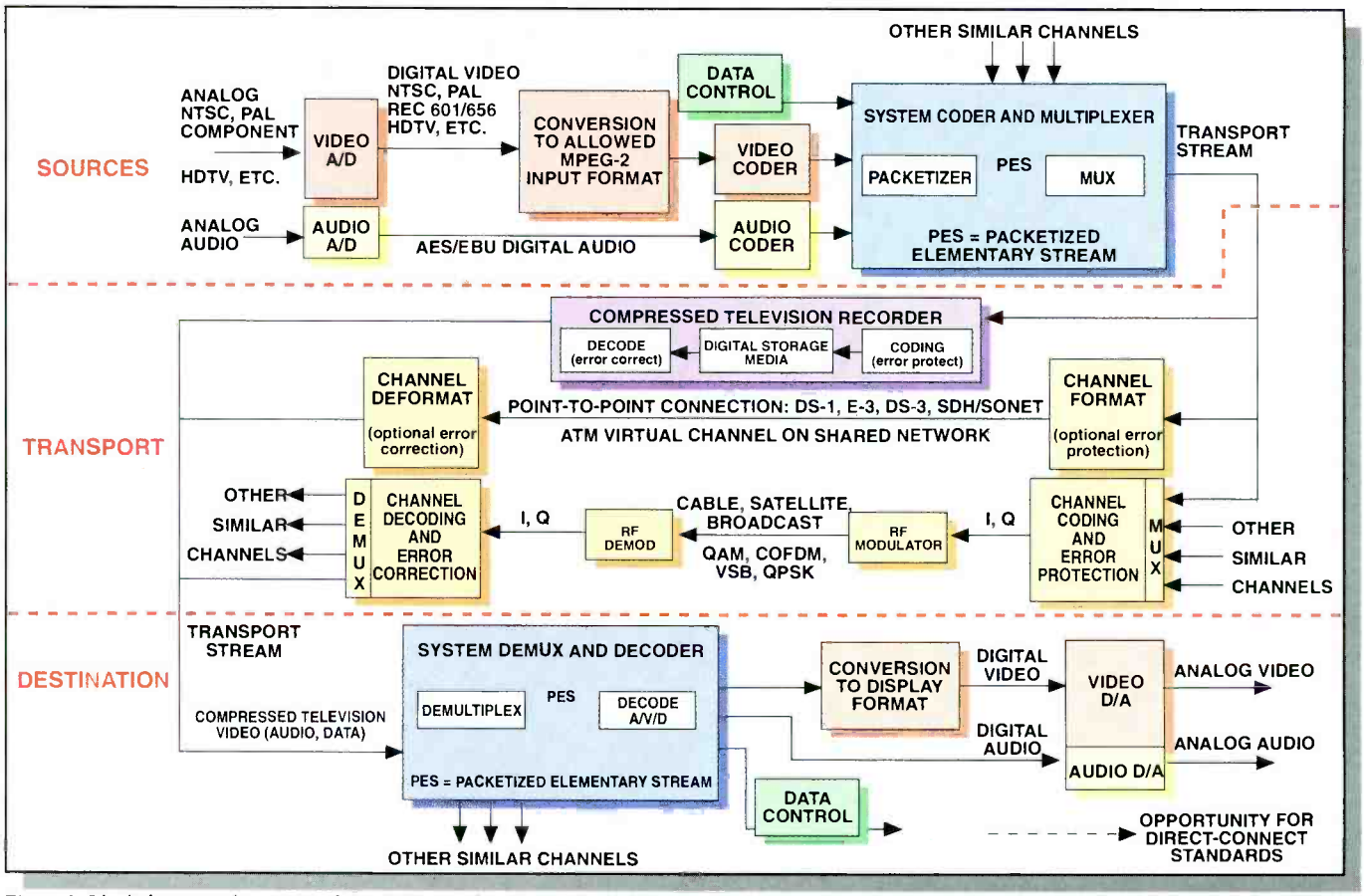

Figure 2. Block diagram of compressed TV processing from source to destination. Diagram depicts various possible transmission paths. Additional explanation can be found in the text.

Functional layers

With the convergence of television and telecommunications, not only are there many more layers for the test engineers to consider, but there are various possible paths with different layers. Figure 3 shows some of the paths and layers that are possible. Emphasis is on intrafacility and broadband transmission. However, the Digital Video Broadcasting (DVB) and Grand Alliance (GA) systems do include RF and cable transmission methods to carry the transport stream data.

There is no agreed-upon physical layer for basic transport stream interconnections, although many have been devised. Shown in the diagram are three possible interconnections with functionality ranging from intrafacility to across continents.

Serial digital interconnect (SDI) is the Recommendation 656 worldwide standard used for serial digital video. A suggested method of carrying packetized data over the same cabling and switching hardware is called serial digital data interconnect (SDDI). The SDH/Sonet telecom methods are well-established worldwide and can directly carry the MPEG-2 transport stream with simple data formatting, although there currently is no standard. Looking toward the future, ATM is a likely candidate for transmission of packetized data, certainly for long distances and perhaps within a studio.

To use ATM, a special adaptation layer is used to map the 188-byte transport stream packets into the 53-byte ATM packets. The DVB group in Europe is working on studio-type interconnections, parallel and serial, to be used with digital TV transmission in compliance with European telecommunications standards for cable and satellite.

MPEG-2 compression requires component video, therefore, composite inputs must be decoded.

Testing layers

A wide variety of testing functions are possible and required for the many avenues available for multimedia transmission. Figure 4 shows appropriate levels of testing — uncompressed audio or video, compressed data and transmission system. Quality measurements at the uncompressed level now consist of two parts: signal quality and audio/picture quality. Signal quality measurements are made with a suite of relatively simple test signals that will determine transmission channel parameters. In a completely uncompressed system, these tests will give a good characterization of audio/picture quality. This is not true for the compression/decompression part of the system. Traditional test signals are relatively simple compared to a natural scene and are easily compressed with little distortion or loss.

Evaluation with such signals is still important because they appropriately test the uncompressed parts of a system that may be quite extensive. However, due to the ease of compression, these signals do not evaluate the encoder/decoder process. Natural scenes can be much more complex, stressing the capabilities of the encoder and thereby producing non-linear distortions that are a function of audio or picture content.

Today, measurement of audio or picture quality is accomplished by subjective methods, people evaluating the resulting quality. In its more scientific forms, this takes a large amount of time and resources. Accomplished by expert observers, subjective evaluation is still not calibrated in any meaningful manner and is certainly not automatic. Considerable effort is being expended in research laboratories to develop objective quality

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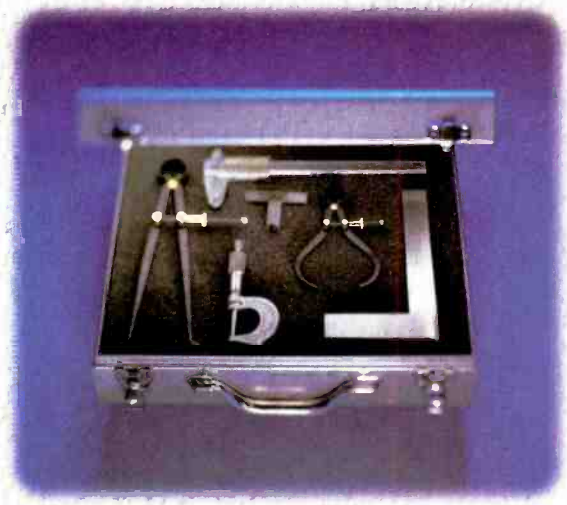
The MPEG-2 compression standard is being rapidly adopted worldwide. In the U.S., MPEG-2 is the basis for upcoming ATV digital transmission formats. Even the newly agreed-upon Digital Video Disk (DVD) distribution format complies with MPEG-2.



But MPEG-2 is more than a single standard. It's more like a tool kit: a set of compression tools that can be combined in different ways to serve different applications.

The transmission and distribution systems listed above are well served by one "profile" within the MPEG-2 matrix. The so-called Main Profile, Main Level. Exclusively confined to 4:2:0 component signals, it's designed to deliver subjectively high-quality pictures to the consumer. Today, compression technology is moving up the digital food-chain – and bringing important new efficiencies to studio production and origination.

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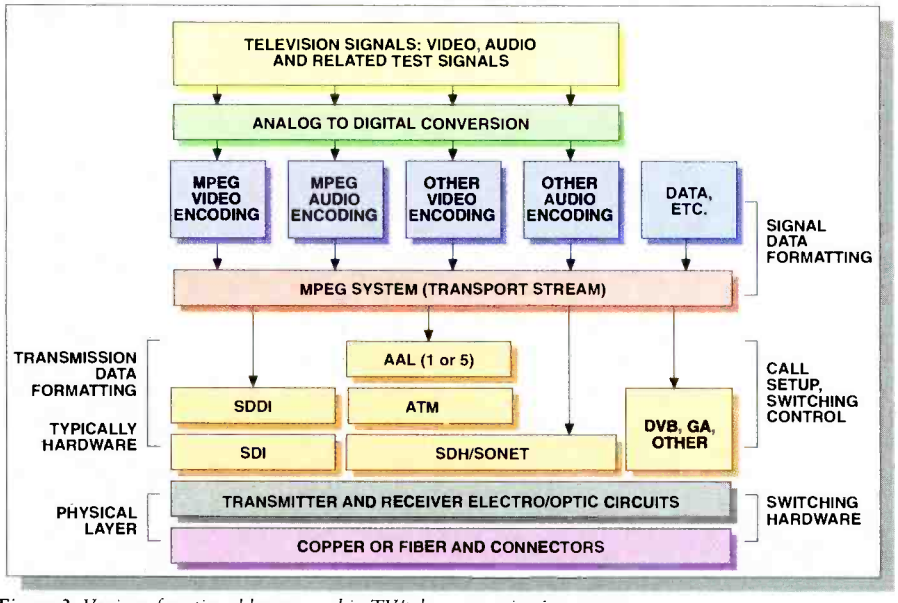

Figure 3. Various functional layers used in TV/telecommunication systems.

measurement methods and determine their correlation with subjective results. A related standard is being developed by the ANSI T1A1.5 committee. However, in the scope it states, "Experimental results indicate that the objective measures presented here are insufficient to predict viewer responses with the accuracy needed to discriminate similar systems." It further states in the purpose, "This standard is intended to be especially useful as a basis for comparing the present operational readiness of a system with the same system's past performance." In the present situation, there is no commercial equipment available to measure audio and picture quality. Methods to provide resolution equivalent to traditional signal quality measurements have not yet been developed.

For a majority of the TV transmission systems, the MPEG-2 transport stream is the common denominator at the compressed data level. The syntax and semantics for the compressed data and the transport stream are well-defined. Although there is a lack of established intrafacility interconnection methods, equipment is available to generate and analyze the transport stream.

There is an extensive amount of information in the transport stream. It is important for test equipment to provide analysis information in a logical and convenient manner. The MPEG-2 system definition provides a convenient approach to analysis. Each packet and table type has a defined structure consisting of header field data and, in most cases, a payload. In order to analyze a transport stream, it must be relatively error free. Because of the complex structure of the transport stream, large numbers of errors will completely confuse any analysis scheme. Therefore, bit-error-rate (BER) measurements are more appropriately made by traditional transmission test equipment or by generating a transport stream with known and simple pseudo data.

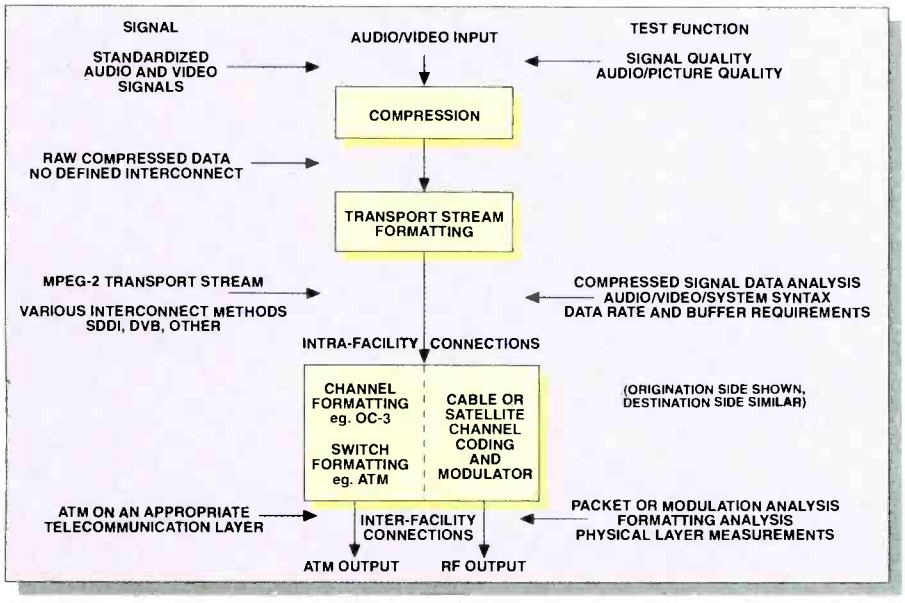

Figure 4. Signals and test functions used at various TV/telecommunication layers.

Considerable effort is being expended in research laboratories to develop objective quality measurement methods and determine their correlation with subjective results.

Generally, transmission systems have a low BER, say 10^{-12}, at which test equipment has difficulty in determining that errors have occurred (due to the long measurement times). Header analysis becomes useful to determine if these low rate errors are occurring. It also emphasizes conformance to the standard, compatibility among interconnected equipment, and the results of processing in multiplexing or demultiplexing programs into or out of a complex transport stream.

A number of possible interfacility transmission methods have been previously described. Many are well-established, such as SDH/Sonet and cable television, with a variety of effective test equipment available. ATM is an emerging technology with new test equipment on the market and in development.

Adaptation of traditional communication test equipment to analyze or interconnect with MPEG-2 transport streams is on the horizon. Fully understanding the basics of MPEG-2 program and transport streams and how to test them may be critical to the future success of you and your facility.

David K. Fibush is in charge of development and marketing of products for compressed TV systems at Tektronix, Beaverton, OR.

For more information on systems used to test MPEG streams, circle (150) on Action Card.

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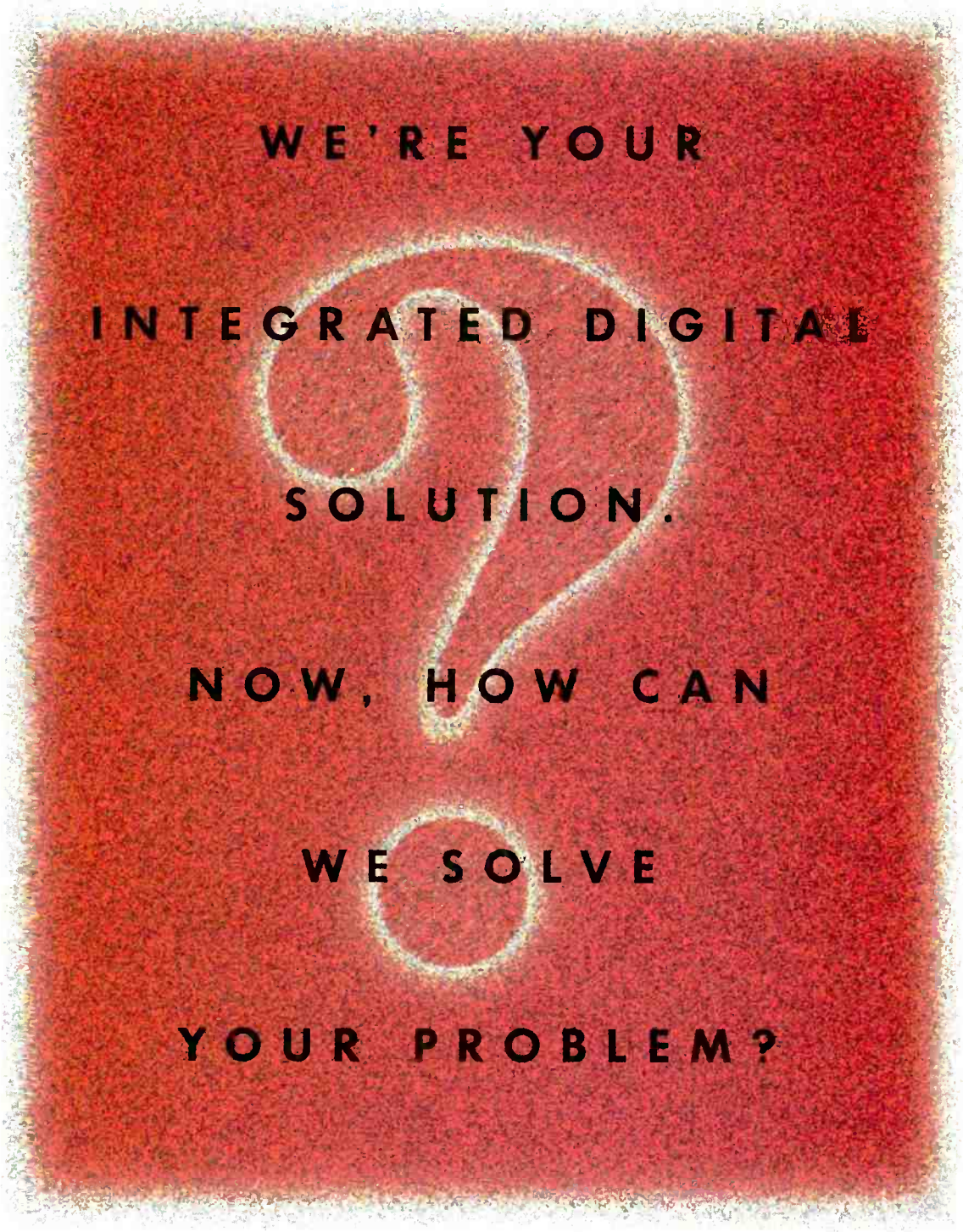

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By Terry Skelton

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The wider screen of tomorrow's television will make TV watching a more cinematic experience. The audio that accompanies this expanded image will also borrow from the film world, using some of the latest digital techniques developed for theatrical surround sound. But some questions remain unsettled on how broadcast facilities will implement ATV audio systems. $

A few years ago when multichannel TV sound (MTS or "stereo television") was introduced, some broadcast facilities' audio systems became obsolete overnight, sometimes right down to the transmitter. Income didn't increase to offset the added costs of stereo, but the change had to be implemented to stay competitive nonetheless. The conversion is still not complete — some stations remain monaural today, while others have gone only half way by using stereo synthesizers.

Yet, for those who found the stereo conversion daunting, the *next* change in TV sound that lurks on the horizon will be so drastic, so sweeping and so expensive, that the introduction of MTS will seem but a tiny and distant memory.

Of course, this change is ATV. All of the discussion about aspect ratios, lines of resolution, frame rates and auxiliary data makes it easy to forget about *sound* in the ATV world, but there will be significant impact to the audio side of TV operations with the new system. The recent establishment of a transmission-format standard for ATV is just the tip of the iceberg, however, generating far more questions than answers as to how this will be accomplished.

Once and future formats

Mono TV audio was simple enough to understand, although even today there are less-than-perfect implementations of it. Stereo required a hard look at procedures and facilities. From a production perspective, the format evolved into feeding mono dialog equally to both left and right channels and putting music, ambience and sometimes effects in stereo. Technically, a sum-and-difference multiplex system (similar to FM radio's) ensured backward compatibility to mono televisions.

