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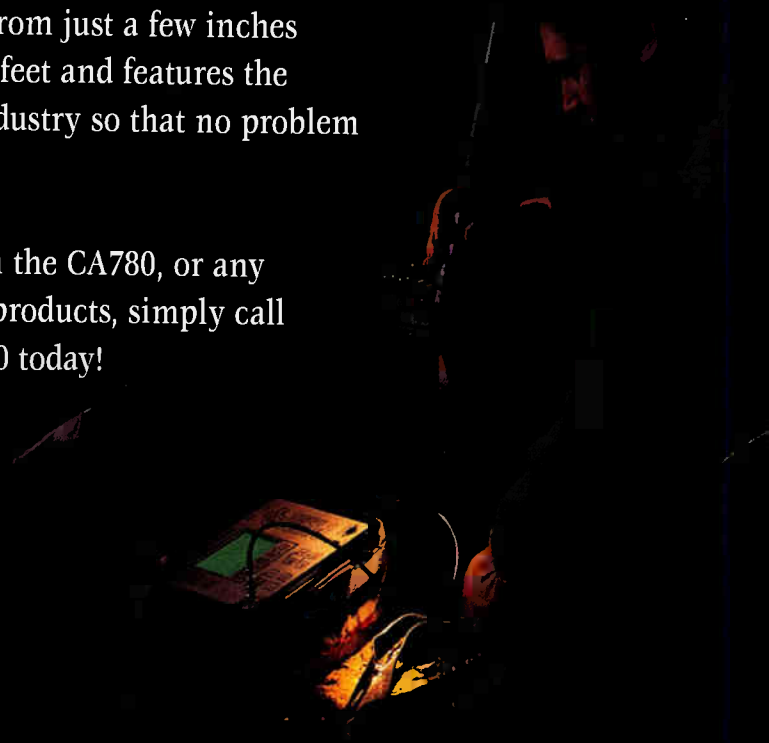

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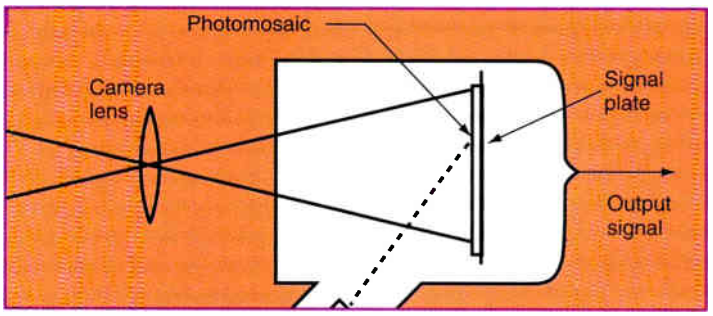

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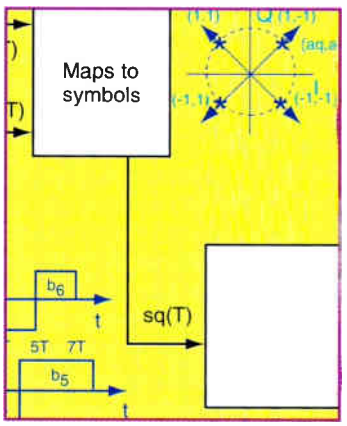

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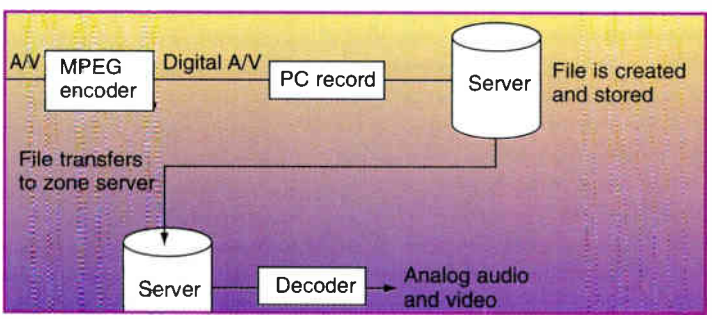