Surround sound followed right on the heels of stereo. Using a variation of the Scheiber matrix system used earlier on quadraphonic LPs, four "channels" of sound (left, center, right and surround) could be encoded on the 2-channel MTS system, and decoded with appropriate receiver hardware. Using this so-called 4-2-4 method, mono, stereo and surround remained fairly compatible. Programs were produced in stereo and checked for compatibility down

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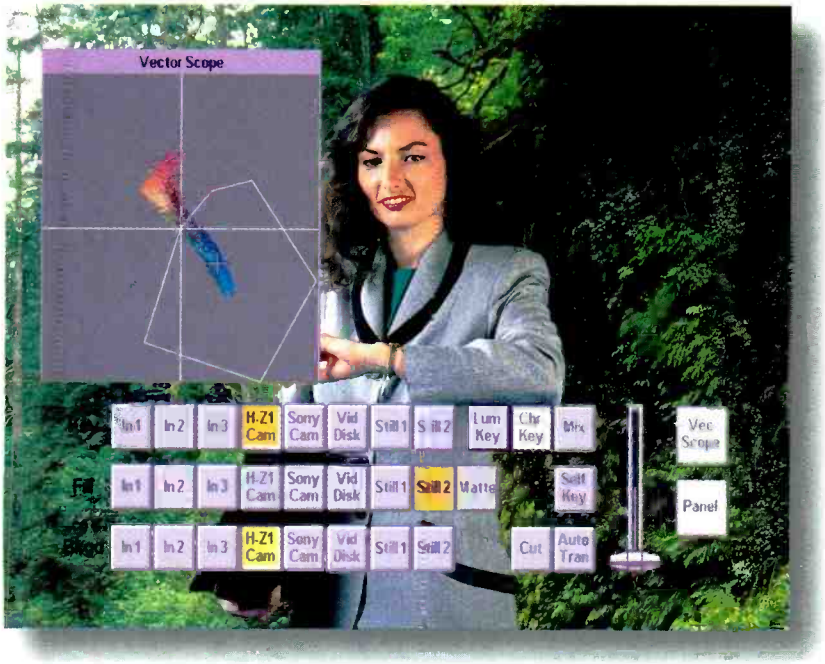

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to mono and up to surround (through a decoder in the control-room monitoring system) to verify that the audio mix worked in all three variations. More advanced facilities produced programs in surround sound *per se*, by installing surround *encoders* for more direct control over surround effects.

With ATV, the TV industry will inherit the most popular motion-picture sound format of the day known as *5.1-channel*. Building on the matrixed surround-sound format, 5.1 provides three channels across the front (left, center and right) and *two* surround channels, left and right. All of these have full fidelity. An additional narrowband channel (hence the .1 nomenclature) is provided for low-frequency effects (LFE).

As with matrixed surround sound, 5.1's use of three front channels solves the problem of *center channel pull* and locates dialog right at the screen where it belongs, no matter where the viewer is sitting. Unlike matrixed surround, however, 5.1 includes not one, but two rear channels ("stereo surround"), which provide much more realistic ambiences and allow specific movement of effects from front to back, left or right. These surround channels also have the same frequency response as the front channels, unlike the matrixed format's surround channel, which exhibited a substantial high-end rolloff. Finally, the 5.1 format also provides a dedicated subwoofer feed for the mix engineer, as opposed to simply feeding the center and/or other channels' output via a low-pass filter to a subwoofer.

Beyond the sheer number of channels, however, the 5.1 format's greatest improvement over standard surround sound is its ability to keep its channels in *discrete* form from the mixing console to the viewer's listening room. This is significantly different from the 4-2-4 method of deriving multiple channels from a 2-channel transmission medium by phase, amplitude and other trickery in the encode/decode matrix.

In addition to its inclusion in the Grand Alliance's ATV system, the 5.1 audio format is already offered on some video laserdiscs and players, and will be included in the upcoming digital video disc (DVD) format.

The process selected by all of these systems for incorporating 5.1-channel audio is the *Dolby AC-3* format. It is a digital encoding process that uses data reduction for a nominal data rate of 384kb/s. (See "Data Compression 101," September 1994.) In terms of spectrum efficiency, this compares favorably with the 2-channel CD data rate of 1.4Mb/s. (Dolby has recently announced that AC-3's use in ATV, DVD and other set-top devices will be marketed under the format name "Dolby Digital.")

Using 5.1 discrete channels avoids the compromises that mixers had to make with matrixed systems and minimizes the variations among different decoding environments. Broadcasters will still have to deal with backward compatibility, however. The 5.1-channel mix will have to still sound good in all forms of 4-2-4 matrixed surround sound, standard MTS 2-channel stereo and mono. A critical difference between formats is that in MTS the left and right channels include *all* of the audio information, whereas the left and right channels of 5.1 do not.

My router needs how many audio channels?

This leads to a number of yet-to-be-resolved issues. If broadcasters end up simulcasting NTSC and ATV, how will the two audio systems be fed during locally originated programs? One solution involves the creation of a stereo mix and a 5.1 mix at the audio console, feeding one to the NTSC transmitter and the other to the ATV transmitter. This would require a sophisticated console or automation system and the routing and recording of up to eight channels of audio.

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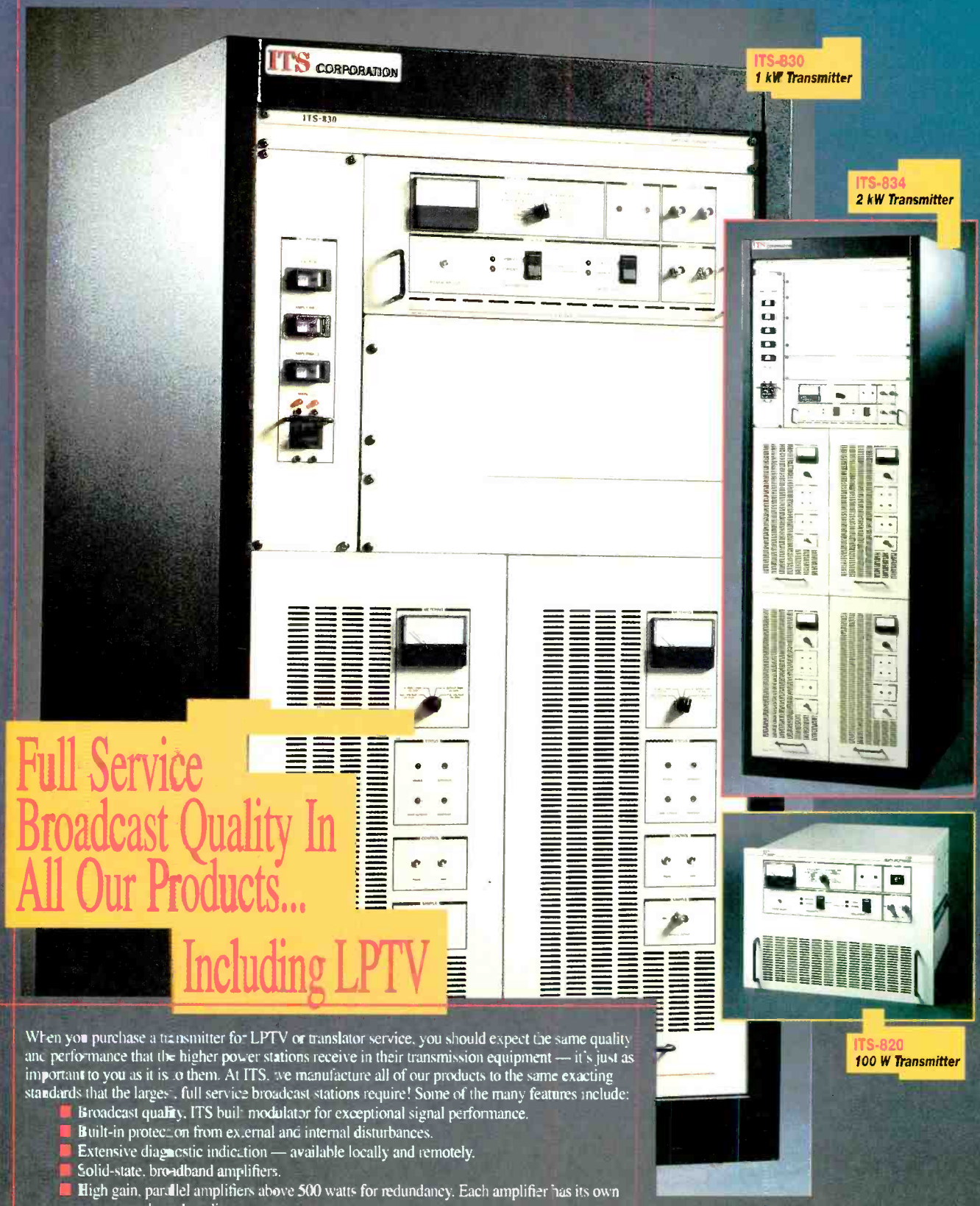

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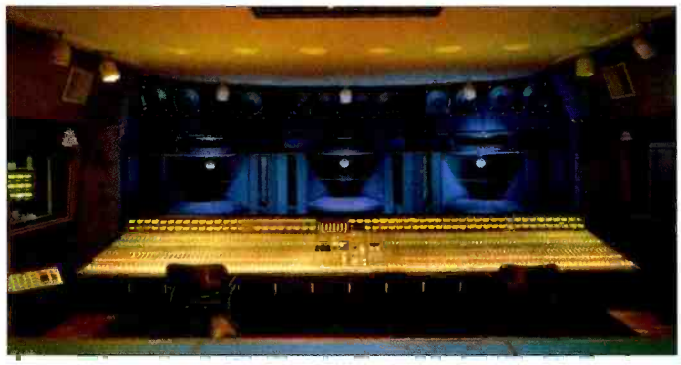
does offer an outboard adapter that turns its DVTRs' four audio channels into 16, using a proprietary coding algorithm.)

Even if you only want to create 5.1-channel audio, you'll still need six matrix levels in the router and six channels of audio on recorders.

Alternatively, you could route and record AC-3-coded signals as a single 384kb/s stream through the facility, but this would require many AC-3 encoders and decoders. AC-3 encoders currently cost $50,000 each.



This surround-sound mixing room at NHK in Tokyo features a Solid State Logic SL8056 console.

Dolby Labs is the only manufacturer of such encoders at present, and the company naturally expects these prices to drop over time. There is also uncertainty about how many encode/decode passes AC-3 can handle before audible artifacts occur. AC-3 was intended to be a 1-pass, final delivery system. Dolby recommends that for production or whenever any downstream encode/decode passes are expected, a higher AC-3 bit rate be used, perhaps 640kb/s. Before final broadcast, the AC-3 stream would have to be downconverted to the 384kb/s ATV standard.

Dolby also cites features in the AC-3 encoder that allow adaptive adjustment of how a program's 5.1 audio channels will "downmix" to matrixed surround, stereo or mono. Given this and other encoder controls (including dynamic-range reduction), Dolby recommends that broadcasters mix their programs only in 5.1, and let the AC-3 encoder handle the conversions to smaller formats.

This would clearly take a considerable burden off of the live TV mixer. Nevertheless, audio mixing for various formats of motion-picture releases today are still done separately for each type: theatrical digital, theatrical analog, laserdisc, videocassette, television and so on. How well the "automatic" downmixing would work in the often hurried world of live television remains to be seen. In any case, mix engineers in control rooms, edit rooms and master control rooms will require the capability to monitor all formats, and to switch easily and frequently between them. The 2-channel stereo feed for the NTSC transmitter could be generated from the downmixed stereo output of an AC-3 decoder.

Other complications

The AC-3 encoder/decoder, like all digital devices, will have a certain amount of processing delay. While it is presumed that the Grand Alliance ATV system will synchronize audio and video if you use a downmixed AC-3 decoder output for the NTSC stereo audio feed, you'll have to delay the NTSC video to maintain lip-sync.

The issue of separate broadcast audio processing (dynamic range control) for the NTSC and ATV audio air chains will also have to be managed.

At present, audio or video cannot be *mixed* into the ATV digital datastream. This means that until new equipment is developed, stations will only be able to *switch* to and from

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The production control room for NBC's Studio 8H and mixer Bob Palladino handle the live air mix for SNL. Note multiple monitoring systems, including large speakers overhead (L-C-R), stereo pair on console meter bridge and mono mini-speaker next to video monitors.

ATV network feeds, making live voice-overs or video overlays and the like impossible on the ATV transmission feed.

However, 5.1-channel audio is managed, future TV audio routing and recording systems will still have to handle SAP, time code and possible future auxiliary data channels.

Available equipment

Thanks to the film industry, there are existing audio consoles that can handle the six or eight mix buses and necessary panning between them that TV mixers will require for ATV audio production.

It is highly recommended that broadcasters convert all of their monitoring facilities to 6-speaker surround (left, center, right, left surround, right surround and subwoofer) for future ATV monitoring. In the meantime, these speakers can be fed by a decoder using *Dolby Pro Logic* (the state-of-the-art in matrixed surround-sound decoding) so they can truly hear what they are broadcasting to the home-theater listener.

It is also recommended that stations begin mixing and broadcasting in surround sound (using a matrixed surround encoder) to get staff used to the concept and practices. Local programming and spots will audibly benefit from this on home-theater systems.

Overall audio quality should also be checked and improved where necessary. The basic audio specifications for AC-3 include frequency response of 3Hz to 20kHz on the five main channels and 3Hz to 120Hz on the LFE channel. Noise is 95dB below clipping. Any problems in the facility will be rather apparent on home-theater listening systems.

Some stations, networks and production companies embraced multichannel TV sound even before the introduction of stereo television. The production teams for shows like NBC's "Saturday Night Live," for example, are eagerly awaiting ATV and its 5.1-channel audio delivery, with plenty of archival material ready to broadcast in this mode.

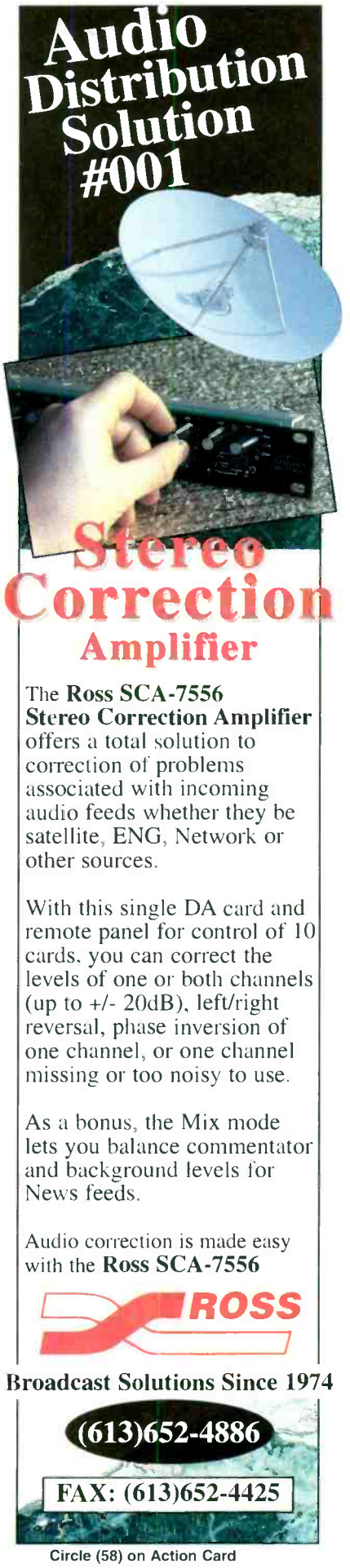
Finally, the emergence of home-theater media centers may converge with the upcoming DVD for a far-reaching audio impact. If DVD truly becomes a replacement not just for audio/video formats like VHS or laserdisc, but also for *audio-only* formats like the CD, the 5.1-channel mixing style may cross over and become a standard in the music recording world, as well. A single, downwardly compatible surround-sound format will then be shared by all popular media. We've come a long way from the 4-inch speaker. ■

Editor's note: Special thanks for help in preparing this article to: Stacey Foster of Broadway Video Entertainment, Tomlinson Holman of TMH Corporation, Russ Berger of the Russ Berger Design Group, Roger Charlesworth of Solid State Logic, Jim Hilson of Dolby Laboratories, Joel Silverman of Lexicon, audio mixer Ed Greene, Rick Seaby of WJZ-TV, Baltimore, and Mike Matthews of NBC-TV, New York.

Terry Skelton is an audio consultant and former network TV technical manager based in Bucks County, PA.

NBC facility photos by Julian Jaime.

For more information on 5.1-channel audio, circle (151) on Action Card.



Circle (58) on Action Card

By James M. Crooks

Building multistation towers

The explosion of the wireless industry has created major growth problems in the area of towers. The cellular phone industry has added more than 10,000 towers to America's landscape. PCS is expected to increase that number tenfold in the next five years. With such a proliferation of vertical steel structures, negative reactions are expected from the general population, as well as landowners, politicians, environmentalists and aviation enthusiasts. In addition, the FCC, FAA and State Aeronautics agencies are expected to give new tower construction a closer look.

A review of the past 10 years indicates that neighborhoods, local governments, county governments, state agencies and now federal agencies have seen enough and want to slow, if not stop, the construction of additional towers. Difficulty in obtaining FAA, State Aeronautic, zoning, land use and dozens of other permits and licenses makes it obvious that the future holds some scary and disastrous scenarios for the would-be tower owner.

During 1995, dozens of companies scrambled to purchase and control towers for future rental property. Two-way radio, cellular telephone and PCS are hurting for tower space. FM and TV translators are having difficulty finding sufficient height to cover their intended audience.

Most existing towers were not designed for the additional wind- and iceload demanded by the insurgence of the wireless phenomena. Many towers are already overloaded and in danger of losing their insurance coverage. The stark reality is that there is a serious shortage of tower space in this country that is certain to continue for a number of years.

Tower options

In most metropolitan areas, tall TV towers are no longer in vogue. To obtain a high structure permit today is rare. Fitting numerous antennas to a shrinking number of towers requires that new towers be strong enough to support multiple antennas. Most existing TV towers were not designed to support more than the existing antenna, which automatically negates adding a new TV broadcast antenna to the present structure. TV broadcasters are faced with a major capital investment for a new tower, assuming a permit can be obtained. An option is to contract for a "community" tower, i.e., a tower designed to support a number of TV, FM, cellular, PCS and 2-way antennas.

On the ground, WISC's (Channel 3) antenna was stacked on top of WHA-TV's (Channel 21) antenna. (Photo courtesy of Ken Dixon.)

This 1,430-foot tower located on property owned by the University of Wisconsin currently holds three TV, three FM and numerous smaller antennas. The design provides for additional antennas to be added later.

After more than 15 years in the planning stage, one such tower was completed in the fall of 1995 in Madison, WI. It presently supports three TV, three FM, police, fire, paging and several 2-way antennas, and is scheduled for dozens of additional antennas. The concept of the 1,430-foot candelabra tower began under the guidance of Don Borchert, who at that time was director of engineering for the University of Wisconsin TV in Madison. The idea was to reduce the number of large towers in Madison and relocate as many broadcast stations on the tower as possible.

Numerous questions arose concerning ownership, regulatory approval and maintenance. It became apparent that a committee needed to be developed with representatives from each potential renter. As the committee began meeting and planning, questions were addressed and researched. Help was obtained from the state, who made certain monies available to spur the project.

A compromise was worked out between the FAA and State Aeronautics, with an agreement that certain broadcast towers would be removed after the project's completion. With the support of State Aeronautics, the governor's office and some local officials, zoning was finally approved, and the University of Wisconsin gave permission to construct the tower on one of its experimental farms on the western edge of the city.

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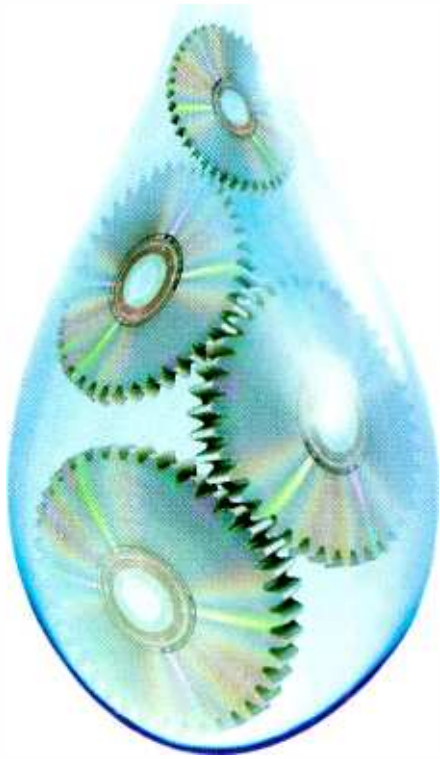

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The committee agreed upon a common equipment building with separate "apartments" for each renter that would satisfy individual needs. The management of the tower was contracted to Motorola and a rent structure was developed that guarantees maintenance of the structure for years to come. Today, the broadcasters have completed their moves, and many of the other wireless providers have already installed equipment on the tower. The shared tower facility seems to be working quite well.