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Features

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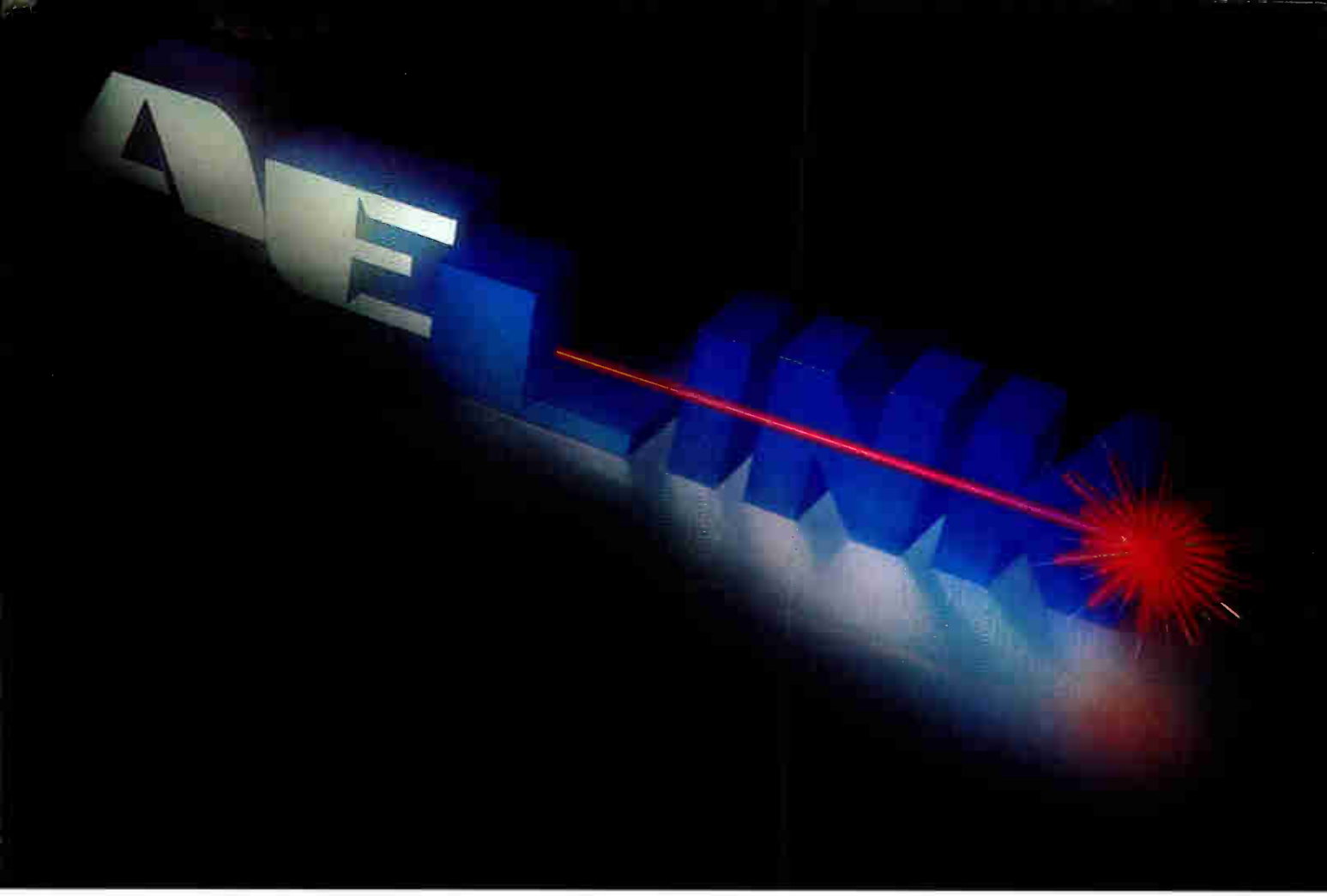

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EDITOR'S LETTER

Be prepared

I just returned from a business trip to Japan where the major topic of conversation was the sarin gas attack in Tokyo's subways. Just days after coming home, a second gas attack occurred in Yokohama. Then, Oklahoma City's federal building is bombed.

Terrorism.

And I began to wonder.

Our own facilities represent what could be a potential terrorist target. Think about it. As we evolve into a telecommunications provider rather than simply an entertainment provider, it's possible that we could become future targets to persons or groups that may desire to disrupt communications. Baloney, you say?

Consider some possible targets: At the cable system level, a headend that provides telephony could be just as vulnerable as the local telco's central office, a power company substation or the local TV, radio or newspaper. Nationally, how about a programmer's studio or uplink? And what about some whacko going after an MSO's corporate headquarters because he was disconnected for nonpay? Terrorists don't have to be the stereotypical radical fundamentalists, you know. Think of the hostage situations and tragedies that have occurred when disgruntled exemployees came back to extract revenge on a former boss and co-workers.

No, this doesn't mean we have to build fortress walls around everything. But we should use common sense. Headends and other critical facilities should have appropriate security: locked doors, fences and gates are a good place too start. Do you limit distribution of vehicle and building keys? Do you change building locks periodically — for example, when employees quit or are fired? Does your office and/or headend have a monitored security system installed? Does that security system have panic and/or holdup alarm buttons in CSR and customer walk-in areas? If you have a separate parking lot for employees or company vehicles, is it kept inaccessible to the general public? When was the last time you had fire and police department officials visit and perform a safety and security review?

While it's impractical to prepare for every possibility, the point is that we are vulnerable. Oklahoma City has shown that. Terrorism is no longer limited to the Beiruts, New Yorks or Tokyos. At the very least, we should give this some thought. Our industry is a lot more visible than it was just a few years ago — and it's going to become even more so in the future.

Ham it up

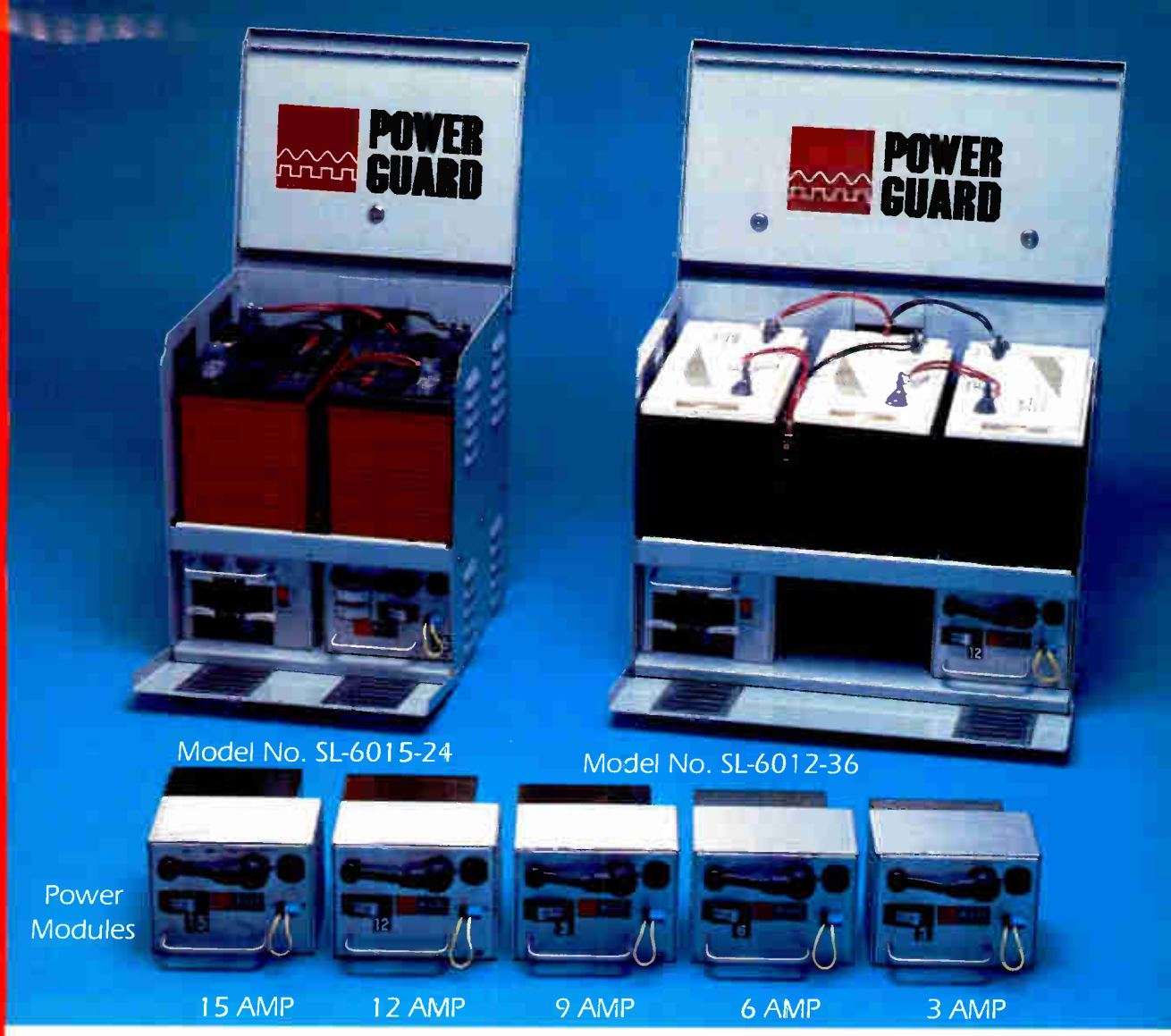
Next month's Cable-Tec Expo in Las Vegas will once again feature activities for industry ham radio operators. First of all, the official 2-meter simplex frequency will be 146.58 MHz. We'll also have the popular "Ham Reception," and new this year, VE testing for those interested in getting a ham license or upgrading. The Las Vegas VE team has agreed to conduct a test session for us during Expo. If you're interested in sitting for an exam, contact Dennis Musser, N0UXA, at Time Warner's National Training Center, 2180 S. Hudson, Denver, CO 80222; e-mail, dennis.musser@twcable.com; telephone, (303) 799-5737.

Ronald J. Hranac
Senior Technical Editor

Correction

In last month's "Future Watch" column by Bob Luff, the e-mail address for Leonardo Chiariglione should have read: leonardo.chiariglione@cselt.stet.it

Power by Design



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OFC: Video highlights

The OFC '95 Conference in San Diego drew a large crowd and featured a number of technologies for improving cable TV system design. One of the most exciting developments is optical amplifier technology that enables a single laser to be split across a large number of fibers into different neighborhoods. At the show a number of different vendors were showing off their optical amplifier wares.

The most common optical amplifier is the erbium-doped fiber amplifier (EDFA), capable of amplifying 1,550 nm optical signals. Over a half dozen vendors showed off optical amplifier gain blocks for incorporation into cable TV systems. The list included AT&T, Samsung, Northern Telecom, Italtel, Fujitsu, NTT, ATx Telecom Systems, Ire Polus and Litton.

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CTmagazine@aol.com

The most bang for the buck award goes to IRE Polus, a Moscow-based laboratory displaying a 20 dBm 1,550 nm EDFA that sells for only $15,000 in small quantities. Until recently they were produced in Russia, with questionable quality control. However, IRE Polus has formed a joint venture with IPG Laser GmbH, which now manufacturers the amplifiers in its German factories.

Litton Lightwave announced that it was developing a new CATV optical amplifier as part of a $250,000 technology reinvestment project with the state of California. It will be based on the company's existing 15 dBm EDFA that amplifies 1,550 nm lasers. It plans to have units available at the National Show this month in Dallas.

Since most existing cable TV systems use 1,310 nm lasers, that has been an area of intense interest to optical amplifier researchers. However, the only commercialized technology has been 1,310 nm praseodymium-doped fiber amplifiers (PDFAs) that offer limited amplification at high cost. At the show, NTT demonstrated a 1,310 nm PDFA. At the low end, the 17 dB version costs $80,000, while the 35 dB gain version is $130,000. They will be available for delivery in quantity before year's end.

One of the problems with optical amplifiers of all types is their nonlinear gain. That is, they amplify different wavelengths of light differently in a random way. Even if you are only trying to send a single wavelength of light down a fiber, this nonlinear gain can impair the signals from linear lasers used in AM video transmission.

An Australian company, Photonic Technologies, exhibited an optical amplifier gain flattener that minimizes this problem. The current unit sells for $5,000 in small quantities, but that will drop substantially once they go into volume production.

AT&T introduced an analog laser for cable TV that supports 77 NTSC channels in 750 MHz over a cable system with a total loss of 11 dB. The company also introduced a new laser module targeted at fiber-to-the-home (FTTH) applications. The unit is capable of sending and receiving signals over a fiber in the 1.3 nm range simultaneously at a rate of 650 Mb/s. It is uncooled, and hence can be located almost anywhere in the network without problems.