Minor problems that arise are addressed by the committee, which is finding that it is not difficult to keep everyone on friendly terms. One sticky problem is handling the RF radiation problems on the tower when maintenance is needed. The tower has an elevator and is mapped based on field strength. Typically, the amount of time spent near an antenna is small. However, if work is required at a specific height for any length of time, power output is reduced as required.

Community towers are one possible answer to the shortage of tower space in the future. However, be aware that it requires considerable planning and compromise, and may not be the best answer for every broadcast facility. ■

The Channel 3/Channel 21 antenna was assembled and raised into position on the northeast corner of the tower's star mount. (Photo courtesy of Ken Dixon.)

If you are planning or thinking about a community tower, some of the many questions that need to be addressed include the following:

1. Who will own the tower, and how will it be financed?
2. How many stations could/would participate in the project and at what level of participation?
3. How large of a tower is needed, and where can/will it be located?
4. Can approval be obtained from the necessary regulatory agencies, including the FCC and the FAA?
5. How much time is needed for construction?
6. Once complete, how will the site be managed, and by whom?
7. How will the liability be managed?
8. What type of building(s) will be used for the equipment?
9. How will "community" issues, such as maintenance and RF radiation, be handled?

James M. Crooks is CEO of Broadcast Communications Systems, Inc., New Glarus, WI.

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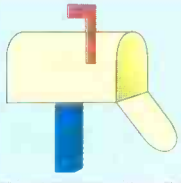

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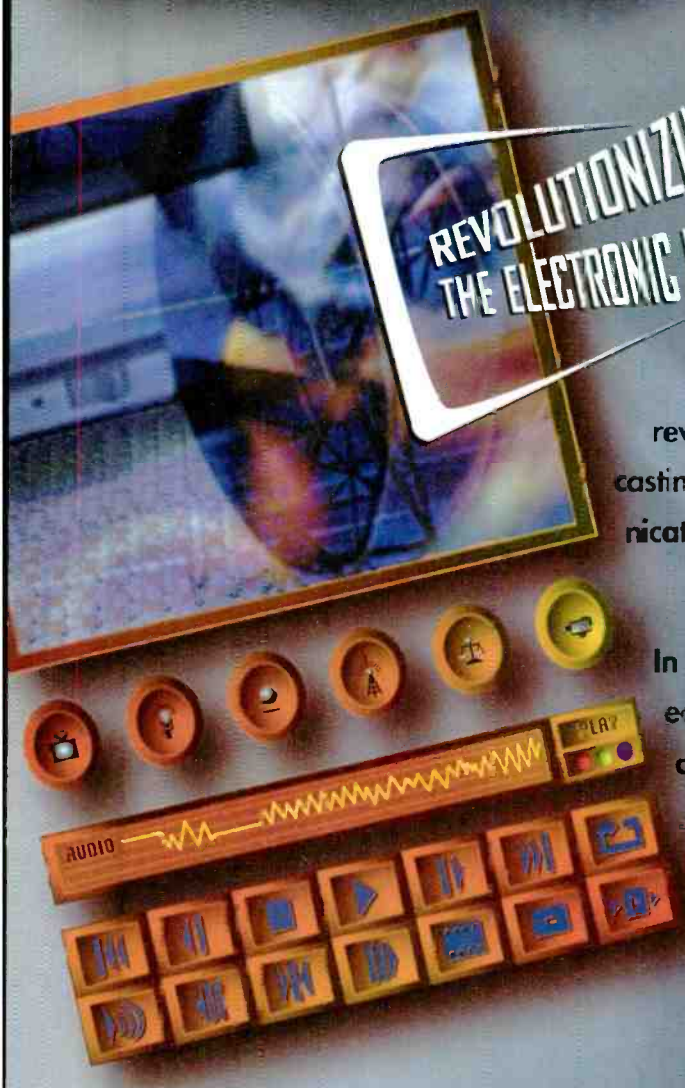

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By John D. Weigand

Intercom systems: The future is here

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As your station's communication needs change and grow, it may become necessary to buy an intercom system for multiple communications. When evaluating a system, you should consider the intercom system itself. This may consist of one or more channels; multiple line telephones with the ability to conference; 2-way radio systems; hybrid telephones with auto-answer connecting to the intercom; IFB systems for field call-in; newsroom in-house paging systems; "red phone" phone systems to the studio anchor positions; and the ability to cue microphones from the producer through a cue microphone into the studio PA system.

In the typical TV station, the producer/director areas have a need for many different communication systems in and out of the production area. The producer/director must talk into an intercom microphone and listen for an answer while juggling a telephone as he converses with a remote site producer. At the same time, the producer/director may also be speaking on a 2-way radio system to various ENG trucks, all of which makes production extremely difficult and complex.

These systems can be combined by use of an intercom matrix system. Similar to a routing switcher, each individual input in the matrix system has one audio source, and each output goes to a separate destination. Using software, inputs can be grouped within the matrix and assigned to an output.

There are new matrixes available on the market that provide users with the ability to program. When an important news story occurs during the evening while the news director is driving to the studio, he can use his cellular phone to state his password to the system and be allowed direct access to the producer station. The producer, meanwhile, will be able to hear the normal intercom stations, while he can both hear and converse with the news director. By pressing one or more toggle switches, the producer will have the ability to talk privately to the news director or to any other number of matrixed individuals, individually or in tandem.

Once the news director receives information from the producer, he can disconnect from the producer intercom station and go to the assignment desk intercom station by pressing the required buttons on his cellular phone. The news director can then dispatch news vehicles to cover the news story he wishes to air. Using the group intercom line, he can converse with any number of his staff until he arrives at the TV station.

The matrix system can also be used when the producer station needs to call out to an outside business line and tie into the intercom system, which often happens during a news remote, such as an election remote. The producer can use the DTMF touch-tone telephone key pad "dial out" of the intercom unit to call anywhere and tie in the distant telephone to the intercom system.

IFB connection

Many additional features may be used in the intercom matrix. Through an interface module connected to any station, the director or producer can turn on 2-way transmitters to connect to an ENG truck intercom system with multiple cameras and direct a production. To key on an IFB, turn on the transmitter through a 2-way radio by keying on a 2-way radio link. The 2-way radio receiver can be located in an ENG van that is connected to a wireless IFB transmitter feeding multiple IFB receivers for talent, persons interviewed and the camera operator. IFB receivers can be purchased for less than $190 each, which adds the factor of economy to the other virtues of the system.

Another use of this system is an ENG van IFB system, which can be connected to cellular telephones, which may be connected into the IFB transmitter, giving the advantage of an alternate path into the intercom system.

Matrix intercom systems from various manufacturers are available in different matrix sizes, which is important because the system can be tailored to the needs of a particular station. The typical station can obtain a 50-input matrix with 100 outputs. It is not necessary to immediately stuff the matrix cage with crosspoint cards.

What the station should look at is the ability for growth options within the system prior to determining which unit to purchase. Only interface cross cards needed immediately need to be purchased for original installation. There are generally more outputs than inputs because of the expanding use of wired and wireless IFB modules for in-studio talent use. The use of in-studio video walls, for example, has necessitated the requirement for talent, even key anchors, to use wireless microphones and IFBs so that they may go stand next to the video wall for various news segments.

The number of IFBs add up quickly. A typical news set of the '90s will have three to four anchors, each with a wireless and a wired microphone and IFB. Beyond this, the satellite/traffic weather position uses an IFB, the interview set and each interviewer and person interviewed will have an individual IFB, the production studio will have a quantity of IFBs depending upon need, the newsroom/studio and the news update desk will need IFBs, a number of wireless IFBs may be outside and various edit rooms may have individual IFBs.

Digital linking

Other outputs involved in the matrix system will include PA systems to the studios, several phone couplers that may be fed individually, and newsroom paging systems, which may or may not be connected to studio PA systems.

A typical news set of the '90s will have three to four anchors, each with a wireless and a wired microphone and IFB.

Stations need the ability to link studio intercom systems to remote truck intercom systems; however, rather than purchase an expensive Telos link, which may not be used more than once or twice a year, these may be rented in order to minimize costs and maximize results. Intercom Specialties in Los Angeles caters to the Telos needs of stations on the West Coast and will probably be highly used during the upcoming Republican National Convention. Stations that think they might have need of these services should act quickly since available rental equipment for the Republican Convention

is going fast. Those from East Coast states might want to employ the services of West Coast consulting services to "stake out territory" and equipment.

If you are covering a large remote, such as the Republican National Convention, selecting a large remote truck that has a Clear-Com Matrix will be valuable if you have a Clear-Com Matrix at your studio, because then the two sites can be digitally linked using a single pair of wires. Data plus digitized audio will be carried from the site to the studio and back again, allowing the units to act as one large matrix system even though the two sites are separated by miles. This system will even work cross-country, using special high-speed digital lines. This type of digital linking provides security with total noise immunity from external sources.

Just because you install a new matrix system does not mean that you must throw out your old one. The old system may be interfaced with the new system using a little bit of engineering ingenuity. You can connect to RTS beltpacks and 4020 IFB modules using little effort and saving money.

Clear-Com crosspoint groupings can be programmed with an ICS-2002 control station or a desktop or laptop PC. With the PC, you can visualize how the system is configured or mapped and set input levels as well as other engineering parameters. The Clear-Com system can be programmed on site without interrupting the engineering operations. The unit can either be programmed or re-programmed while the system is on the air without adversely affecting the operations, and it is relatively simple to do so. You can program a configuration off-line and have it automatically loaded for different intercom configurations on a pre-determined schedule, adding flexibility to your operations. The configuration can easily be entered manually on the spot or pre-programmed for the needs of news and production staff.

If it seems to you like this is going from the dark ages of a 2-way intercom system and stepping into a highly integrated, flexible, easily programmed future, you are correct. It is now a totally different world in the area of intercom systems, and it is a world we may all salute. ■

John Weigand, director of engineering for KFMB Stations for 18 years, is owner/operator of JDW Enterprises, BEC International Consulting/USA and China.

Editor's note: Field Reports are an exclusive *Broadcast Engineering* feature for broadcasters. Each report is prepared by well-qualified staff at a station, production facility or consulting company.

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For more information on submitting a Field Report article, please contact Carrie Poland, technical reports editor, by phone 913-967-1740, fax 913-967-1905 or via E-mail be@intertec.com.

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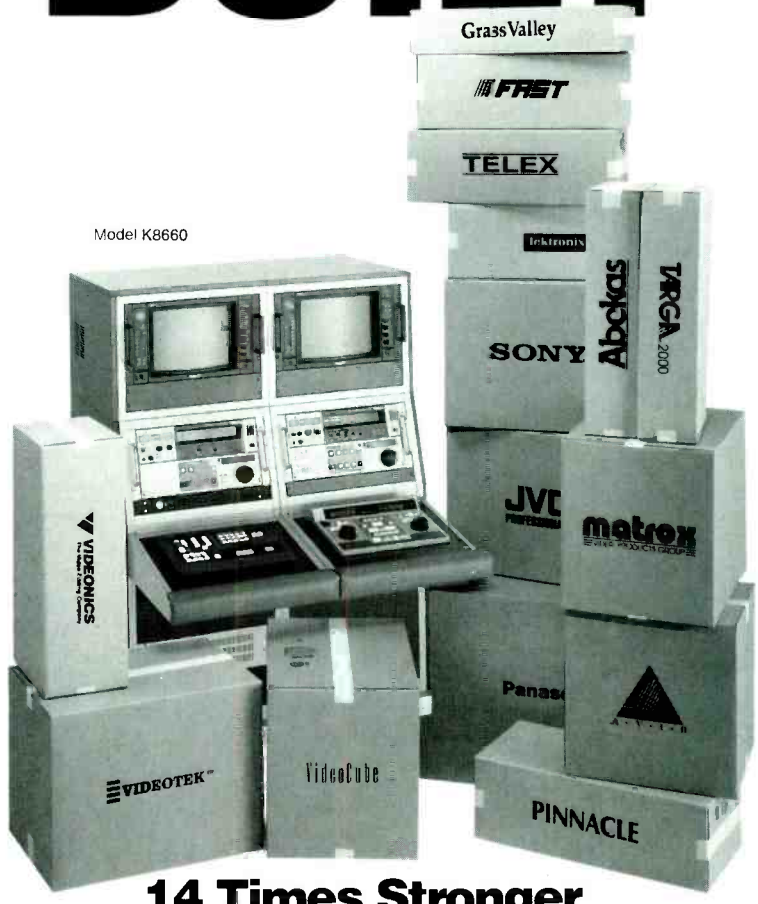

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By John Missale

The Brughetti system

Performance at a glance:

- *Integrates into the entire facility*
- *Uses general-purpose workstations*
- *User-friendly, non-technical interface*
- *Hybrid capabilities*
- *Hardware independent: can control almost any device*

Interactive Television (ITV) is making news. A major focus of the recent ITV media coverage is Time Warner Cable's Full Service Network (FSN) and its test trial in Orlando, FL.

FSN offers customers on-demand access to entertainment and informational services. The News Exchange (TNX) is an extension to the FSN service, offering the world's first digital on-demand news service.

The challenges associated with launching and managing a news-on-demand (NOD) system are significant. Not only do the issues surrounding ITV have to be dealt with, but so do the enormous demands of news production, transmitting the compressed news in real time and non-real time, remote controlling the propagation of the news assets to the subscriber delivery servers and remote controlling the TNX application.

TNX is an on-demand news service developed by Time. The service offers clients an overview of the day's news at any time and allows them to select from news programs and segments in such categories as state and local, world and national, business and personal finance, sports, weather and entertainment.

Customers can select from material supplied by well-known producers of news and information TV programming. Content partners include ABC News, CNN, NBC News and The Weather Channel. Publications such as *Time*, *Fortune*, *Money* and *Entertainment Weekly* also supply video segments to TNX, while local material is provided by regional newspaper and TV affiliates.

The New Media facility

TNX's news production is centralized at the Time Inc. New Media facility in New York where feeds are recorded and edited with studio content and graphics. The programming is then digitally compressed and transmitted over fiber-optic cable to the FSN staging server in Orlando.

The facility is specially designed to provide digital production, compression and special transmission requirements. It houses the newsroom, equipment center, studio, studio control room, two edit suites, on-line production room, graphics production center and master control room. The volume of information coming in and being transmitted made full integration and automation essential. To make this facility possible, Time brought in the Brughetti system.

The system is an integrated resource management, content creation and transmission system. In a networked environment, it links all workstations and video equipment, creating an accessible resource pool interconnected by video routing switchers and data network. This enables the facility to share video with a variety of linear and non-linear storage devices, resulting in a facility that can quickly and efficiently create, edit, manipulate and transmit content.

The challenges associated with launching and managing a news-on-demand system are significant.

Time became an early adopter site for the Brughetti system, working with Brughetti to develop a system that would meet Time's needs. Although it's an on-going process, Time has an interactive, collaborative facility. The staff can quickly turn network feeds or segments into ready-to-air TNX content while handling the management requirements of a news-on-demand facility.

The installation

The system is composed of three software applications: AIR: playout manager, PURE: image creator and SLICE: transition maker. The core technology is DIPLOMAT, a predictive, real-time resource scheduling and management system that controls, interacts with and manipulates all physical devices, network routing and content.

All Brughetti applications share a common working environment, including an E-mail system, a library, media acquisition and task assignments for the management of projects and information. The storage and routing services are controlled by Brughetti's machine control solution CARBON, which enables DIPLOMAT to control broadcast equipment as a pool of resources. Each CARBON can control up to eight devices without loss of speed or flexibility, and any machine connected to the network can be controlled directly from the individual workstations.

The system operates on Silicon Graphics workstations, including six Indy workstations and one Onyx. There is an Indy in both edit suites, plus one in the studio and three in the master control room. The Onyx will eventually be used for graphics production. In the interim, it is used to simulate the FSN staging server in Orlando. One reason for choosing the Brughetti system is that it mapped extremely well into a UNIX environment.

As for the broadcast equipment being controlled by Brughetti, the list includes a bank of more than 20 VTRs (D-Beta and Beta-SP), a BTS Media Pool (eight channels), BTS Venus and Mars routing systems, two VELA MPEG encoders and digital keyers.

Master control

The strength of the system lies in its integrated environment and its operator workflow management capabilities. TNX uses a combination of SLICE editing stations, PURE graphics stations and AIR playout stations with access to common libraries. With the integrated E-mail system, EDLs and program-specific tasks can be sent to operators throughout the facility.

The system resembles a non-linear editor in that program material can be automatically recorded and edited. Once an edit is finished, the EDL can be published into the main library for approval and immediate transmission. Program material is transmitted to the staging server via two Vela MPEG encoders. The MPEG video file, followed immediately by the audio file, is streamed via an ATM link to Orlando. In addition to these files, the system software in Orlando requires specific control files to properly install the material onto the production servers on Time Warner Cable's FDDI ring for playout. Standard file trans-

fer protocol (FTP) is used to transfer the control files once the MPEG files have been successfully received by the staging server.

One of the most powerful features of the Brughetti system is its ability to deal with *pending clips*, which is a placeholder for a source, such as an expected feed or studio-created content that does not yet exist. System operators can create pending clips to receive feeds and playout material. This provides the ability to schedule the recording of an incoming feed and instantaneously drop the pending clip into the playout stack so that it is scheduled for transmission almost immediately after recording is scheduled to begin.

The system will instantly attempt to schedule a device with the capability to playback content almost immediately after it is recorded. In Time's case, the company will primarily be using the Media Pool so that the feed can be MPEG encoded and "streamed" directly to the FSN staging server. The intuitive nature of the system enables users to have programming available almost immediately after its original broadcast — with little or no operator intervention.

Editing and graphics

Should the incoming material require editing, the clip sends E-mail messages to editors, notifying them that a feed has been recorded and that it requires editing. The editing system from Brughetti is called SLICE, an on-line digital-based edit controller for video and audio.

SLICE is a true hybrid system that supports linear and non-linear recording formats enabling editors to transparently source and mix from inputs, such as tape, disk, archival footage and live feeds.

Because the system is fully integrated, journalists, editors, graphic designers and producers can access on-going projects and work on their portion of a segment without affecting the work of others.

SLICE features a broad set of editing tools. Using a visual timeline, a program can be created by accessing video and audio clips from a library. Clips can be rearranged at any time by dragging them to a new position.

When Time began researching graphics production systems, it found that with most packages, either speed or quality had to be traded off. Brughetti's PURE is designed to handle news, sports, elections and special-events coverage. The system reduces the amount of time operators spend recreating and touching up repetitive graphics. PURE is based on user-definable templates and has the ability to quickly create complex graphics, allowing operators to concentrate on developing content.

The integrated approach

The decision to install an integrated facility management system, such as Brughetti, is a strategic one and needs to be made early in the planning stages. Time's decision to go with a product that was, at the time, little more than a concept, was a risk — and it hasn't been without its challenges. Time has been able to develop a system that will take it well into the next era of news production. The Brughetti system has provided a fully integrated facility and created a more efficient and productive environment. ■

John Missale is vice president, Broadcast Operations and Engineering, Time Inc., New Media.

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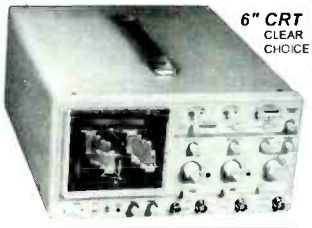

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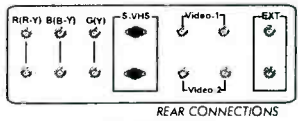

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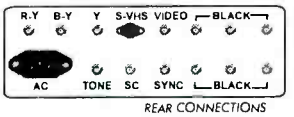

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By Dave Johnson

Mentoring benefits all involved

It was an engineer that took me aside at the transmitter shack and pulled out his oscilloscope and said, "Here! This is how AM is impressed on a carrier frequency." It was an engineer who told me to always cosmetically clean whatever I work on, "Because clean gear always works better, or at least the people who get it back will think so." They were just two of several people throughout my career who have served as mentors to me.