In fact, one AT&T researcher at the show, Sarah Woodward, suggested that low-cost uncooled Fabry Perot lasers could be used to create a cheap FTTH network. Using $100 lasers, she was able to send 60, 2 Mb/s channels down a fiber. In some cases, she heated the lasers with hot plates to stress the system, but the lasers operated reliably. She suggested that this would be feasible once digital means of delivering video are cheaply available on a large scale. — *George Lawton, West Coast Correspondent*

For more information contact:

- AT&T Microelectronics, Allentown, PA, phone: (800) 372-2447.
- IPG Laser GmbH, Berlin, Germany, phone: 030-6392-5040; fax: 030-6392-5041.
- Litton Lightwave, Woodland Hills, CA, phone: (818) 715-2005.
- NTT Electronics Corp., New York, phone: (212) 687-8564.
- Photonic Technologies Pty Ltd., Pagewood, Australia, phone: 61-2-314-0344; fax: 61-2-314-0486.

Supercomm '95 breaks all records

The Supercomm '95 trade show held in March in Anaheim, CA, broke all attendance records with over 25,000 visitors registered before the end of the show. It has traditionally been a telephony show, but that changed this year with a large infiltration of cable TV vendors including Scientific-Atlanta, General Instrument, Zenith and Philips, among others.

Pacific Bell made a number of announcements at the show regarding its rather extensive cable TV system deployment. Steve Harris, vice president of external affairs at Pac Bell, explained why the company was building the net-

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work in an AT&T press conference: It plans to save $50 per line in its core telephony because of the improved maintenance possible with a hybrid fiber/coax network.

Harris said the company will begin component testing as the parts become available and begin commercial rollout in early 1996.

Pacific Bell also announced that it had chosen Northern Telecom as the primary supplier for the video transport backbone serving Pacific Bell's HFC network. The network will support SONET at OC-3 (150 Mb/s), OC-12 (655 Mb/s), and OC-48 (2.4 Gb/s) data rates using Northern Telecom's Cornerstone supertrunk system. The backbone will carry analog, digital and interactive video, as well as digital music, the Sega channel, and FM radio signals. The signals will be encoded using Northern Telecom's DV45 digital video CODEC.

In other news, AT&T announced that it had tapped General Instrument and C-COR to create a line of interoperable amplifiers for HFC networks. Tom Lynch, vice president of distribution systems for GI's communication division, noted, "This will provide the telecommunications industry with an availability of interoperable RF amplifiers and is consistent with the sourcing method for Regional Bell Operating Companies."

Siemens demonstrated a number of technologies for interactive video through their partnership with Scientific-Atlanta and Sun. One of the more interesting developments is a system that analyzes video content. The company has developed a prototype that analyzes football footage to look for and classify different kinds of plays and events. It takes approximately two hours to create an analysis for one hour of video, so the game cannot be used for real-time yet. However, Siemens believes this technology has a market in a new kind of CD-ROM or interactive TV experience in which a sports enthusiast can search through reams of video for types of plays classified by the computer.

Zenith introduced a new set-top box authoring system called ScreenPlay. The tool runs on PCs and enables developers to quickly generate, modify and edit on-screen displays and applications for Zenith's digital set-tops and analog MultiMedia 2500 set-tops. ScreenPlay uses a Windows-based graphical user interface to create TV displays and logos. "This Zenith software gives broadband system operators a host of visual and informational options," said Bill Luehrs, senior vice president of operations of the Network division at Zenith.

Zenith's MultiMedia set-tops support real-time interaction, in-band transmission of conditional access data, baseband SSAVI scrambling and unlimited pay-per-view control. It can support 15 lines 32 characters wide, and is fully compatible with interactive program guides from Starsight Telecast Inc.

A new startup, WinStar Communications Inc., announced that its wireless telecommunications bypass service is now operational in all of its 30 licensed areas in major cities across the U.S. The company has licenses for 400 MHz in the 38 GHz band in these markets. It is working on a system that can put 45 Mb/s onto four channels in each of these bands. Since 38 GHz radios are very directional, this frequency can be reused thousands of times. The company is able to overcome the rain fade problem by boosting the power proportional to the rain and

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achieve a reliability of 99.999%, according to the company. The service could be used by cable operators to offer telephony or video services in new areas. — *GL*

Telcos subject to FCC cable regs, NAB says

According to the National Association of Broadcasters, telcos offering video programming directly to subscribers are subject to cable regulations including must-carry, retransmission consent and program nonduplication rules, as established by the Communications Act.

NAB made its comments in a March 21 filing in the FCC's proceeding to determine how its video dial tone rules will be affected by court decisions allowing telcos to provide video services inside their telephone service areas.

The Communications Act envisions only common carriers that exclusively provide transmission capacity, and cable systems that offer video programming, NAB said. Once telcos provide video programming, the language of the act and a recent court decision make clear that they become cable operators subject to cable regulations.

NAB said this does not preclude the FCC from reasonably tailoring its regulations to the particular circumstances of a telco's proposal to provide video programming in conjunction with video dial-tone services. NAB agreed with the FCC's tentative conclusion that it would be constitutional to retain the prohibition on telephone companies purchasing in-region cable systems that have no multichannel competitor.

Subs hot on DBS

USSB, which created the U.S. direct broadcast satellite (DBS) industry with DirecTv last June, reports that customer satisfaction is soaring. According to a company survey, 88% of its customers are satisfied with their service, surpassing approval ratings for cable companies (51%) and telcos (65%). Plus, 12% of USSB subscribers use cable to receive local broadcast channels DBS companies cannot offer.

Bell-Atlantic plans video services

Bell-Atlantic won the right to provide video programming services across local access and transport area (LATA) boundaries. Two written orders from the U.S. District Court will allow the company to: deliver video programming nationwide by satellite; provide nationwide compression and digitizing services by satellite for its own or others' programming; provide local video distribution across LATA boundaries within its mid-Atlantic service area; provide local video distribution in multi-LATA systems of up to four LATAs outside its territory; use a central video storage facility to serve multiple LATAs throughout the U.S.; operate satellite receive-only facilities; and own and operate TV and radio stations whose signals cross LATA boundaries.