Mentoring makes a difference

Mentoring is an important function in the career of anyone who is successful. Those few sage words, those good examples, those who take an active interest in you and those who instill certain values in your work, all serve to make us who we are today. Many times, our mentors don't even know how they impact us. We quietly observe and make mental notes of how our mentors do things or the type of person they are. Sometimes, we don't even know how they have affected us until after we have moved on. Suddenly, we find ourselves doing things the way they did or applying some of the principles we learned under their tutelage.

The real question, though, is what are you doing today to mentor someone? Are you showing new people the ropes? Are you performing in a manner someone would admire or respect? Are you making a conscious effort to promote the field of broadcast engineering? You should be. You must think it is an honorable profession or you wouldn't be doing it. Make yourself an example. Push a newcomer to work better. Take a student under your wing. Promote membership in the SBE.

Promote SBE membership

If you are not a member, you should consider joining. It is a great opportunity to promote the best of what broadcast engineering is. It is also a good place to meet those people who can assist you in your career, either as a mentor to you or as a resource in the future.

If you are a member, you should work to promote your chapter. Tell a friend who is not a member about a meeting that may be of particular interest to him. Encourage them to join. Consider running for a local office. It is amazing what you can learn and the contacts you can make as an officer. If you are an officer, look around inside the chapter and see who could help your chapter down the road. Encourage them to run for local office. I don't mean a month before you need to have a ballot out, you approach Fred and say, "You know, I think you'd be a great chapter chairman." Begin for next year by getting them involved now. Have them help you with activities so they see how easy and rewarding it really can be. I know I owe my participation on the national level to someone who pushed me along. He encouraged, prodded, pushed and stood by me when I needed him. He was just doing what he believes, promoting broadcast engineering. And, he serves as a mentor to me.

Instilling professional values

Our profession needs new people with good ideas. While you can be a beacon of light and not know it, make an effort to guide those fresh young faces and instill the values of professionalism. Some of those faces are not as young as you might think. In the long run, you may find it has made you a better person. ■

Dave Johnson is audio visual supervisor for CompuServe in Columbus, OH. He also is membership chairman of the Society of Broadcast Engineers.

Photo courtesy of Marvin Born, WBNS-TV, Columbus, OH.

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INDUSTRY BRIEFS

BUSINESS

Panasonic Broadcast, Secaucus, NJ, announced that NBC selected the Panasonic D-3 digital composite format and the D-5 digital component format as the main VTR formats for the 1996 Atlanta Olympic Games. The D-3 will serve as NBC's main recording format, while the D-5 will be the medium graphics creation and storage for the Games.

Philips Electronics North America Corporation, New York, completed its acquisition of **Alamar Electronics USA**, a producer and installer of broadcast, cable and satellite TV automation systems. Although it will continue to operate within its existing management structure, Alamar became part of Philips' Business Electronics.

Dielectric Communications, Raymond, ME, was awarded a contract by New York City's Television Broadcasters for two antenna system designs. The contract involves nine stations and the installation of two antennas on the World Trade Center.

Scitex Digital Video, Redwood City, CA, launched its global "Abekas Rockin' the World" roadshow for its Abekas product line. Scheduled tour dates include March 4 and 5 in Denver and Seattle, as well as March 7 in Salt Lake City and Vancouver, Canada.

Prime Image, Saratoga, CA, was awarded a patent for its standards converter. Patent number 5,453,792 includes the basic technology behind the double conversion of a video signal from one standard to another.

Media Capital Associates, L.L.C., Scottsdale, AZ, a privately financed leasing company, was recently created to meet the demand for more customized leasing programs.

Stainless, North Wales, PA, was awarded a multimillion-dollar contract for construction of two new TV towers by Lin Television. The towers will serve the Lin stations in New Haven, CT, and Portsmouth, VA.

Fiber Options, Bohemia, NY, has moved its European offices to: 8a Legrams Terrace, Fieldhead Business Centre, Bradford, West Yorkshire BD7 1LN UK; phone: +44 (0) 1274 739139; fax: +44 (0) 1274 738787.

Wegener Communications, Duluth, GA, was chosen by Eli Lilly and Company to make the move to digital for Eli Lilly's new global business TV network. The fully digital and encrypted network will link facilities in the United States and abroad for corporate communications, training and customer information purposes.

Sony, Montvale, NJ, announced the purchase of 14 of its DVW-A500 Digital Betacam editing recorders to **KSL**, Salt Lake City, and two of the recorders to **KJZZ-TV**, Salt Lake City.

Solid State Logic, Oxford, England, recently installed its 4064 G Plus console with Ultimation in **Royaltone Studios**, North Hollywood, CA.

Dynatech Video Group, Salt Lake City, will package a number of its products and solutions with the **Tektronix** Profile disk storage device. The included solutions are to incorporate specific Dynatech equipment, including EditStar, the UTAH-300 analog/digital router and the company's custom software control and automation products.

Studio Audio, Stretham, Cambridgeshire, UK, will distribute **Adcom's** Night Suite non-linear D-1 video editor exclusively in the United Kingdom and in Nashville.

NVISION, Nevada City, CA, supplied NBC, New York, with several NV Series digital audio and time-code routing systems. The network is currently completing various stages of its "Genesis Project," which represents a major upgrade of NBC's production complex in Rockefeller Center, Manhattan.

LNR Communications, Hauppauge, NY, received a multimillion-dollar contract to supply a quantity of flyaway INTELSAT Qualified Satellite Terminals (IQST). Under contract to **GLS Associates**, LNR will manufacture, integrate, test, deliver and support Ku-band INTELSAT-qualified, highly transportable and fully redundant digital satellite communications terminals.

Graham-Patten Systems, Grass Valley, CA, supplied commercial TV service provider NOB, Amsterdam, with two new D/ESAM 400 digital edit suite audio mixers for use within a pair of all-digital facilities.

Accom, Menlo Park, CA, sold six fully configured Axial 2010 on-line editing systems to post-production facility **Complete Post**, Hollywood, CA.

Quantel, Darien, CT, delivered a second fully configured Henry with the HIPPO image processing package to post-production facility Modern Videofilm, Burbank, CA.

Lighting Dimensions, TCI join Intertec Publishing

Two trade publications that focus on the industries of lighting and entertainment technology and design joined the Communications Division of Intertec Publishing, Overland Park, KS, on Jan. 1. Intertec purchased the magazines from — and the assets of — Entertainment Technology Communications Corporation, New York, which included a trade show and a web site.

Lighting Dimensions and *TCI* (formerly *Theatre Crafts*) will continue to be published in New York and will synergistically complement these other Intertec titles: *Broadcast Engineering, BE Radio, Sound & Video Contractor, Video Systems* and *World Broadcast News*. Intertec now publishes approximately 80 titles.

Lighting Dimensions, founded in 1977, is the magazine for lighting designers, consultants, specifiers and buyers working in the design, development, marketing and sales, and application in all areas of lighting — architectural, commercial, interior design and entertainment.

In addition, Lighting Dimensions International is a trade show for the entertainment technology industry, sponsored by *Lighting Dimensions* magazine. The 1996 show will be held Nov. 21-24 in Orlando, and will attract more than 8,000 professionals to four days of workshops and three days of exhibits from more than 300 international companies.

TCI is a 29-year-old publication read by working professionals and dedicated amateurs in the performing arts, including theatre, film, video, dance, opera, concerts, industrial productions and theme parks. Articles cover staging and production, scenery, costume, sound and lighting design, props, special effects, makeup, training, computers, administration and management.

News from both publications is produced by ETEC on the World Wide Web. The address is http://www.etecnyc.net. ■

PEOPLE

Eric D. Falkenberg assumed the title of president of Sachtler Corporation of America, Freeport, NY.

Daniel A. Keshian was appointed president of Avid Technology, Tewksbury, MA.

Glen Sakata was promoted to western regional sales manager for Louth Automation, Palo Alto, CA.

James P. Biernacki assumed the position of vice president of sales for Storage Concepts, Irvine, CA.

Also, **Martin R. Bock** will take over marketing efforts, development of new products and expansion of the current product line for the company.

Mark A. Franzen was appointed chief financial officer for Storage Concepts.

Tim Harrison will serve as national sales manager for Soundcraft, Northridge, CA.

Milton E. McNally became vice president and chief operating officer for Clear-Com Intercom Systems, Berkeley, CA.

Bill Harland became product line manager for the Broadcast Products Business Unit of Andrew, Orland Park, IL.

Rod Cormier was appointed to manager of the test department at Fiber Options.

Also, **Fred Scott** was named vice president in charge of broadcast and professional video product/sales for the company.

Michael J. Kohut will receive the Cinema Audio Society's (CAS) 1995 Career Achievement Award at the CAS Awards Banquet on March 9. Kohut is executive vice president of the post-production facilities at Sony Pictures Studios.

Marc Spector was promoted to director of marketing communications, worldwide for JBL Professional, Northridge, CA.

In addition, **David Kimm** joins the company as director of recording and broadcast products.

Tom Weeber was promoted to director of sales, United States and Canada for JBL Professional.

Chris Wilkerson and **Michael Rucker** became district sales managers/south central region for broadcast products for Quantel, Darien, CT.

Sal Raia was named executive vice president for Fiber Options, Bohemia, NY.

Tom Hooper became territory manager for the southern United States at Pinnacle Systems Inc., Sunnyvale, CA.

Also, **Sam Wright** became territory manager for the western United States at Pinnacle.

Glen M. Inamura became regional manager, western United States for D-Vision Systems, Chicago. ■

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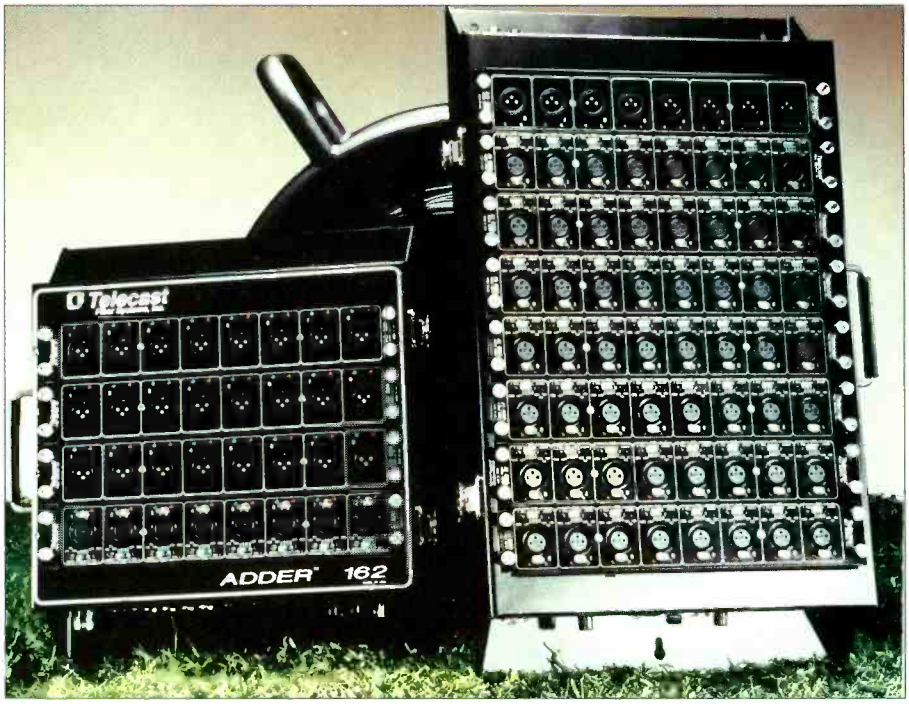
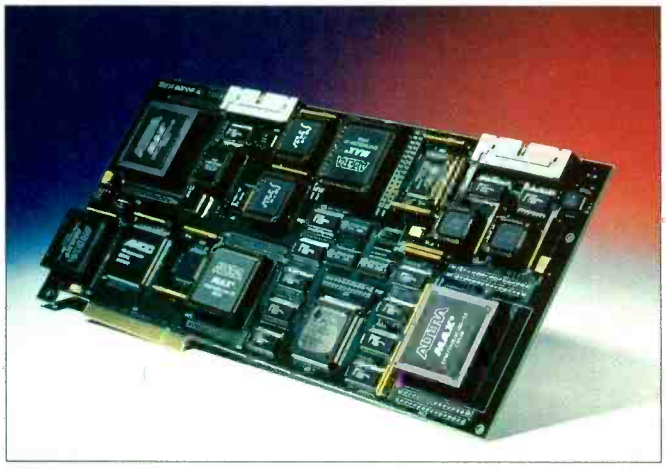
Fiber-optic microphone splitter "snakes"

Telecast Fiber Systems

• Adder family of "snakes:" 20-bit portable digital, fiber-optic microphone splitter "snakes;" the bidirectional systems simultaneously transmit and optically split up to 64 studio-quality audio channels plus intercoms and data/control channels both ways over a single optical fiber; the Adder family consists of the Adder 162 and the Adder 322, capable of carrying 32 and 64 channels respectively, over a lightweight, durable optical fiber cable; the Adder saves over 99% of cable weight while eliminating noise pickup, crosstalk, hum and grounding problems; the Adder is available as portable or 19-inch rack enclosures; digital modulation and multiplexing combine all signals onto a single optical fiber for 2-way transmission via standard ST optical connectors; variable gain preamps accept microphone or line inputs; each input also provides switchable phantom power; a unique feature splits stage inputs into multiple optical outputs to different locations; the systems are battery or AC powered, with internal UPS.

Circle (350) on Action Card





Compression with high-quality scaling

Genesis Microchip/C-Cube Microsystems

• PCI-833/560 Edit Pro: a PCI-based reference design that combines C-Cube's high-performance compression/decompression processing with Genesis's state-of-the-art video scaling technology; the PCI-833/560 provides NTSC/PAL video I/O — digitized internally to CCIR-601 4:2:2 YUV — Genesis gm833x2 scaling, plus C-Cube's CL560 compression/decompression and PCI bus mastering; scaling the image prior to compression and enlarging it back to its original size after decompression improves image quality and compression efficiency (up to 50% in some applications), in addition to reducing memory and bandwidth costs.

Circle (351) on Action Card

EAS system

Chyron/TFT/Broadcast Software Solutions

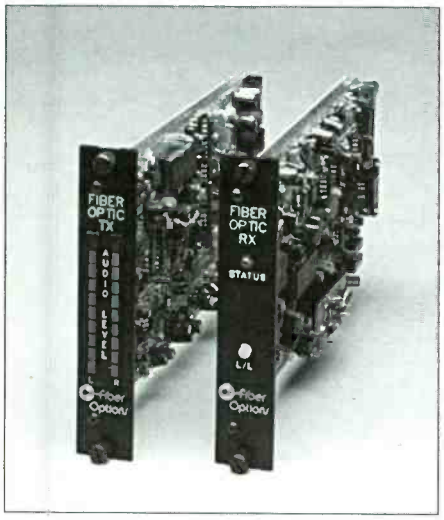
• CODI EAS system: an Emergency Alert System that features Chyron's CODI CG, the TFT's encoder/decoder and Broadcast Software Solutions' Master EAS software; the system conforms to the FCC's specifications; instead of a 24-second tone, the CODI EAS system begins a digital code that routes and processes the emergency alert message; users can choose to accept only local and state warnings that are relevant to the immediate geographic area; users can also select the type of events their audience will be alerted to; operation of the system is instantaneous and can be run manually or automatically; an external computer can be used, but is not necessary to manage TFT's 911 encoder/decoder.

Circle (352) on Action Card

Software upgrade for Postbox
Panasonic Broadcast & Television Systems Company

• Version 1.1 for the WJ-MX1000 Postbox non-linear A/V workstation: a major upgrade for the WJ-MX1000 that offers more than 70 operational enhancements; the WJ-MX1000 has the capability to perform all the functions of a complete post-production facility in one easy-to-operate turnkey system; a key-learn function allows the user to create a path for the key pattern using key frames; the 3-D key patterns include spheres, perspectives and ripples in the key modify window; with the hot-play feature, audio or video clips can be played from a bin; a slow-speed function allows a video clip to play in one of three speeds (50%, 25% and 12.5%); when dropping an A/V clip onto the time-line, the audio can be appointed to the track of the user's choice.

Circle (353) on Action Card



Audio transmission system
Fiber Options

• Series 1320B/1320SB: an audio transmission system that uses state-of-the-art digital technology to convert two channels of line-level audio to CD-grade broadcast-quality digital signals that are transmitted over a single fiber (multimode or single mode); the increased data capacity made possible by pushing up to 20-bit processing yields a dynamic range of 110dB and greater than 100dB total harmonic distortion; the 1320B multimode system operates over two to three kilometers; the system transmitter incorporates a diagnostic indicator for use in verifying the presence of a valid video signal, as well as dual 10-segment audio input displays; the system receiver provides an optical level/loss LED in addition to output signal status LEDs for video and audio.

Circle (354) on Action Card

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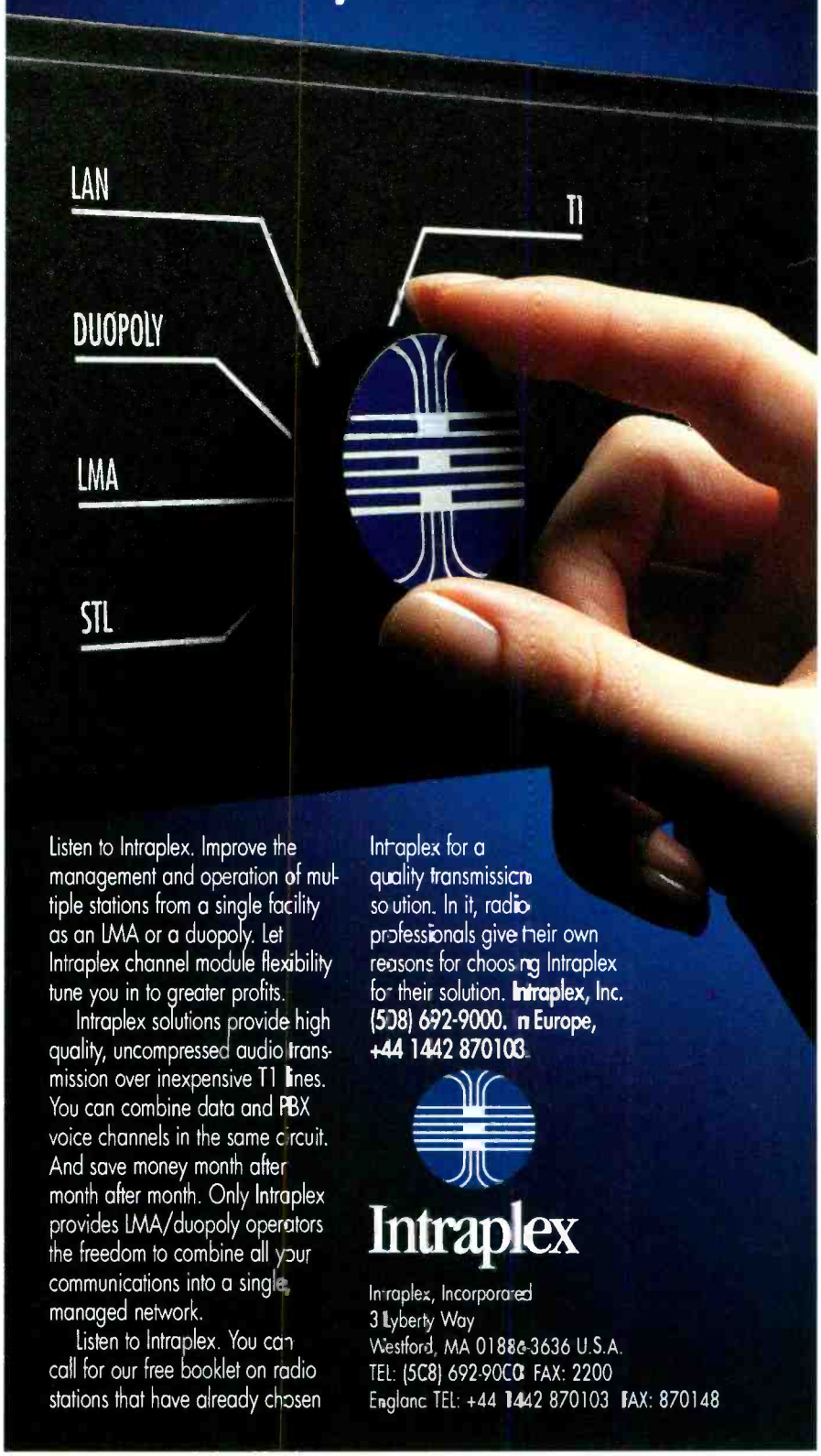

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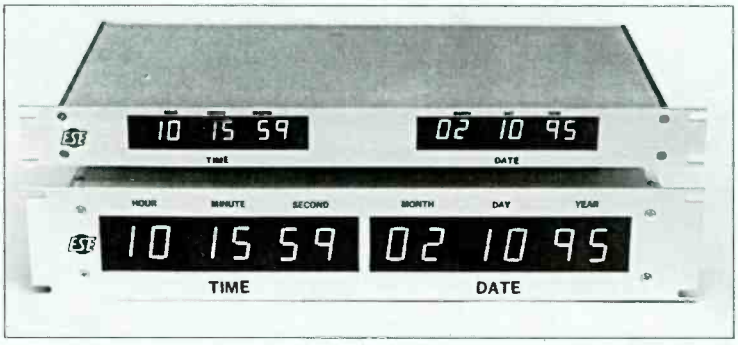
Circle (54) on Action Card

Battery analyzer
Cadex

• C7000: a programmable battery analyzer capable of servicing all major rechargeable batteries; the batteries interface through interchangeable battery adapters that configure the analyzer to the correct function when installed; each adapter holds up to 10 battery configuration codes to service all battery types within a product family without the need to reprogram; battery-specific adapters are available for all major batteries; user-programmable smart cables service batteries for which no adapter is on hand; the C7000 services batteries against preset parameters for accurate test results; batteries with short, mismatched or soft cells are identified in minutes and their deficiencies are displayed on the LCD.