Cox, Northern Telecom to test integrated services

Cox Communications Inc. and Northern Telecom announced a technology trial to deliver integrated digital telephony, data, video and energy management applications over a hybrid fiber/coax (HFC) network.

The trial, being conducted on Cox's Hampton Roads, VA, system, will test transmission components in the cable network as well as the viability and capability of an integrated transport platform. Northern Telecom's broadband access technology will be tested in Cox employee homes over the next six to 12 months.

☛ Reliance Comm/Tec Corp. and Philips Broadband Networks entered into an agreement to develop and market systems for narrowband telephony over hybrid fiber/coax cable networks. The jointly developed system is based upon Philips' Broadband Communications Gateway and Reliance Comm/Tec's Matrix interactive multimedia access system for transmission of voice and data services over traditional cable TV networks.

☛ As part of a settlement negotiated with the Federal Communications Commission, Continental Cablevision will cut its rates by 15%, refund subscribers at least $9.5 million and invest $1.35 billion over six years to upgrade its domestic cable systems. The settlement came in response to complaints the company overpriced its services. The FCC said it found no wrongdoing.

☛ Sprint, TCI, Comcast and Cox announced they will invest $4.4 billion over the next three years in local phone service to compete with the seven regional Bell operating companies (RBOCs). Teleport Communications Group also will join the group.

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New board, new name voted in by members

March 28 marked the official closing of the Society of Cable Television Engineers' annual election to fill empty seats on its 1995-96 board of directors.

The results of this year's board election are as follows:

At-Large Director: Wendell Bailey, National Cable Television Association, representing the entire United States.

At-Large Director: Wendell Woody, Sprint, representing the entire United States.

Region 1 Director: Patrick O'Hare, Viacom Cable, representing Califomia, Hawaii and Nevada.

Region 2 Director: Steve Johnson, Time Warner Cable, representing Arizona, Colorado, New Mexico, Utah and Wyoming.

Region 6 Director: Robert Schaeffer, Star Cablevision Group, representing Minnesota, North Dakota, South Dakota and Wisconsin.

Region 9 Director: Hugh McCarley, Cox Cable Communications, representing Florida, Georgia, South Carolina and the Caribbean.

Region 11 Director: Dennis Quinter, TWC Berks Cable, representing Delaware, Maryland, New Jersey and Pennsylvania.

They will join the eight SCTE board members currently serving their 1994-1996 terms:

At-Large Director: Tom Elliot, TCI, representing the entire United States.

Region 3 Director: Andy Scott, Columbia Cable, representing Alaska, Idaho, Montana, Oregon and Washington.

Region 4 Director: Rosa Rosas, Moffat Communications, representing Oklahoma and Texas.

Region 5 Director: Larry Stiffelman, CommScope Inc., representing Illinois, Iowa, Kansas, Missouri and Nebraska.

Region 7 Director: Terry Bush, Trilithic Inc., representing Indiana, Michigan and Ohio.

Region 8 Director: Steve Christopher, CommScope Inc., Alabama, Arkansas, Louisiana, Mississippi and Tennessee.

Region 10 Director: Mike Smith, Adelphia Cable Communications, representing Kentucky, North Carolina, Virginia and West Virginia.

Region 12 Director: John Vartanian, Viewer's Choice, Connecticut, Massachusetts, Maine, New Hampshire, New York, Rhode Island and Vermont.

Newly elected directors will officially take their seats, beginning their two-year terms, at the next board meeting, scheduled to be held Tuesday, June 13, prior to Cable-Tec Expo '95 in Las Vegas, NV.

Also in this election, the Society's membership voted in favor of a referendum to change the name of the organization to "The Society of Cable Telecommunications Engineers."

Ninety-three percent of all voting members favored the change of SCTE's name to "Society of Cable Telecommunications Engineers." This change will officially occur in June, when it is confirmed by the board of directors at its meeting held prior to Cable-Tec Expo '95.

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new name, see this issue's "President's Message" by SCTE President Bill Riker on page 118.

Society unveils telephony seminar

The telephone companies are training their employees in cable TV. Are you training your staff in telco technology?

SCTE can help you to compete. The telcos' entry into cable could mean an explosion of fierce competition, mergers, buyouts and many cable professionals crossing over into telephony or finding themselves working with telco equipment.

To keep one step ahead of these developments, SCTE will be offering a new seminar, "Introduction to Telephony."

This three-day seminar will provide information on the basics of telephone system operations, telephone networks and customer equipment along with various interconnect and service options.

The seminar also will be beneficial for nontechnical personnel, who will receive a comprehensive understanding of the general workings of telephony.

The seminar will be presented by SCTE Director of Training Ralph Haimowitz, who is widely recognized throughout the telecommunications world as one of its foremost instructors.

Offered as part of SCTE's Technical Training Seminar Program, which includes the "Technology for Technicians I and II" and "OSHA/Safety" seminars (both taught by Haimowitz at a variety of locations across the country) , this course deals primarily with basic telephone systems and services. The program outline includes the following:

Basic telephony
- Telephones
- Central office
- Switching
- Transmission
- Public switched networks
- Multiline telephone systems

Basic networking
- Understanding networking
- Network services
- Switched voice services
- Private line services
- Digital Centrex service
- Additional network services

Customer premises equipment
- Understanding CPE
- CPE telephones
- Key systems
- PBX and hybrid systems
- Building and station wiring

Telephone terminology
- Glossary of Terms

This seminar will first be presented April 24-26 in Sacramento, CA. A certificate of attendance will be provided to all who attend the seminar. For those who pass the seminar examination, a certificate of achievement will be given.

SCTE also has applied with the State University of New York Empire State College to be able to award 2.1 continuing education units (CEUs) for this course.

Registration will include all course materials, including a technical manual, notepad, pencil, telephony glossary and videotape on terminology, as well as morning and afternoon refreshments. Registration will not include transportation, meals or hotel accommodations.

For information on "Introduction to Telephony," please contact SCTE's Special Projects Department at (610) 363-6888. SCTE looks forward to seeing you at this new seminar, which will undoubtedly benefit anyone involved in the constantly evolving telecommunications industry.

Why take an interest in DAVIC? — Part 2

By Bob Luff
Chief Technical Officer, Broadband Group
Scientific-Atlanta

As was described in last month's column, the Digital Audio-Visual Council (DAVIC) is a global organization comprised of hundreds of technical experts in the digital video/audio arena. They share a common goal of assisting in the success of emerging digital services by the timely availability of internationally agreed-upon specifications of open interfaces and protocols.

Success in quickly reaching multi-industry and multinational consensus on these open interfaces and protocols will result in creating an environment that will maximize content creation and hardware interoperability. This is key to cable industry (and paycheck!) expansion from new digital services and revenues.

Lack of participation in DAVIC by the cable industry may well result in serious challenges at several levels, including content creation, distribution, friendly interface to consumer electronics and at least a delay in increased revenues (or something much worse in today's less forgiving competitive environment). So far, cable MSOs are nearly a "no-show" at important DAVIC meetings. Why? What should be done?

What's at risk?

Before addressing the previous two key questions, let's better understand why it should be a priority for U.S. cable MSOs to not only closely follow DAVIC but also to take an active leadership role.

First, no other industry has so much to win or lose! The U.S. cable industry is the envy of the world with over 60 million subscribers creating more than $20 billion in annual revenues. It has created the means to support some of the most important and creative programming in the entertainment industry: CNN, Disney, C-SPAN, Discovery, Mind Extension University, Nickelodeon, and yes, even *Beavis and Butthead*. And on the technology side, systems like yours have constructed highly cost-effective 450, 550 or 750 MHz hybrid fiber/coax systems.

Now they can be easily upgraded to two-way interactive and interconnected networks — even able to deliver telephone dial tone on the same wires. But much of cable's past and future success depends on continued use of this base of existing system and set-top technology investments. There are hundreds of thousands of hybrid fiber/coax system miles and tens of millions of analog set-top terminals in use by the cable industry today. Even as digital arrives, the industry's core multibillion dollar analog network and set-top capabilities will continue to work with an estimated installed base of more than 200 million TV sets and VCRs.

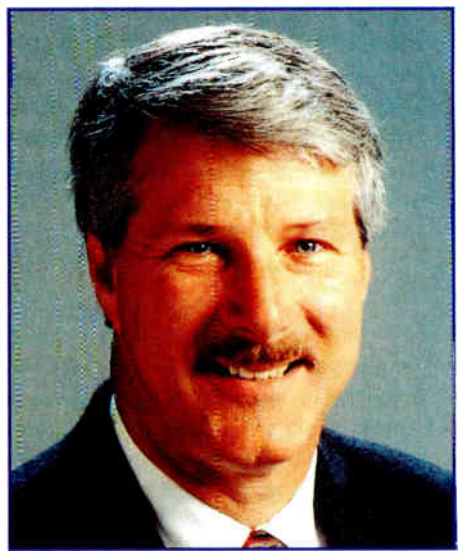
Cable's "no-show"

Does this mean that standards organizations like DAVIC are against cable? No, not at all. I attend a great number of standards meetings, including DAVIC. In every case the organization and its individual members (yes, sometimes cable's competitors) genuinely want cable involved. They understand that the cable industry is expert in many areas and there is a desire to build from that base in the public interest.

Unfortunately, in almost every case (including DAVIC) there is almost no participation from the cable MSOs. Yes, CableLabs is on the board and I serve on DAVIC's Management Committee. But in democratic consensus organizations like DAVIC, decisions are pounded out in various technical committees and over the Internet where, in DAVIC's case, there is very little participation from the U.S. cable MSOs.

Why?

Certainly the cable industry is not purposely boycotting important standards focused organizations. I believe the reasons are varied and all innocent enough but in the end other industries are determining cable's (and your) future by default. The main reason is that MSOs historically have never been staffed for such participation. These standards bodies consume a large amount of time. In the case of DAVIC, main meetings are over a week long including travel and they occur every six weeks.



"U.S. cable risks being left out or going 'Beta' while the rest of the world goes 'VHS.' "

That's just one standards group. As much as I would like to portray them as models of organization and efficiency, the plain truth is that they are somewhere between mass confusion and watching paint dry. Another reason for lack of cable participation is the belief that CableLabs will set cable's standards.

However, CableLabs is not a standards-setting organization — its charter specifically precludes such activity. Certainly the Society of Cable Television Engineers and the National Cable Television Association are logical alternatives but it would seem that they both fall into the previously discussed issues of only representing one industry's perspective rather than a cross-convergence industry and cross-nation consensus. In addition, both have hard-working staff tending to a variety of other issues.

What should cable fight for?

Let's remember that CATV has evolved into a volume business. "Whoever dies with the most subscribers wins!" Well, sort of. Each of our systems has a high fixed cost — headend and all

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CCDs

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

CCDs (charge-coupled devices) are universally used as the imaging sensors in both professional TV applications (i.e., broadcast studio cameras and portable ENG — electronic news gathering — cameras) and consumer video cams. However, the development of television, as we know it, would have been impossible without TV camera tubes.

TV camera tubes

Much experimentation in TV imaging has been done, some dating back before the turn of the century using mechanical devices (e.g., the Nipkow disk proposed in 1884). However, the development of modern TV dates from the introduction of all electronic TV camera tubes. In 1923 Vladimir Zworykin demonstrated the first practical image tube, which he called the iconoscope. See Figure 1.