Circle (355) on Action Card



Digital time and date "slave" display
ESE

• ES-126 & ES-127: two additions to the ESE master clock system family; time and date are displayed side by side and two display sizes allow viewability from up to 50 feet away; both units feature a 12-digit ESE serial time-code reader that displays six digits of time (hours, minutes and seconds) and six digits of date (month, day and year); the ES-126 displays are .56-inch high yellow LEDs in a single rack-mount enclosure; the ES-127 has 1-inch high LED displays in a 3½-inch rack-mount enclosure; both units are designed to read ESE serial code (TC90) from ESE's master clocks (ES-160A, ES-181, ES-185, ES-195 and ES-206E).

Circle (356) on Action Card

HERE'S A *FEATURE PRESENTATION* THAT *YOU SHOULD SEE*

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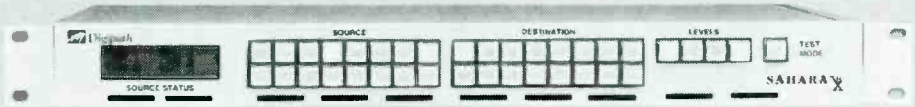
ROUTING SWITCHERS



THE CRITIC'S LOVE IT!

Single or Multi-Channel Configurations
- Configure any channel combination within the same chassis. [ie: up to 4 channels of 4x4]

Router Models
- Sahara 16x (1RU) [up to 16x16]
- Sahara 32x (2RU) [up to 32x32]
- Serial Digital Video
- Analog Video - 100 Mhz
- Analog Audio - 150 Khz
- RS232 & RS422 ports (all models)

"Plug-in" Input & Output Modules
- Expand router to any matrix size with our individual "plug-in" input & output modules.
- Quick & easy maintenance, simply exchange the malfunctioning module.

Serial Digital Monitoring
- **16X model** – Activating this feature disables the matrix and allows the user to scan the incoming serial digital signal to identify:

1) the source input number
2) type of signal format incoming
3) percentage of equalization being utilized
4) SYNC status

- **32X model** – has a "built-in" monitoring feature to view all 32 inputs and outputs.

Default Configuration or PC Configured-up to 8 levels
- Connect, turn-on, and you're ready to go using the Default Configuration.
- System configration via PC permits:
  - Virtual Matrix Mapping
  - Definable Defaults
  - Source & Destination Locks
  - 50 Salvos
  - 50 Group Switching
  - 20 different Panel Formats
  - Panel ON-LINE diagnostics
  - Disk back-up

Remote Control Panels
- A variety of configurable remote control panels are available in different sizes.
- Panel connection with router is done with a standard 75Ω coaxial cable.
- All panels provide All-Follow and Single-Level switching, with 3 or 4 programmable Break-Away groups.
- LCD display (standard on all panels) provides the following functions:
  1) switcher status for up to 8 levels
  2) communication error with switcher
  3) panel configuration status
  4) switch malfunction alert
  5) test mode monitoring

Digipath
Tel: (514) 697-0810 Fax: (514) 697-0224

Circle (59) on Action Card

Digital reverberator
Lexicon

• **PCM90:** a digital reverberator introduced as a companion to the PCM 80 digital effects processor; the PCM 90 features a range of versatile high-quality reverberation programs that derive their heritage from Lexicon's top-of-the-line studio processors, the 480L and the Model 300; its unique dual-processor architecture features two of Lexicon's proprietary reverb DSP ICs, the Lexichip II, allows flexibility in reverberation quality and control; the PCM 90 features true stereo capability with 18-bit A/D converters, as well as digital inputs, and a 24-bit internal digital bus; the PCM 90 and PCM 80 can work independently or as a system in which the PCM 80 and PCM 90 can offer as many as four independent inputs and outputs, digital or analog.

Circle (357) on Action Card

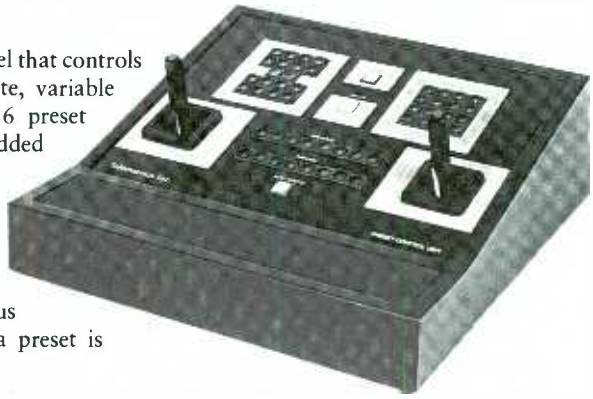
Broadcast video fiber optics
Multidyne

• **FTX-95/FRX-95:** fiber-optic video and digital stereo audio transmission system that features specifications that exceed RS-250C short-haul requirements; the signal-to-noise ratio exceeds 75dB and the differential phase and gain are less than 0.5% and 0.5°, respectively; the system includes front-panel controls for video gain and 1,000 feet of cable equalization; the video bandwidth of 10MHz supports HDTV, NTSC, PAL, SECAM and video with diplexed audio carriers at 4.5MHz, 5.8MHz and 6.4MHz; the video input and output is back-porch clamped; the 20-bit stereo digital audio delivers a signal-to-noise ratio exceeding 85dB; the receive unit has front-panel controls for left and right channel audio gain and supports digital audio transmission for AES/EBU, IEC 958, SPDIF and EIAJ CP-340 formats; the FTX-95 system is optionally available with up to two auxiliary data channels for RS-232C, RS-422 or CMOS; the system can also support up to two 10Hz to 5kHz auxiliary audio channels.

Circle (358) on Action Card

Camera robotics serial control panel
Telemetrics

• **CP-DTQ-S desktop preset control panel:** a camera robotics serial control panel that controls four robotic pan/tilt head with dual joysticks that provide proportional rate, variable speed control for all pan/tilt, zoom and focus operations; in addition, 16 preset positions can be stored in memory for each of the four pan/tilts; for added efficiency, the CP-DTQ-S features a modular design so users can configure the unit with the features and capabilities they need; an optional motion-control feature allows users to store a series of movements in the onboard memory and recall them with the push of a button; the unit also interfaces with the Telemetrics TM-VIS vertical interval switcher with the addition of a video switching option — it includes eight program and eight preview buttons, plus the ability to automatically switch video from preview to program when a preset is selected.



Circle (359) on Action Card

Multipoint broadcast service
AT&T

• **Multipoint Broadcast Service:** AT&T has reduced the price it charges radio stations to connect to its Multipoint Broadcast Service from 32 cents a minute to 19 cents per minute making radio teleconferencing a cost-competitive alternative for broadcast distributors; with digital sound quality equal to that of a compact disc, Multipoint Broadcast Service makes branching broadcast distribution simple; to broadcast a football game or concert, a distributor calls AT&T's service and obtains a teleconferencing 700 number for radio stations to dial into; up to 48 stations with compatible digital codecs can connect at one time for as long as four hours.

Circle (360) on Action Card

Circle (62) on Action Card

PAL/NTSC digital encoder
Faroudja Laboratories

• DFD-U: a series of PAL/NTSC decoders that make use of digital adaptive comb filter technology to convert PAL, NTSC or Y/C inputs into RGB, component, or D-1 serial and parallel outputs; different options are available, including a frame synchronizer with full time-base correction; remote control via an RS-232 terminal is also available; all models make use of 10-bit processing, ACC and APC, and digital chroma enhancement; the DFD-U is especially suited for use as a first stage for video compression encoding (MPEG and others) when the input is under NTSC or PAL form.

Circle (361) on Action Card

Transmission system
Opticomm

• Series DS-726/T3: a full duplex fiber-optic DS-3 modem; the DS-726/T3 uses a highly linear stage to transmit data rates at 44.736Mb/s over a multimode fiber-optic cable by using 865nm short or 1310nm long optical wavelength devices; the wide optical dynamic range of the DS-726/T3 allows various optical cable core sizes and lengths to be used; the transmission distance can vary from a few feet up to 10km without causing optical receiver overload; on the receiver side, an integral detector amplifier is used to ensure low-noise high-sensitivity reception; signal quality is monitored by measuring the transmit data input level and the received optical signal strength (an input alarm or span alarm is indicated when it drops below a predetermined level); with a 3-rack unit door panel, the DS-726/T3 can easily be field converted into a rack-mounted unit; the 19-inch wide rack chassis can accommodate up to 10 units; the unit can be powered from a +15VDC or -48VDC built-in power source.

Circle (367) on Action Card

Pre-read monitor switcher for edit controllers
Editing Technologies Corporation

• PRM-100: a pre-read monitor switcher for use with digital VTRs that support pre-read; as the preview switcher for the pre-read function in a digital suite, the PRM-100 allows A-B roll editing in the digital realm using only one source machine; the switcher requires only one PC-type slot and is controlled by any ENSEMBLE series edit controller (Pro-3 or greater).

Circle (363) on Action Card

Enhanced Media Composer system
Avid Technology

• Version 6 for Media Composer: a family of digital non-linear editing and finishing systems with new features and increased functionality; based on the Avid Broadcast Video Board, version 6 incorporates new on-line image resolutions with compression levels as low as 3:1, support for mixable resolutions, support for 720 pixel media (720x486 NTSC, 720x576 PAL) as specified in the CCIR-601 specification and component video I/O (Betacam SP: R-Y, B-Y, Y); it also incorporates support for a dedicated full-screen video monitor that allows users to view edits instantly in full-screen.

Circle (364) on Action Card

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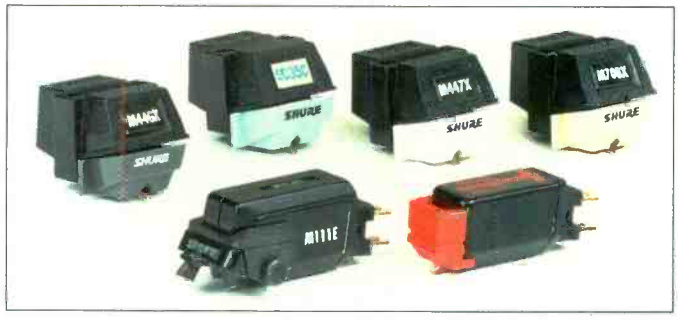
Phono cartridge line
Shure Brothers



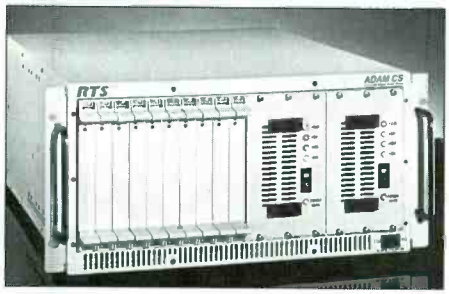
• Phono cartridge line (MIIIE, SC35C, M44GX, M447X, M70BX & M92E): six models introduced in response to the resurgent interest in vinyl discs for recorded music; each model comes with a diamond-tipped stylus and all the necessary mounting hardware for use with most ½-inch commercial or consumer tone arms (two models may also be used on P-mount tone arm systems); features include a heat-treated stylus tube and a biradial diamond tip; the top-of-the-line MIIIE cartridge is equipped with Shure's proprietary Dynamic Stabilizer shock absorber and the Side Guard Stylus Protection System; designed for DJ and broadcast use, the SC35C cartridge is built to work with tone arms requiring a tracking force of 4g to 5g, while its stylus assembly is rigid enough to withstand back-cuing yet compliant enough to provide mid-and high-frequency reproduction.

Circle (365) on Action Card

Digital broadcast interface
Thomson Broadcast

• DBI 2010: an audio and video acquisition unit that brings together the necessary functions to interface the digital inputs of the DBE 2010 service encoder to analog video and audio sources; the DBI 2010 delivers a serial 270Mb/s digital video signal stream with embedded audio and ancillary data and four stereo digital/analog audio channels from a component or composite analog video signal input; features include VBI data extraction and built-in synchronizer.

Circle (366) on Action Card



Intercom system
Telex

• RTS ADAM CS: a digital matrix frame that uses the same time-division-multiplex (TDM) circuitry as the larger ADAM matrix, but designed around a compact enclosure with reduced channel capacity and bus clock rate; the ADAM CS is ideal for smaller facilities, islands within larger facilities, mobile units, rental applications and temporary installations; the unit is fully compatible with all existing CS9000 series accessories and supports trunking between itself, ADAM and existing CS9000 matrices; due to the reduced bus speed, ADAM CS is not compatible with the bus expander available for the larger ADAM system.

Circle (362) on Action Card

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The rules have changed. Most engineers now understand that to drive long runs with great HF response requires low Z (60 ohm) outputs. Fewer engineers understand, however, that multiple output drivers are not desirable. In fact, all the networks will consider is a single amplifier with resistive splits. Want to be listening to a monitor feed and get burned when the air feed fails? Neither would we.

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Circle (56) on Action Card

Continued from page 74

quantizer becomes more coarse throwing away more data. As it empties, the quantizer becomes less coarse, saving more of the image data.

Most MPEG encoders provide a suite of tools to assist the person encoding the footage. These tools may provide the ability to set the number of I, B and P frames within a stream and to change the sequence of frames to keep artifacts at a minimum. Additionally, buffer and datastream management tools may be included. Many systems today provide automatic encoding of footage to predetermined parameters.

Various video compression systems exist today, with MPEG being one of the most well-known. Other types include motion JPEG, wavelets and proprietary solutions from a wide range of manufacturers. Many people are under the mistaken impression that MPEG-1 has been replaced by MPEG-2, and that MPEG-2 is better. The truth is that MPEG-1 and MPEG-2 were designed for different applications. (For more information, see "Video Compression," February and October 1995.) Three things that must be considered when evaluating a compression system are: apparent image quality, data rate and system cost in time and money.

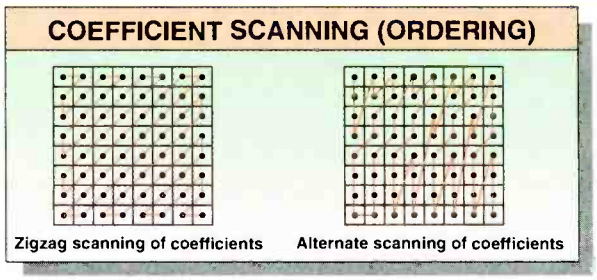


Figure 4. To improve the overall compression, coefficients are scanned using one of two methods. In this manner, the data is formatted for optimum run-length encoding.

Image quality is relative, but in the end it has to be good enough for your application. Depending on the application, frame rate can be traded for resolution. Image size is also a parameter that is adjustable in some applications. Data rate is usually a fairly fixed parameter, typically due to either financial or technical limitations. Dividing the input data rate by the output data rate will provide the required compression ratio.

Finally, there is the system cost. MPEG compression systems range in cost from less than $20,000 to more than $100,000. Image compression requires considerable horsepower and if you do a lot of compression or need it in real time or faster, horsepower can make the difference. If, however, your needs are small and you don't mind waiting, lower-priced systems may be able to satisfy your needs.

One way or another, image compression will be a part of the future. Taking the time to understand it today will make tomorrow's questions easier to answer. ■

Acknowledgment: Special thanks to Peter Symes, Tektronix/Grass Valley Products, for his help with this article.

THE DCT EQUATION

$$F(u,v)=\tfrac{1}{4}C(u)C(v)\sum_{x=0}^{7}\sum_{y=0}^{7} f(x,y)\cos\left[\frac{(2x+1)u\pi}{16}\right]\cos\left[\frac{(2y+1)v\pi}{16}\right]$$

where x and y are pixel indices within an 8-by-8 block, u and v are DCT coefficient indices within an 8-by-8 block, and:

$$C(w)=\frac{1}{\sqrt{2}} \quad \text{for } w=0$$

$$C(w)=1 \quad \text{for } w=1, 2, \ldots, 7$$

. . . AND THE INVERSE . . .

$$f(x,y)=\tfrac{1}{4}\sum_{u=0}^{7}\sum_{v=0}^{7} C(u)C(v)F(u,v)\cos\left[\frac{(2x+1)u\pi}{16}\right]\cos\left[\frac{(2y+1)v\pi}{16}\right]$$

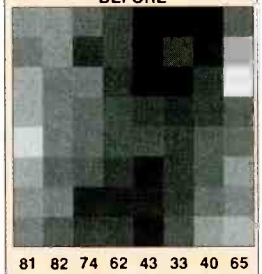
A compression example

Here is an example of the compression process in order to help in understanding it. The color photograph was scanned in and converted to a bit-map image. From the bit map, luminance values were obtained from an 8x8 pixel block. For printing, the contrast of the block was enhanced, but the actual pixel values were used in all of the calculations. As stated, the first step is to digitize the image. In this example, an 8-bit gray scale was used, with a 0 value corresponding to black and 255 corresponding to white. The DCT was applied to the 8x8 matrix, and Table 1 shows the values obtained, hardly data compression.

These DCT values are then scaled and quantized using the default Q table (See Figure 3 in the main article.) Table 2 shows what's left after using a fairly aggressive MQUANT. The zig-zag scanning method produces the following: 66, 2, -1, -1, 2, 4, 1, 0, 0, 0, 0, 1, 0, -1, 1, 0, 0, 0, 0, 0, 0, 0, 0, -1, followed by 40 zeros. This string is then run-length and entropy-encoded.

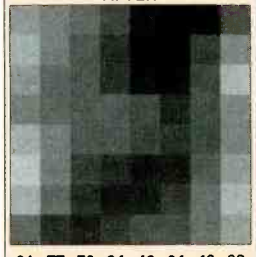
To decompress the image, the inverse equation is applied and the results are shown, again using an enhanced contrast ratio. ■

BEFORE



81	82	74	62	43	33	40	65
79	83	58	64	43	58	46	87
85	78	75	55	43	40	55	101
85	78	73	62	57	52	55	68
96	78	70	62	64	57	65	73
85	73	65	57	49	57	65	84
81	75	54	50	52	55	70	78
78	65	57	59	49	62	80	86

AFTER



81	77	73	64	46	34	43	62
86	77	67	56	42	37	55	79
84	75	65	57	47	46	64	87
80	73	69	67	60	55	64	80
86	76	70	68	62	56	63	76
95	78	63	57	54	54	67	83
88	71	56	53	54	58	71	86
72	60	53	58	63	65	72	82

MATRIX AFTER DCT

526.375	38.293	82.036	26.966	19.375	6.531	5.662	8.239
-10.770	30.436	-3.116	-23.448	7.197	-12.624	6.925	-7.444
-15.202	-8.093	3.226	-4.757	-2.552	1.614	-4.467	-9.597
-4.377	15.421	-7.687	6.656	-1.227	0.074	-2.595	1.815
1.386	12.818	-16.416	6.177	-2.112	8.365	-3.360	8.640
-11.258	10.800	-2.001	-4.704	-3.150	-1.120	-3.600	9.454
0.208	-1.809	8.526	-15.470	2.014	4.646	5.544	6.762
3.402	2.291	7.840	-2.888	3.404	-0.560	-2.208	9.047

Table 1.

AFTER SCALING AND QUANTIZATION

66	2	4	1	1	0	0	0
-1	2	0	-1	0	0	0	0
-1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0
0	0	-1	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Table 2.

B&H PHOTO-VIDEO

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JVC

KY-27C
3-CCD Color Video Camera

- New ½" broadcast-quality 380,000 pixel CCDs with advanced electronics deliver resolution of 800 horizontal lines and reduced smear.
- High sensitivity of F9.0 at 2000 lux allows a truly usable minimum illumination of 1 lux with JVC's exclusive LoLux dual pixel readout sampling technique.
- LoLux mode allows shooting scenes that were previously impossible due to insufficient lighting. CCDs are maximized for low light sensitivity equivalent to an electronic gain of 24dB, then the dual pixel readout system is added which provides an additional 6dB. Together they provide +30dB without the noise and picture degradation normally associated with this much gain.
- Signal-to-Noise ratio of 63dB assures virtually "noise free" images.
- Auto Shooting Mode where you only have to zoom, focus and record. All other parameters are controlled automatically.
- Enhanced ALC (Automatic Level Control) mode for continuous shooting in all light levels. This allows continuous automatic shooting from dark interiors to bright outdoors. Also features an aperture priority mode, manually set the iris for desired depth of focus and the ALC circuit automatically achieves correct video level.
- The Multi-Zone Iris Weighting system gives preference to objects in the center and lower portions of the picture. The Automatic Peak/Average Detection (APD) provides intelligence to ignore unusual objects such as bright lights.
- Auto knee circuitry extends a scene's light to dark dynamic range reproduction by up to five times without overexposure.
- Has large 1.5-inch viewfinder with 600 lines of resolution and SMPTE color bars. Status system provides audio levels, accumulated or remaining recording time, VTR operation, battery voltage and camera setup. Zebra pattern indication and safety zones with a center marker are also provided.
- Equipped with Variable Scan function. This allows flicker-free shooting of computer screens. Variable scan enables a precise shutter speed from 1/60.2 to 1/196.7 of a second in 256 increments to be set, matching a computers scan rate. Almost any computer display can be clearly recorded.
- Star filter creates dramatic 4-point star effects. Users can also select from a wide range of optional filters.
- Advanced Memory System (AMS) stores customizable settings for various shooting conditions.
- Camera head allows direct input of genlock signal and timing adjustment. A wide range optional remote controls, RS-232 interface, multicore and triax CCU's are available.
- Docks directly to the JVC BR-S422U, BR-S411UB and BR-S420CU professional S-VHS recorders. Optional adapters for docking to Hi-8 and Betacam SP are also available.

Vinten

THE ADVANCED RANGE OF VISION LIGHTWEIGHT HEADS AND TRIPODS

Vision SD 12 and SD 22
Pan and Tilt Heads with Serial Drag

The Vision SD 12 and SD 22 are the first heads with the "Serial Drag" pan and tilt system. The system consists of a unique, permanently-sealed fluid drag and an advanced lubricated friction drag. So for the first time, one head gives you all the advantages of both fluid (viscous) and lubricated (LF) drag systems – and none of their disadvantages. Achieve the smoothest pans and tilts regardless of speed, drag setting and ambient temperature. The Serial Drag system provides the widest range of infinitely variable precise settings with repeatable, consistent drag in each pan and tilt direction.

Features:
- Simple, easy-to-use external control for perfect balance.
- Patented spring-assisted counter-balance system permits perfect "hands-off" camera balance over full 180° of tilt.
- Instant drag system breakaway and recovery overcome inertia and friction for excellent "whip pans".
- Consistent drag levels in both pan and tilt axis.
- Redesigned flick on, flick off pan and tilt caliper disc brakes.
- Greater control, precision, flexibility and "touch" than any other head on the market.
- Touch activated, time delayed illuminated level bubble.
- Environmental working conditions from as low as -40° to as high as +60°C.
- SD 12 weighs 6.6 lbs and supports up to 35 lbs.
- SD 22 weighs 12.7 lbs and supports up to 55 lbs.

Vision Two Stage ENG and LT Carbon Fibre ENG Tripods

The ultimate in lightweight and innovative tripods, they are available with durable tubular alloy (Model #3513) or the stronger and lighter, axially and spirally wound carbon fiber construction (Model #3523). They each incorporate the new torque safe clamps to provide fast, safe and self-adjusting leg clamps that never let you down. Two stage operation gives them more flexibility when in use as well as greater operating range.

- "Torque Safe" requires no adjustment. Its unique design adjusts itself as and when required, eliminating the need for manual adjustment and maintenance and making for a much more reliable clamping system.
- New hip joint eliminates play and adds rigidity.
- They both feature 100mm levelling bowl, fold down to a compact 28", and support 45 lbs.
- The #3513 weighs 6.5 lbs and the #3523 CF (Carbon Fibre) weighs 5.2 lbs.

Vision 12 Systems

All Vision 12 systems include #3643 SD 12 dual fluid and lubricated friction drag pan/tilt head, single telescoping pan bar and clamp with 100mm ball base.

SD-12A System
- 3364-3 SD-12 Pan and tilt head
- 3518-3 Single stage ENG tripod with 100mm bowl
- 3363-3 Lightweight calibrated floor spreader

SD-12D System
- 3364-3 SD-12 Pan and tilt head
- 3513-3 Two-stage ENG tripod with 100mm bowl
- 3314-3 Heavy-duty calibrated floor spreader

SD-12LT System
- 3364-3 SD-12 Pan and tilt head
- 3523-3 Two-stage carbon fibre ENG tripod w/100mm bowl
- 3363-3 Lightweight calibrated floor spreader
- 3425-3A Carry strap
- 3340-3 Soft case

Vision 22 Systems

All Vision 22 systems include #3386-3 SD-22 dual fluid and lubricated friction drag pan and tilt head, single telescoping pan and clamp with dual 100mm/150mm ball base.

SD-22E System
- 3386-3 SD-22 Pan and tilt head
- 3219-52 Second telescoping pan bar and clamp
- 3516-3 Two-stage EFP tripod with 150mm bowl.
- 3314-3 Heavy-duty calibrated floor spreader

SD-22 LT System
- 3386-3 SD-22 Pan and tilt head
- 3219-52 Second telescoping pan bar and clamp
- 3523-3 Two-stage carbon fibre ENG tripod w/100mm bowl
- 3314-3 Heavy-duty calibrated floor spreader
- 3425-3A Carrying strap
- 3341-3 Soft case

SD-22 ELT System
- 3386-3 SD-22 Pan and tilt head
- 3219-52 Second telescoping pan bar and clamp
- 3383-3 Two-stage carbon fiber EFP tripod w/150mm bowl
- 3314-3 Heavy-duty calibrated floor spreader

WE BUY, SELL AND TRADE USED VIDEO EQUIPMENT

anton bauer

Logic Series DIGITAL Gold Mount Batteries

The Logic Series DIGITAL batteries are acknowledged to be the most advanced in the rechargeable battery industry. In addition to the comprehensive sensors integral to all Logic Series batteries, each DIGITAL battery has a built-in microprocessor that communicates directly with Anton/Bauer InterActive chargers, creating significant new benchmarks for reliability, performance, and life. They also complete the communications network between battery, charger and camera. With the network in place, DIGITAL batteries deliver the feature most requested by cameramen: a reliable and accurate indication of remaining battery power.

DIGITAL PRO PACS

The Digital Pro Pac is the ultimate professional video battery and is recommended for all applications. The premium heavy duty Digital Pro Pac cell is designed to deliver long life and high performance even under high current loads and adverse conditions. The size and weight of the Digital Pro Pac creates perfect shoulder balance with all cameras/camcorders.

- **DIGITAL PRO PAC 14 LOGIC SERIES NICAD BATTERY** 14.4v 60 Watt Hours. 5 1/8 lbs. Run time: 2 hours @ 27 watts, 3 hrs. @ 18 watts
- **DIGITAL PRO PAC 13 LOGIC SERIES NICAD BATTERY** 13.2v 55 Watt Hours. 4 3/4 lbs. Run time: 2 hours @ 25 watts, 3 hours @ 17 watts

GOLD MOUNT BATTERIES

Logic Series Gold Mount batteries are identical to the respective DIGITAL versions with respect to size, weight, capacity, IMPAC case construction, and application. They are similarly equipped with micro-code logic circuits and comprehensive ACS sensors. They do not include DIGITAL microprocessor features such as the integral diagnostic program "Fuel Computer", LCD/LED display and InterActive viewfinder fuel gauge circuit.

- **PRO PAC 14 NICAD BATTERY** (14.4v 60 Watt Hours)
- **PRD PAC 13 NICAD BATTERY** (13.2 v 55 Watt Hours)
- **MAGNUM 14 NICAD BATTERY** (14.4v 72 Watt Hours)
- **MAGNUM 13 NICAD BATTERY** (13.2 v 66 Watt Hours)
- **COMPAC MAGNUM 14 NICAD BATTERY** (14.4v 43 WH)
- **COMPAC MAGNUM 13 NICAD BATTERY** (13.2v 40 WH)

Century precision optics

WIDE ANGLE ADAPTERS
Tools For Creative Videographers

Century Precision's wide angle adapters open new possibilities for videographers. By providing a wider angle of view they let you capture more of the action from close up–especially crucial when shooting in tight quarters. Using a wide angle adapter also yields increased depth of field and shorter MDD (minimum object distance), enabling you to move closer to the subject and to arrange subjects within a shot over a greater range of distance relative to the lens. Century's wide angle adapters are divided into two classes: fixed focal length adapters and zoom-through converters. The Wide Angle Adapter Set, .6X Double Asphere and Super Fisheye are designed for use with a zoom lens set at its widest focal length. With one of these adapters a zoom lens performs as a wide or super wide angle fixed focal length lens. (Focus is done by using the lens' macro function.) For zoom-through applications, the .8X Wide Converter is perfect for shooting situations which require wide angle and the ability to zoom.

WA-7X5X WIDE ANGLE ADAPTER SET

- Compact, lightweight and economical, the Wide Angle Adapter Set is the industry standard. The set consists of two lenses, the .7X Wide Angle and .5X Super Wide Angle. The .7X attaches to the front of a zoom lens, increasing coverage by 30%.

- For example, when attached to a lens that zooms to 9mm, the.7X W/A adapter shortens the effective focal length to 6.3mm. Adding the .5X Super Wide further alters the wide end of the lens to just 4.5mm. Thus producing coverage nearly double that captured by the lens alone.

WA-7X93	.7x Wide Angle Adapter 445.00	**WA-7X5X**	Wide Angle Adapter Set (WA -7X93 and WA -5X45) 895.00
WA-5X45	.5X Super Wide Angle Adapter 535.00	**FA-6X**	Step-up Ring (specify 75mm, 80mm, 85mm, 90mm) ..ea. 104.95

SUPER FISHEYE ADAPTER

- When you need the widest possible angle of view, the Super Fisheye Adapter produces an extraordinary degree of barrel distortion for a magnification factor of approximately .55x. For example, adding the Super Fisheye to a modern 15x 8 lens results in a 116° horizontal angle of view—a remarkable 145° when measured diagonally.
- Due to the Super Fisheye's characteristic barrel distortion, extreme low and high angle shots are also made more dramatic. An attic crawlspace can induce heightened claustrophobia or a forest of tall skyscrapers made to bend menacingly over the audience. And since the Super Fisheye takes in a much wider angle of view than the human eye, it can also be used to plunge the audience into a scene— surrounding them with a noisy crowd or exiling them to a lonely beach.
- The Super Fisheye's tremendously wide field of view suggests a myriad of creative possibilities—from panoramic vistas that seem to stretch to the edge of the earth, to comical forced perspective close-ups, in which an actor's distorted features seem to pop through the video screen. While extreme telephoto shots tend to flatten the subjects against the background, the Super Fisheye exaggerates depth, pulling nearby objects closer and causing distant objects to recede into the background.
- In addition to the Super Fisheye (designed for the newest generation of internal focus zooms) Century Precision also offers the Fisheye Adapter for industrial video zoom lenses with 75mm lens fronts.

WA-FESU	Super Fisheye Adapter (specify lens front diameter)	1049.95
WA-FE75	Fisheye Adapter for industrial zoom lenses with 75mm fronts	445.00
FA-6X	Step-up Ring (specify 75mm, 80mm, 85mm, 90mm)	ea. 104.95

.8X ZDDM-THRU WIDE ANGLE CONVERTER

The .8X Wide Converter offers the high quality, economical way to expand a lens' angle of view when the shot requires a zoom—as well as situations which require both a wider angle of view and the ability to zoom.

- The .8X attaches quickly to the front of a zoom lens, effectively shortening its focal length while maintaining full zoom capabilities. With the converter attached, 20% more coverage is realized when the lens is set to wide angle, telephoto or anywhere in between. For example,when added to an 8.5-119mm lens, the .8X Wide Converter alters the focal range to 7-98mm. This can be especially advantageous when shooting in confined quarters.

- The .8X not only expands field of view but also reduces minimum object distance (MOD). The camera can therefore move considerably closer to the subject while maintaining focus. And because there is no light loss with the .8X, there is no need to change exposure or lighting.

WA-8XCV	.8X Wide Zoom-Thru Converter	1479.00
FA-388X	138mm Filter Adapter	164.95

.6X DDUBLE ASPHERE WIDE ANGLE ADAPTER

- Unequivocally superior to every other wide angle adapter, the .6x Double Asphere utilizes a single element with two aspheric surfaces. This design ensures a performance that is not possible with conventional single element adapters. The adapter minimizes distortion and reduces chromatic aberration while dramatically increasing edge resolution.
- Remarkably lightweight and compact, the .6X was created especially for use with the latest internal focus lenses like Canon and Fujinon's 15x8. The .6X increases their coverage 40%, effectively changing a15x8 into a super-sharp 4.8mm fixed focal length lens.
- The .6X fits most lenses via interchangeable adapter rings. An accessory Lens Shade/Filter Holder accepts either a single 4x5 or Panavision-size filter holder.

WA-6XAS	.6X Double Asphere (fixed focal length)				1225.00
FA-6XAS	Sunshade for .6X Double Asphere with slot to accept one 4x5 or 4x5.65 filter in a holder				349.95
FH-4X50	4x5 Filter Holder	199.95	**FH-4565**	4x5.65 Filter Holder	199.95

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TASCAM

DA-88 Multi-Track Recorder

The first thing you notice about the eight channel DA-88 is the size of the cassette - it's a small Hi-8mm video cassette. You'll also notice the recording time - up to 120 minutes. These are just two of the advantages of the DA-88's innovative use of 8mm technology.

- Intrinsic to the 8mm video format is the Automatic Track Finding (ATF) control system. This approach records the tracking control information, along with the program material, using the helical scan (video) head. Competing S-VHS based system record the tracking data with a linear recording head, independent of the program data. The S-VHS tape must be run at a higher speed (thereby delivering shorter recording time) to deliver control track reliability, and requires some form of automatic or manual tracking adjustment. Synchronization and tracking must be adjusted, either automatically or manually (just like on your home vcr) as the machine ages, or if the tape is played back on another machine.
- On the other hand, the ATF system ensures that there will be no tracking errors or loss of synchronization. The DA-88 doesn't even have (or need) a tracking adjustment. All eight tracks of audio are perfectly synchronized. What's more, this system guarantees perfect tracking and synchronization between all audio tracks on all cascaded decks - whether you have one deck or sixteen (up to 128 tracks!).
- Incoming audio is digitized by the on-board 16-bit D/A at either 44.1 or 48KHz (user selectable). The frequency response is flat from 20Hz to 20KHz while the dynamic range exceeds 92dB. As you would expect from a CD-quality recorder, the wow and flutter is unmeasurable.
- One of the best features of the DA-88 is the ability to execute seamless Punch-ins and Punch- outs. This feature offers programmable digital crossfades, as well as the ability to insert new material accurately into tight spots. You can even delay individual tracks, whether you want to generate special effects or compensate for poor timing. All of this can be performed easily on a deck that is simple and intuitive to use.

OPTIONS

- **RC-808** – Single Unit Remote Control
- **RC-848** – System Remote Control
- **MU-8824** – 24-Channel Meter Unit
- **SY-88** – Complete SMPTE/EBU Chase Synchronizing and MIDI Machine Control interface

Fostex

RD-8 Multi-Track Recorder

This digital multitrack recorder is designed specifically for the audio professional. Fostex has long been a leader in synchronization, and the RD-8 redefines that commitment. With its built-in SMPTE / EBU reader/generator, the RD-8 can stripe, read and jam sync time code - even convert to MIDI time code. In a sync environment the RD-8 can be either Master or Slave. In a MIDI environment it will integrate seamlessly into the most complex project studio, allowing you complete transport control from within your MMC (MIDI Machine Control) compatible sequencer.

- Full transport control is available via the unit's industry-standard RS-422 port, providing full control right from your video bay. The RD-8 records at either 44.1 or 48KHz and will perform Pull-Up and Pull-Down functions for film/video transfers. The Track Slip feature helps maintain perfect sound-to-picture sync and the 8-Channel Optical Digital Interface keeps you in the digital domain.
- All of this contributes to the superb sound quality of the RD-8. The audio itself is processed by 16-bit digital-to-analog (D/A's) converters at either 44.1 or 48KHz (user selectable) sampling rates, with 64X oversampling. Playback is accomplished with 18 bit analog-to-digital (A/D's) and 64X oversampling, thus delivering CD-quality audio.
- The S-VHS transport in the RD-8 was selected because of its proven reliability, rugged construction and superb tape handling capabilities. Eight tracks on S-VHS tape allow much wider track widths than is possible on other digital tape recording formats.
- With its LCD and 10-digit display panel, the RD-8 is remarkably easy to control. You can readily access 100 locate points, and cross-fade time is fully controllable in machine to machine editing. Table of Contents data can be recorded on tape. When the next session begins, whether on your RD-8 or another, you just load the set up information from your tape and begin working. Since the RD-8 is fully ADAT compliant, your machine can play tapes made on other compatible machines, and can be controlled by other manufacturers ADAT controllers. Your tapes will also be playable on any other ADAT deck.
- In addition to familiar transport controls, there are a number of logical, user friendly features. This is the only unit in its class with an on-board, back-lit variable contrast LCD display. It provides all of the information you'll need to keep track of offsets, punch points, generator functions and other pertinent data. Three function keys, combined with HOME, NEXT and UP/DOWN buttons, enable you to navigate the edit menus effortlessly. If you need to have access to the front panel controls, the optional model 8312 remote control gives you remote command of the most common functions.

NOVA SYSTEMS, INC.

NovaRouter 8x8, 16x16, 32x32 Intelligent Matrix Routing Switchers

A series of serially controlled audio and video matrix routing switchers, NovaRouters are available in 8x8,16x16 and 32x32 matrices. They are capable of up to five switching levels to support unlimited combinations of stereo audio, component, composite and S-video, RGB/S and VGA graphics. Audio follow video or breakaway routing is controlled by very intuitive computer software or optional XY control panels.