The photomosaic was the critical element in the iconoscope tube. It consisted of tiny particles of a photoemissive material mounted on a mica insulator, which in turn was mounted on a metal signal plate. When light from the scene was focused on the mosaic, electrons were emitted from the particles in proportion to the intensity of the light, leaving them positively charged. When the mosaic was scanned by the electron beam, the number of electrons absorbed by each particle was determined by the amount of its positive charge. The resulting current was transferred to the signal plate by the capacitance between the particle and the plate. Although the iconoscope represented a major first step to a workable TV system, it didn't quite have the responsivity (it required enormous amounts of light on the scene) and had aggravating spurious internal "shading" signals that required correction and the large photomosaic size (4 by 6 inches) required nonstandard long focal length lenses.

The introduction of the image orthicon tube right after World War II corrected these defects. The image orthicon had much greater sensitivity than the iconoscope permitting use under normal lighting conditions. See Figure 2. An optical image of the scene is formed on the front of the photocath-

"The progress in TV camera imaging sensors from the iconoscope to the electronically shuttered frame-interline transfer CCD has been nothing short of phenomenal."

Figure 1: Iconoscope tube

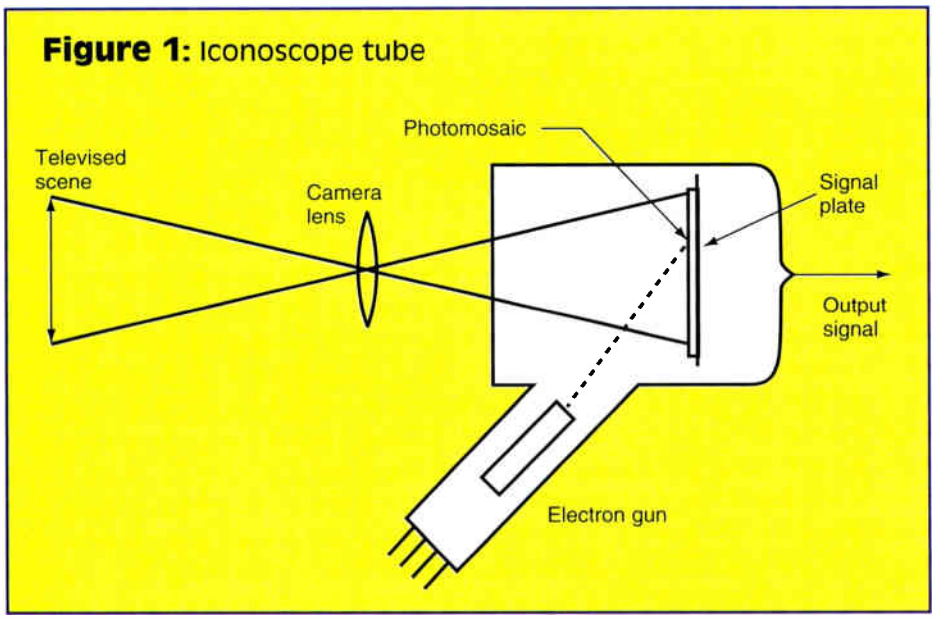
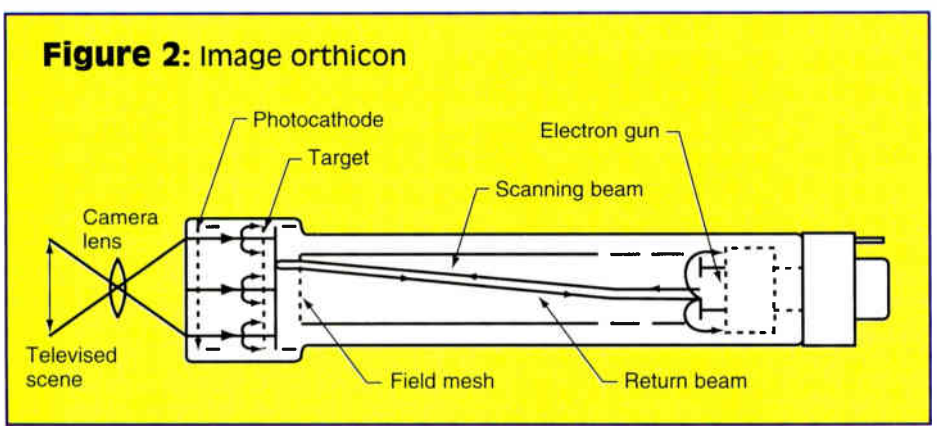