All NovaRouters include an RS-232 interface and software. The software and VGA display provide quick visualization of all crosspoints and facilitates routing operations. An unlimited number of switching configurations may be stored in memory and recalled at the click of a mouse. User defined labels for all sources and destinations provide positive identification of the matrix status. One PC (386 or better) can control several NovaRouter Systems for multiple studio or large presentation system applications.

An optional, easy-to-use, push-button XY control panel provides routing functions for basic systems without the use of a computer. All video, audio and audio follow video switching functions are controlled by source select and destination select switches. Changing and verifying the matrix configuration is simple and clear. The XY controls may be front panel mounted or are available as a rackmountable remote control unit.

Broadcast quality audio and video processing and microprocessor control ensure superior quality and performance. Yet the simplicity and modular configurations of NovaRouters make them economical for broadcast, production, cable TV, graphics, presentation, educational and teleconferencing applications.

System Configurations:

	8 x 8 Matrices:	Price	16 x 16 Matrices:	Price	32 x 32 Matrices:	Price
Video	NR-8V	1395.00	NR-16V	3299.00	NR-32V	7199.00
S-Video	NR-8Y	2595.00	NR-16Y	5799.00		
Stereo Audio	NR-8A	1299.00	NR-16A	2249.00	NR-32A	4999.00
Balance Stereo Audio	NR-8AB	1750.00	NR-16AB	3299.00	NR-32AB	5695.00

XY Front Panel Control:		Price	XY Remote Control:		Price
XY-8P	8x8	275.00	XY-8RM	8x8	375.00
XY-16P	16x16	495.00	XY-16RM	16x16	595.00
XY-32P	32x32	895.00	XY-32RM	32x32	995.00

CHYRON Graphics

PC-CODI TEXT and GRAPHICS GENERATOR

A PC-compatible (ISA bus) board, the PC-CODI incorporates a broadcast quality encoder and wide bandwidth linear keyer to provide highest quality realtime, video character generation and graphics display. Used individually or configured with multiple boards, it is a complete and affordable solution for information displays, broadcast, video production or multi-media applications.

- Standard PC/AT ISA bus interface, 2/3 length form factor
- Fully-antialiased displays
- Less than 10nsec. effective pixel resolution
- 16.7 million color selections
- Fast, realtime operations
- Character, Logo and PCX Image transparency
- Display and non-display buffers
- Bitstream typeface library selection
- Variable edges: border, drop shadow and offset
- Variable flush
- Full position and justify control of character & row
- User definable intercharacter spacing (squeeze & expand)
- Multiple roll/crawl speeds
- Automatic character kerning
- User definable tab/template fields
- Shades backgrounds of variable sizes and transparency
- User definable read effects playback: wipes, pushes, fades
- High quality composite & S-video (Y/C) encoder
- Integral composite and S-video linear keyer
- NTSC or PAL sync generator with genlock
- Module switchable NTSC or PAL operation
- Software controlled video timing
- Board addressability for multi-channel applications
- Auto display sequencing
- Local message/page memory
- Preview output with safe-title/cursor/menu overlay
- Composite & S-video input with auto-genlock select

SONY COLOR MONITORS

PVM-1350 13˝ Presentation Monitor

- Employs a P-22 phosphor fine pitch CRT to deliver stunning horizontal resolution of 450 horizontal lines.
- Equipped with beam current feedback circuit which eliminates white balance drift for long term stability of color balance.
- Has analog RGB, S-video and two composite video (BNC) inputs as well as 4 audio inputs.
- Automatic Chroma/Phase setup mode facilitates the complex, delicate procedure of monitor adjustment. Using broadcast standard color bars as a reference, this function automatically calibrates chroma and phase.
- Chroma/Phase adjustments can also be easily performed with the monochrome Blue Only display. In Blue Only mode video noise can be precisely evaluated.
- Factory set to broadcast standard 6500K color temperature.
- Provides an on-screen menu to facilitate adjustment/operation on the monitor. The on-screen menu display can be selected in English, French, German, Spanish or Italian.
- On power up, automatic degaussing is performed. There is also a manual degauss switch to demagnetize the screen.
- Sub control mode allows fine adjustments to be made on the knob control for contrast, brightness, chroma and phase. The desired level can be set to the click position at the center allowing for multi-

PVM-1351Q 13˝ Production Monitor

Has all the features of the PVM-1350 *PLUS* -

- Is also a multisystem monitor. It accepts NTSC, PAL and NTSC video signals. NTSC 4.43 can also be reproduced.
- Equipped with a SMPTE 259M Serial Digital Interface. By inserting the optional serial digital interface kit BKM-101C for video and the BKM-102 for audio the PVM-1351Q can accept SMPTE 259M component serial digital signals.
- Equipped with RS-422 serial interface. With optional BKM-103 serial remote control kit all of the monitor's functions can be remotely controlled with greater confidence and precision.
- Equipped with input terminals such as component (Y/R-Y/B-Y), analog RGB, S-video, 2 composite video (BNC) and 4 audio terminals for complete flexibility.
- Aspect ratio is switchable between 4:3 and 16:9 simply by pressing a button.
- Underscan and H/V delay capability. With underscan, entire active picture area is displayed. Allows you to view entire image and check the picture edges. H/V delay allows viewing of the blanking area and sync/burst timing by displaying the horizontal and vertical intervals in the center of the screen.
- Color temperature switchable between 6500K/9300K/User preset. 6500K is factory preset. 9300K is for a more pleasing picture. User preset is 3200K to 10,000K.

PVM-1354Q/PVM-1954Q 13˝ and 19˝ Production Monitors

All the features of the PVM-1351Q *PLUS*:

- SMPTE C standard phosphor CRT is incorporated in the PVM-1354Q/1954Q. SMPTE C phosphors permit the most critical evaluation of any color subject. Provides over 600 lines of horizontal resolution.
- The PVM-1354Q mounts into a 19-inch EIA standard rack with the optional MB-502B rack mount bracket and SLR-102 slide rail kit same as PVM-1351Q. The PVM-1954Q mounts into a 19-inch EIA rack with the optional SLR-103 slide rail kit.

SHURE

FP32A PORTABLE STEREO MIXER

This small and rugged portable mixer is well equipped to handle the demands of EFP, ENG, live music recording or any other situation that requires a low noise high performance mixer.

- High quality-low noise electronics, perfect for digital recording and transmission
- Three balanced inputs, two balanced outputs plus tape out and monitor
- Supports all types of condenser mics with internal phantom supply
- Inputs can be switched between mic and line level
- Each channel has own pan pot
- Each channel has illuminated meter and peak indicator
- Two units can be cascaded to provide six input channels
- Internal 1KHz oscillator for record and send level calibration
- Internal (2x9V alkaline batteries) or external power
- Switchable low cut filters

MACKIE

MicroSeries 1202 12-Channel Ultra-Compact Mic/Line Mixer

Usually the performance and durability of smaller mixers drops in direct proportion to their price, making lower cost models unacceptable for serious recording and sound reinforcement. Fortunately, Mackie's fanatical approach to pro sound engineering has resulted in the Micro Series 1202, an affordable small mixer with studio specifications and rugged construction. The Micro Series 1202 is a no-compromise, professional quality ultra-compact mixer designed for non-stop 24 hour-a-day professional duty in broadcast studios, permanent PA applications and editing suites where nothing must ever go wrong. So no matter what your application, the Micro Series 1202 is ideal. If price is the prime consideration or you simply want the best possible mixer in the least amount of space, there is only one choice.

CR-1604 16-Channel Audio Mixer

In less than three years, the Mackie CR-1604 has become the industry standard for compact 16-channel mixers. It is the hands-down choice for major touring groups and studio session players, as well as for broadcast, sound contracting and recording studio users. For them the CR-1604 offers features, specs, and day-in-day-out reliability that rival far larger boards. Its remarkable features include 24 usable line inputs with special headroom/ultra-low noise Unityplus circuitry, seven AUX sends, 3-band equalization, constant power pan controls, 10-segment LED output metering, discrete front end phantom-powered mic inputs and much more.

TASCAM

M-2600 Series 16/24/32 Channel Eight Channel Mixers

LOW NOISE CIRCUITRY

- Combining completely redesigned, low noise circuitry with Absolute Sound Transparency™ the M-2600 delivers high-quality extremely clean sound. No matter how many times your signal goes through the M-2600, it won;t be colored or altered. The signal remains as close to the original as possible. The only coloring you hear is what you add with creative EQ and your outboard signal processing gear.
- Double reinforced grounding system eliminates any hum. World-class power supply provides higher voltage output for better headroom and higher S/N ratio.

THE BEST AUX SECTION IN THE BUSINESS

The most versatile AUX section in its class; rivaling expensive high-end consoles. 8 sends total, 2 in stereo. Send signal in stereo or mono, pre- or post-fader. Available all at once. Return signal through any of 6 stereo paths.

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B&H AUDIO-VIDEO

HORITA

WG-50
Window Dub Inserter

- Makes burned-in SMPTE TC window dub copies
- Indicates drop-frame or non-drop-frame time code
- Also functions as play speed SMPTE time code reader
- Adjustments for horizontal and vertical size and position
- Dark mask or "see-thru" mask surrounds display
- Provides reshaped time code output for copying TC
- Displays time code or user bits • Display on/off
- Field 1/ field 2 indicator • Sharp characters
- Always frame accurate (on time)

$269

TG-50
Generator / Inserter

Combination time code generator and window dub inserter. It includes all features of WG-50 **PLUS–**

- Generates SMPTE time code in drop/non-drop-frame format
- Jamsync mode jams to time code input and outputs new TC
- Simple "on screen" preset of time code and user bits
- Run/stop operation using front panel momentary switch
- Selectable 30/60/90/120-second automatic generator back-time
- Make a window dub copy while recording TC on source tape

$349

BSG-50
Blackburst/Sync/Tone Generator

The BSG-50 provides an economical means for generating the most common RS-170A video timing signals used to operate various video switchers, effects generators, TBCs, VCRs, cameras and video edit controllers.

- 6 BNC video/pulse outputs
- Now available: 6 blackburst, 4 sync, 2 subcarrier
- Each sync output individually settable for composite sync, composite blanking, H-drive, or V-drive.
- Separate buffer for each output–maximum signal isolation
- 1KHz, 0dB sinewave audio tone output, locked to video
- Outputs can easily be configured to meet specific user and equipment needs

$269

CSG-50
Color Bar/Sync/ Tone Generator

- Generates full/SMPTE color bars, blackburst and composite sync signals
- Built-in timer can automatically switch video output from color bars to color black after 30 or 60 seconds. Easy and convenient for producing tape leaders and striping tapes with color bars and black.
- Front panel selection of full-field or SMPTE color bar patterns or colorblack (blackburst) video output.
- Includes crystal-controlled, 1KHz, 0dB audio tone output.
- Outputs: video, sync, ref frame, 1 KHz, 0dB
- Audio tone switches to silence and color bars change to black when using 30/60 second timer
- Fully RS-170A SC/H phased and always correct. No adjustment required

$349

TSG-50
NTSC Test Signal Generator

The TSG-50 generates 12 video test signals suitable for setting up, aligning, and evaluating the performance of various video equipment found in a typical video editing system, such as video monitors, distribution amplifiers, VCRs, switchers, effects generators, TBCs, etc. In addition to the video signals, the TSG-50 also generates composite sync and, with a video DA such as the Horita VDA-50, becomes a high quality, multiple output, house sync generator.

- Fully RS-170A SC/H phased and always correct. No adjustments ever required
- Built-in timer automatically switches video output from color bar pattern to black after 30 or 60 seconds. Makes it easy to produce tape leaders of color bars followed by black
- Video signals generated are in accordance with industry standard EIA RS-170A video timing specification.
- Audio tone switches to silence and color bars change to black when using 30/60 second timer.
- Convenient pattern selection - 12 position front panel switch.
- Includes crystal controlled, 1 KHz, 0dB audio tone output.
- Generates precise oscilloscope trigger output signal one H line before start of color field 1.
- Outputs: video, sync, ref frame, 1KHz, 0dB

$439

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TRG-50 – Generator/Inserter/Search Speed Reader
TRG-50PC – Has all of the above plus RS-232 control.
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RLT-50 – Hi8 (EVO-9800/9850)TC to LTC ranslator
TSG-50 – NTSC Test Signal Generator
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SAG-50 – Safe Area, Convergence Pattern and Oscilloscope Line Trigger and Generator

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TRUEVISION
TARGA 2000 PCI
PC-based Digital Video Capture Board

Designed for high performance IBM compatibles, Truevision's TARGA 2000 PRO PCI brings tremendous power to the desktop video editing market. With the proliferation of PC-based video (and audio) programs, and the domination of the platform by Microsoft's Windows, there has been a demand for high performance hardware that won't tie up the computer's resources. The TARGA 2000 PRO PCI meets that demand with a board that performs all its own signal processing. Realtime CODEC (COmpression/DECompression) processing of audio and video, 24-bit video windowing and full motion/full screen print-to-tape are just a few of its many capabilities.

- Allows recording and playback of video directly to/from hard drive at full motion, full frame rates (50 fields/sec - PAL, 60 fields/sec-NTSC). Video is stored and played back at the highest resolution for each format (768 x 576 x 24 bit - PAL, 640 x 480 x 24 bit - NTSC). Compression can be adjusted on the fly to optimize for image quality and/or minimum storage space.
- Equipped with composite, S-video and component (Betacam) inputs and outputs.
- Accelerated Windows 3.1 and Windows NT drivers offer integrated, true-color (24-bit), non-interlaced desktop up to 1152 x 870 pixels
- Genlock using separate sync input for working in professional video suites
- Provides a large work area for displaying video, as well as editing application controls. Any part of the display (or even the whole image) can be recorded to tape (video-out-of-a-window)
- The audio is digitized at 16-bit resolution (at 44.1KHz or 48KHz sampling rates), yielding professional quality stereo sound. Since all audio and video processing is done by on-board DSPs, you are assured of perfectly synchronized sound and images.
- View your desktop and video-in-a-window on your non-interlaced high resolution desktop display while the processed video is output at NTSC or PAL resolutions to a video monitor and/or a VCR.
- All Windows, VFW (Video For Windows) and ADI compatible software run perfectly on the TARGA 2000. You have a choice of hundreds of applications, with more to come (see Real Impact below).

Complete Truevision TARGA 2000/Avid Real Impact Non-Linear Turnkey System:
• TARGA 2000 PCI digital video capture board • Avid Real Impact software • 220-watt, 6-bay midtower case • PCI motherboard with 256K synchronous cache • Pentium 133 Mhz processor • Diamond Stealth64 Video VGA display card • 32MB of EDO (Extended Data Out) RAM • Quantum 1.28GB IDE system drive • Seagate (Barracuda) 4.2GB SCSI-2 Wide hard drive • Adaptec AHA-2940W Fast Wide SCSI II controller card • 3.5" floppy drive • Plextor 4.5x SCSI internal CD-ROM drive • Altec-Lansing 300.1 three-piece speaker system • MAG Innovision MXG-17F 17" multiscan monitor • Focus 2001A keyboard, Microsoft MS mouse, Windows NT 3.51 software..... **$12,250**

Enhancement Options Available:
• Additional 32MB of RAM • Additional 256K cache memory • Seagate (Elite) 9.1GB SCSI Wide hard drive • Mag 21" multiscan monitor • 8x CD-ROM drive • Adobe Premier 4.0a for Windows

Real Impact
Video Editing Software for TARGA 2000

NEW!

With the introduction of Real Impact, Avid provides Windows users with the same professional image quality, intuitive cut/copy/paste editing, and instant random access capabilities that have won 2 Emmy awards—for thousands of dollars less than outsourcing an average video. Designed exclusively for Truevision's TARGA 2000, Real Impact lets you create professional-quality video with audio, graphics, animations, special effects and titles—with the speed, flexibility and creative freedom you need. Create sales, training and product videos right on your PC quickly and easily—without compromising quality. Produce video in 24-bit color, with CD-quality sound and perfect lip sync.

Easy to Use: A true Windows 32-bit application (Windows NT 3.51 or later). Real Impact's intuitive interface and extensive on-line help get you productive right away. It's powerful editing features let you work with video, audio, graphics, animations and titles with the simplicity of cut, copy and paste.

Video Capture: Digitize video and audio from your camcorder, VCR or professional tape deck—without dropping a frame. Your video will be full-screen, full-motion, 30 frames-per-second and your audio in sync. With its Dial-a-Quality image feature, Real Impact allows you to adjust image quality for differing system, storage and delivery requirements.

Create a Storyboard: Extensive media management with Real Impact's built-in media library and database let you easily find the video and audio clips that you want. Instant random access makes previewing edits simple and immediate. And, with timeline editing, you just click and drag to experiment with different cuts, rearrange clips and assemble your story. There are 32 levels of undo/redo.

Add Graphics, Titles and Special Effects: Its easy to create and seamlessly incorporate audio, graphics and animations into your video using popular Windows-based applications. Real Impact supports AVI video files, WAV audio files, FLC animation files as well as BMP, JPEG, PCX, TGA and TIFF graphics files.

Add Audio: Polish your audio with music and narration. Adjust pan and volume in real time. Simultaneous playback of four audio tracks makes audio editing quick and easy. View your four audio tracks in sync with the video immediately, no waiting for tracks to compile.

Digital Media Interchange: Real Impact is compatible with the Open Media Framework (OMF) Interchange, an industry-standard file format for the seamless integration of digital data among applications and across platforms. Through OMF, you can import video and audio files from other OMF-compatible applications such as Avid's Media Composer system.

Output to Tape, CD-ROM or Over a Network: Real Impact gives complete control over how you distribute video. There's no long rendering process—creating professional quality tape is a snap. Embedding video in multimedia presentations for distribution on disk or CD-ROM is as simple as the click of a mouse. Support for third-party MPEG tools make it possible to create MPEG files for network distribution.

Avid's Support Advantage: Like all other Avid products, Real Impact is backed by Avid's world-class customer service. Toll-free telephone support and bulletin board service are just some of the benefits.

Real Impact Features:

Video:
- Real-time JPEG compression, decompression and playback at 60 fields per second.
- Supports Sony serial and VLAN deck control protocols, supports SMPTE time code.
- Edit two tracks of video for layered effects.

Audio:
- Edit up to four tracks of 44.1 KHz, 16-bit CD-quality audio.
- Real-time pan and volume adjustments, digital audio scrub.
- Audio waveform for precise audio editing.

Digital Editing:
- Instant random access to footage. Cut, copy, paste editing with 32 levels of undo and redo.
- Instant trim editing mode, plays back all edits instantly.

Import/Export:
- AVI video files, WAV audio files, FLC animation files.
- OMF Interchange files.
- BMP, JPEG, PCX, TGA and TIFF graphics files.

Special Effects:
- Filter effects with previews and adjustable parameters.
- Transition effects include wipes, dissolves, zooms, pushes and squeezes.
- Layered effects include picture-in-picture, luminance and chroma key.
- Support for Avid TransJammer effects Vol. 2 or later (Vol. 1 requires a free update through Avid Technical Support).

Integrated Title Generator:
- Fully anti-aliased titles.
- 32-bit processing (24-bit color and 8-bit alpha channel).
- Support for TrueType fonts and international character sets.
- Drop shadows, transparency and color blends.
- NTSC and PAL-safe color palettes.

Media Management:
- Media library for organizing digital media clips.
- Database with search capabilities.
- Customized views for easy clip access and retrieval.

MAGNI

MM-400

- The MM-400 is a combination waveform and vector monitor especially configured for the cost-conscious producer. A low-cost alternative to CRT-based waveform monitoring the MM-400 produces a video picture of the input signal's waveform and displays it on any video monitor. It provides a simple, affordable and accurate way to set camera levels before a shoot, or to check time base correctors and color fidelity in editing. Problems like hue shift, smearing, muddy contrast and loss of detail are easily identified for correction.

FEATURES:
- Converts waveform or vector display information into a standard video signal which can be displayed on a video monitor or routed around a video facility, no need for additional expensive monitors. Switch between pictures and waveforms at the push of a button.
- Incorporates an advanced SC/H phase and color frame indicator that is a must for editing and post production. At a glance it tells you if a signal's subcarrier-to- horizontal phase is properly adjusted and if the signal's color frame matches the house black burst connected to the MM-400 external reference input.
- Works anywhere and with any analog video format—NTSC, PAL, Component or S-Video. It has automatic detection between NTSC and PAL formats.
- Three loop-through inputs can accept three composite signals or one component, or RGB signal.
- No complex displays or special test signals are required for component video monitoring.
- Interchannel timing and amplitude display make component analog monitoring easy, has color bar limit markings for Betacam, M-II and SMPTE formats.
- Waveform and vectorscope controls, including channel, sweep speed, position control, phase rotation are on easy-to-see dedicated pushbuttons.
- Besides instant toggling between picture and waveform, a mix mode combines waveform and picture displays for simultaneous viewing.
- The MM-400 can be readily used by even novice operators. It has easy-to- understand set-up menus for display color, interchannel timing, SC/H phase alarm.
- Usable in any video facility of any size for displaying signals, its low cost makes it affordable by the smallest studio, while its features and performance make it ideal for monitoring in high-end facilities as well.

LEADER

Model 5850C
Vectorscope

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

Model 5860C
Waveform Monitor

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

Model 5864A
Waveform Monitor

5864A

5854

A fully portable waveform monitor for field use, the Model 5864A is a two-channel unit that provides 2H and 2V sweeps with MAG, FLAT and IRE response, and normal and X4 gain.

Model 5854
Vectorscope

2-channel portable vectorscope is ideal for field use and features A and B phase reference, fixed and variable gain. Both units shown with optional battery holder and NP-1 type battery.

Minimum shipping USA (Except AK & HI) $7.00 up to 3lbs. Add 60¢ for each additional lb. For ins. add 40¢ per $100. Prices valid subject to supplier prices. Not responsible for typographical errors. © 1995 Photo-Video

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BECK BROADCAST PRODUCTS

TBC-RMT (TBC Remote Control Unit) Remote control of up to 3 TBC's. For use with internal TBC's on BVW, DVW, PVW, UVW, and BVH Beta machines or any machine using Sony BVR-50 controller. Purchased with 1, 2, or 3 modules. With 3 modules. **$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 push-buttons for channel assignment. **$980**

SCP-10 (Serial 422 Patch Panel) 10x10 passive non-normalling 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 readable 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**

LM 2+2 (Audio Level Matcher) Provides a complete interface between an unbalanced audio device and a balanced environment. Two channels of balanced to unbalanced conversion complement two channels of unbalanced to balanced. Independent gain trims. **$212**

LM VCA (Audio Level Matcher w/Remote Gain) Two channels of independent voltage controlled gain with gain trims. Balanced or unbalanced inputs and outputs. 100 dB range with 0 to +5V control. True logarithmic response. Used for remote gain riding, remote monitor gain. **$255**

STG (Stereo Tone Generator) With simultaneous, unbalanced and balanced outputs, digital precision and crystal controlled accuracy. Provides a source of digitally generated 400 Hz and 1kHz tone for any consumer or professional input. **$305**

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CHIEF ENGINEER WANTED: Requires extensive hands-on maintenance experience, people management and interdepartmental communications experience at a commercial television station. Long range technical planning and budgeting, knowledge of equipment and current trends in technical developments in the industry required. Positive personnel relations and efficient utilizations of manpower a must. M/F, ADA, EOE Employer. Send resume to: Dan Steele, Operations and Program Manager, WPSD-TV, P.O. Box 1197, Paducah, KY 42002-1197. No phone calls, please.

HELP WANTED

THE WEATHER CHANNEL® in Atlanta, GA has immediate openings for two broadcast Maintenance Engineers. Successful candidates must have a minimum of two years broadcasting experience. Knowledge of Sony Betacam/SP's, personal computers, Odetics, Utah Scientific or Grass Valley equipment is a plus. Must work well in a team environment. Good work ethic and a positive attitude are a must. Send resume to: The Weather Channel, 2600 Cumberland Parkway, Atlanta, GA 30339 or Fax: (770) 801-2522 Attn: Engineering Department. Competitive salary and benefits package offered. EOE/M/V/D.

MAINTENANCE ENGINEER: Immediate opening for a Maintenance Engineer. Associate Degree in Electronics and 4-6 years experience in TV Maintenance. FCC General Class license required-SBE certification desirable. Individual must be energetic, self-starter with experience in component level troubleshooting and maintenance of a wide variety of audio, video and RF equipment. U-Matic maintenance experience required. Beta experience a plus. Must also share in driving/operating KU band SNG truck (Missouri chauffeurs license required). Some weekends and nights may be required. Minorities and women encouraged to apply. Send resume listing references, salary requirements and any manufactures technical schools to: Chief Engineer, KOMU-TV, 5550 Hwy. 63 South, Columbia, MO 65201. An EEO Affirmative Action Employer.

TECHNICAL SERVICE ENGINEERS IMTECH Corporation, the leading US manufacturer and designer of videowall systems for broadcast, corporate, retail and entertainment industry applications, has openings for motivated, growth- & results-oriented **Technical Service Engineers**. If you are a hands-on, talented team player and want to apply your skills to challenging projects and installations – and also enjoy the smaller tasks that come between big assignments – then we would like to meet you. IMTECH creates innovative large-scale display systems which combine many converging technologies including: audio, video, computer-generated graphics, state-of-the-art hardware and devices, and custom control and communications software. Our Technical Service Engineers are responsible for the planning and execution of new system installations, troubleshooting and field service for existing clients, and support for trade shows and product demonstrations. Some travel and customer interaction are required. This position requires a degree in Media Communications, Electronics or a related field of study, or equivalent work experience, and 2+ years' experience in the installation, maintenance, troubleshooting and repair of audio, video and communications equipment. A good understanding of serial control protocols, PC hardware and Windows-based software is necessary. Our offices are located in Denville, NJ (45 minutes west of Manhattan). For consideration, please forward your resume to: IMTECH, Attn.: TS-SCN, 2 Stewart Court, Denville, NJ 07834, or send e-mail to info@imtech.com. EOE.

ASST. CHIEF ENGINEER: Cottonwood Communications has recently acquired KSPR-TV, an ABC affiliate, and has an immediate opening for an assistant to the Chief of Engineering with primary maintenance responsibilities. Must have solid electronics background with component level troubleshooting capability. Knowledge of studio equipment with emphasis on Beta and 3/4 tape formats required. Beautiful facility in the Missouri Ozarks. Send resume to ATTN: CEO, KSPR-TV, 1359 St. Louis Street, Springfield, MO 65802. EOE.

MAINTENANCE ENGINEER/VIDEO ENGINEER Atlantic Video has openings for tape maintenance engineers and video engineers with Ikegami plumicon camera maintenance experience. FCC general class and SBE certification a plus. Send resume or call voice mail box to arrange an interview. All inquirers confidential. Chief Engineer, Atlantic Video Inc. 650 Massachusetts Avenue, N.W. Washington, D.C. 20001. Voice Mail (202) 408-3423 Fax (202) 408-8496.

ENGINEER

Don't pass up this opportunity! National cable network with expanding facilities has challenging growth opportunities for experienced engineers. If you are an assistant chief engineer, maintenance or video engineer with experience troubleshooting to the component level, we'd like to speak with you. A background in 601 serial component technology and analog equipment is essential. Knowledge of satellite compression technology, tapeless media, digital compression and interactive technologies is a plus; BSCE, BSET OR BSEE desired. For confidential consideration, please send your resume and salary history/requirements to: **BHA Box 204, 555 Madison Avenue, New York, NY 10022.** Equal opportunity employer M/F/D/V.

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CHIEF ENGINEER KFMB-TV, San Diego, is seeking a Chief Engineer to be responsible for all technical operations and maintenance. Strong computer skills and up-to-date technical knowledge necessary. Three to five years of management experience preferred. Team building a definite plus. College degree preferable. Send confidential resume with references to Anna Swearingen, Director of Human Resources, KFMB-TV, P.O. Box 85888, San Diego, CA 92186. EOE. No phone calls please.

CHIEF ENGINEER/SYSTEMS MANAGER: K•EYE TV CBS' most successful switch station (http://www.k-eyetv.com) seeks computer-savvy Chief with can-do attitude to maintain and grow Granite Broadcastings' state-of-the-art facility. Must have UHF transmitter, ENG, and studio/production operations experience, as well as expertise in non-linear editing (all-AVID editing newsroom), LAN, and other computer-based operations. Electronics technology or related college degree, systems management experience, and SBE certification preferred. Minimum 3 years Chief Engineer or related experience required. GBC/K•EYE 42 TV is an Equal Opportunity Employer. No phone calls, please. Send resume to: K•EYE 42 TV, Attn: Dennis Upah, 10700 Metric Blvd., Austin, Texas 78758.

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HELP WANTED

FM/TV BROADCAST ENGINEER POSITION. T.S.G. Inc. seeking experienced, Broadcast Prof. with strong background in AM/FM TX & studio equipment to the component level. FCC & SBE Certification desired. Pos. Req. excellent work & Prof. ethic standards. Share FM station maint responsibilities throughout S. LA. Computer, Mgmt, VTR experience a plus. Send resume to 12015 Cloverland Court, Baton Rouge, LA 70809. 504-751-9800ph, 504-753-1726fax.

ENGINEERING MANAGER: CLTV News, Tribune Company's regional news cable channel in suburban Chicago, seeks an engineering manager to oversee modern broadcast facility. Knowledge of LMS, automation, field and studio equipment, computer systems, microwave, fiber and MDS important. We need a hands-on supervisor for a team of maintenance and MIS professionals, fully responsible for our technical standards and our commitment to providing top quality around-the-clock news coverage. Five years broadcast engineering experience with management background preferred; strong experience from related industries will be considered. We offer excellent employee benefits at our state-of-the-art facility. Send your resume with your salary requirements to Human Resources. CLTV News, 2000 York, Suite 114, Oak Brook, IL 60521; or fax to 708-571-0489.

NASHVILLE TELEVISION STATION has immediate opening for qualified maintenance engineer. Successful candidate should be experienced with UHF transmitters, microwave, satellite and computers. A minimum of 3 years experience is required. Must have FCC and/or SBE certification. Competitive salary and benefits. Please indicate position applied for and submit resume to: Director of Human Resources, WNAB-TV, 3201 Dickerson Pike, Nashville, TN 37207 or Fax (615) 650-6293. No phone calls please. WNAB-TV is an Equal Opportunity Employer.

MAINTENANCE ENGINEER Black Entertainment Television Inc. Ability to troubleshoot to the component level production switchers, digital video effects systems, routing switchers, vtr's character generators, cameras, editing systems and audio equipment. This will include system interfacing to computers and compatible components, equipment installation for studio and remote productions. Must be knowledgeable of system timing theory, broadcast specifications, and electronics course study. Ability to perform fiber switches and satellite downlink. Must have 3 years experience. BET, Corporate Human Resources, 1905-E 9th Street, N.E., Washington, D.C. 20018.

SENIOR LEVEL MAINTENANCE ENGINEER High end S.F. facility has immediate opening for senior level maintenance engineer. Min. 10 years of hands on maintenance, repair & operations skills on post production video and audio equipment, ENG/EFP equipment, system troubleshooting, and computer systems. Experience in D1, D2, Analog & digital Beta, Avid, Quantel, PC and Mac required. Fax or e-mail to: 415-705-0171 or employment@rtv.com.

MAINTENANCE ENGINEER KDNL-TV, ABC affiliate in St. Louis, MO is accepting applications for an experienced maintenance engineer. Minimum of 5 years exp. 1" and 1/2" Beta repair background is also required. ENG/EFP maintenance experience a plus. An understanding of computer systems and networking is desirable. Send resumes to: Joe Miller, Chief Engineer, KDNL-TV, 1215 Cole Street, St. Louis, MO 63106. FAX 314-259-5767. EOE, M/F.

ASSISTANT CHIEF ENGINEER Independent UHF station needs experienced person to maintain transmitter, microwave systems and studio equipment. FCC General Class License required. Please send resume to KTZZ-TV Personnel Dept. 945, Dexter Ave. N., Seattle, WA 98109. Fax (206) 281-0207. EOE.

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By Paul McGoldrick

Composite digital

This month, we will take a look at composite digital. As a reminder, last month we noted that composite digital standards are based on the NTSC or PAL composite analog signals being directly digitized at a sampling frequency of 4fsc (14.3MHz for NTSC, 17.7MHz for PAL). With 10-bits/sample there are 1,024 levels from peak negative chroma to peak positive chroma. Many have the immediate temptation to call such signals D-2, but that is inaccurate and confusing. Much of this is because the composite digital standard and the D-2 recording machine were synonymous for a while. The advent of the D-3 VTR, also a composite digital machine, changed that simple scenario.

Ancillary data can be added to the composite digital signal in the areas of constant maximum negative-direction amplitude at the base of the line sync, field sync and equalizing pulses.

In the composite digital standard, the complete signal is digitized. The timing of the sampling points is critical to maintaining SC/H relationships between different machines — tape interchange — and the exact positions of samples are defined around horizontal blanking. The complex drawing showing the timing points, and the numbering of the samples, has a web-like quality to it and is known as the "spider" drawing. Because of a math error in earlier copies of the drawing, some D-2 machines have unmatched SC/H compared to later versions.

Ancillary data can be added to the composite digital signal in the areas of constant maximum negative-direction amplitude at the base of the line sync, field sync and equalizing pulses. In the D-2 machine, the entire line blanking is regenerated during playback rather than taking the off-tape signal version. (See Figure 1.) This guarantees better edges and burst shaping.

You are not alone!

If you believed all of the talk about "digital," you would assume that if you are still dealing with NTSC signals you are in the age of the dinosaurs. The numbers say differently; about 95% of the handling of video signals in the United States are still NTSC. The workhorse 1-inch machine still dominates, and even the venerable U-matic refuses to go away. The change to digital is a focused event. Some production houses must be involved with D-1. The majority of users have no absolute need for digital.

When a change or upgrade is needed in the recording area, a logical step is to change the 1-inch machine for a D-2 or D-3 direct cable replacement. Although the machines are digital, the input signal and the output signal can still be analog NTSC, using the same coaxial cables.

There are a good number of composite digital interface pieces (switchers, etc.). There is composite digital test equipment and there are composite digital monitor inputs (both the latter frequently marked as D-2), but the majority of installations are still using composite analog in and out. Ampex and Sony supported the composite digital standard with the D-2 recorder, and it is a highly functional device. Using a 19mm (¾-inch) cassette machine, it has found considerable acceptance as an on-air machine even in operations where program production and editing is on a completely different format. The convenience of cassettes has been an important consideration.

Strangely, the D-2 machine has been less warmly embraced in PAL countries. That might be assumed to be associated with Europe's much more general acceptance of component analog machines, but D-3 has been more adopted there just as it has been less accepted in North America. Panasonic's D-3 uses a 13mm (½-inch) tape format, and like D-2, records eight bits.

The workhorse 1-inch machine still dominates, and even the venerable U-matic refuses to go away.

With good analog-to-digital (A-to-D) and digital-to-analog (D-to-A) converters, the picture quality from D-2/D-3 machines is high. The ability of a digital machine to produce multiple generations is not, of course, significant when the analog inputs and outputs are being used. If machines are linked digitally, the storage of eight bits only does mean in a composite digital standard that black and white cannot be simultaneously set correctly. Care must be taken to avoid a build-up of errors in multiple generations.

However, the digital standard and the recorders are still composite and all of the original encoding and decoding artifacts associated with NTSC or PAL are still going to be encountered at some point in the chain. Where the composite digital standard is pre-eminent is where signal sources are already composite and little, if any, modification is going to be performed. In this kind of situation, it makes no sense to decode and record the signals in a component standard. ■

Next month:
Component digital

Paul McGoldrick is a freelance writer and consultant based on the West Coast.

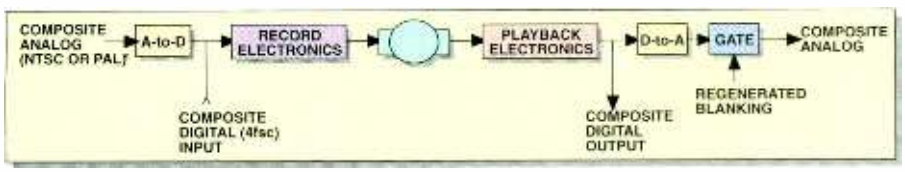

Figure 1. The basics of a composite digital recorder/player, D-2 or D-3.

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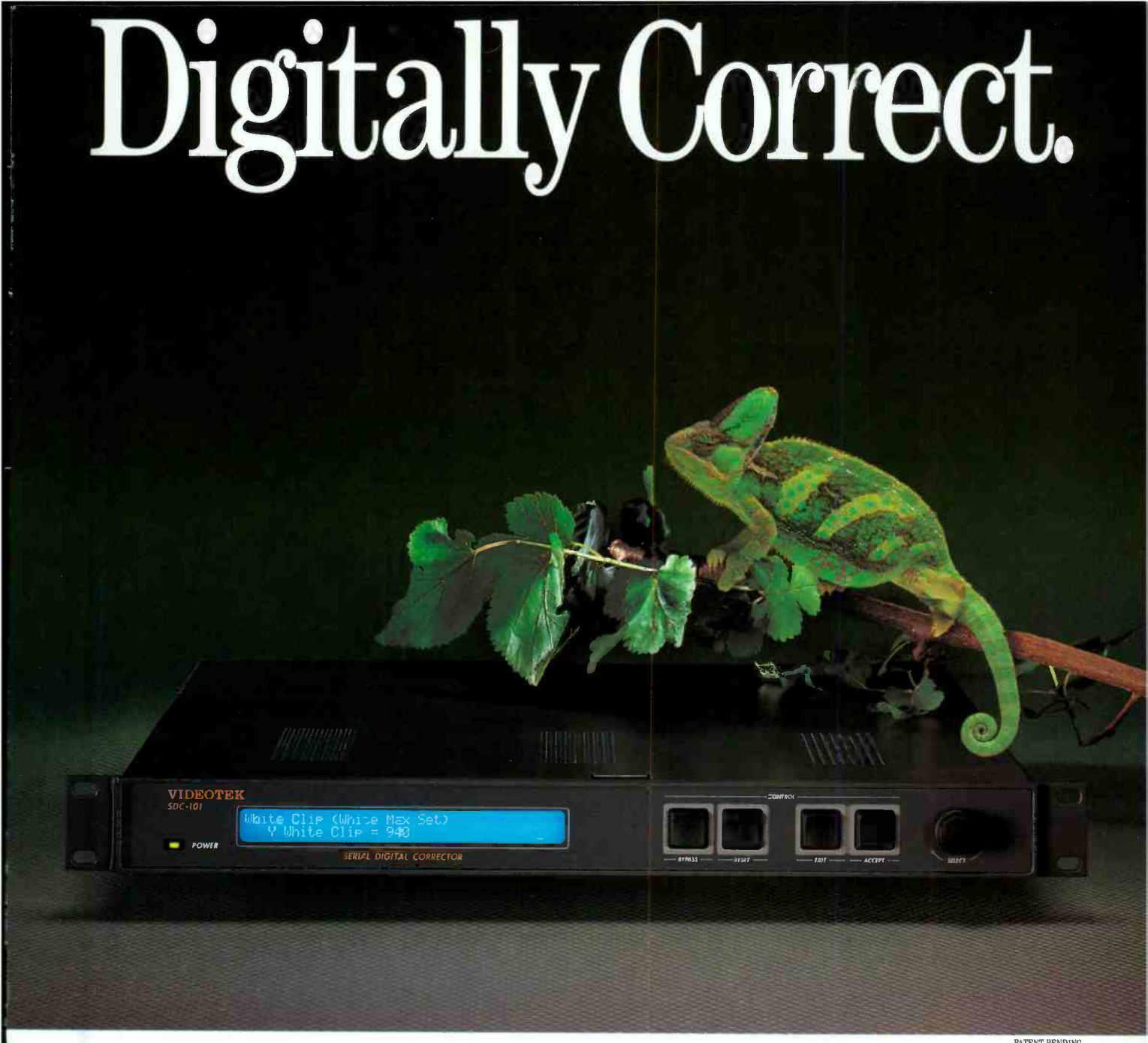

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