Figure 2: Image orthicon



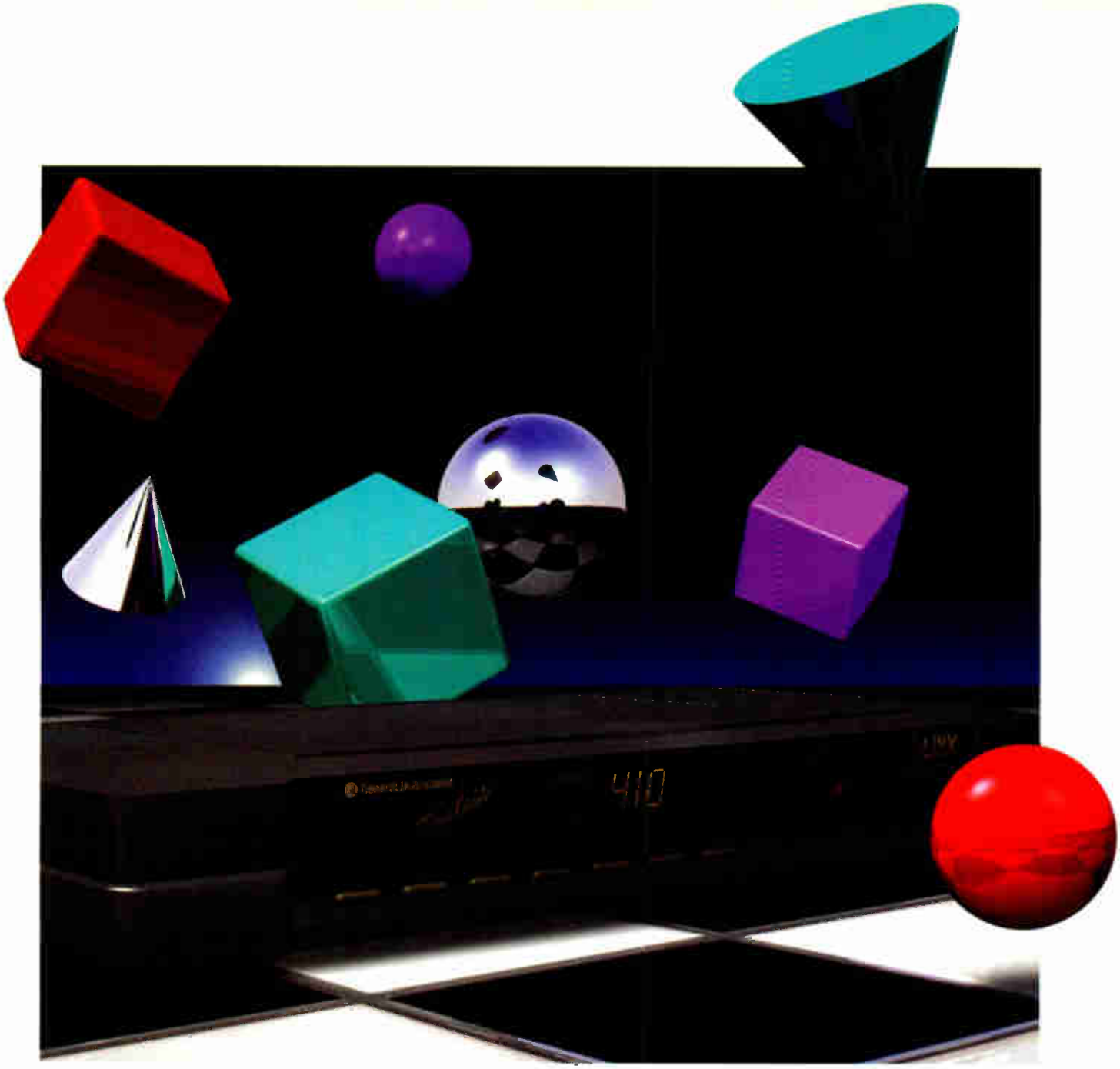


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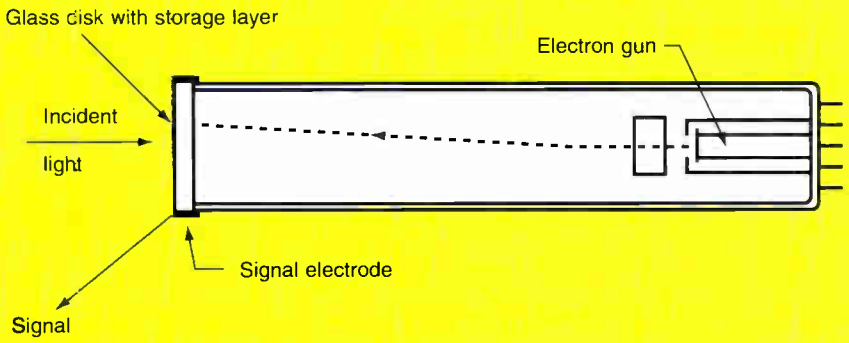
Figure 3: Vidicon tube



ode and the electrons emitted from its rear form an electron image on the target mesh assembly (an extremely fine mesh spaced close to a thin glass membrane). Most of the electrons from the photocathode pass through the mesh and strike the glass membrane causing secondary electrons to be emitted. These are collected by the mesh. This leaves the glass membrane positively charged, and electrons are absorbed by the scanning beam. The return beam provides a negative image — that is, its current is highest in dark areas of the picture where very few electrons are absorbed from the scanning beam. The diameter of the image orthicon was 4-1/2 inches permitting use of standard lenses used in 35mm film cameras.

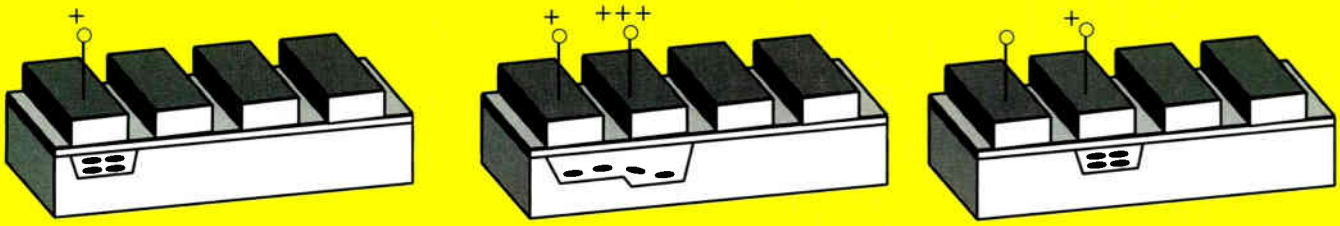
The development of the vidicon provided a tube much better suited for use in film chains (i.e., producing the video of a motion picture film) than either the iconoscope or the image orthicon. See Figure 3.

Unlike the iconoscope and the image orthicon, which are photoemissive, the vidicon is photoconductive. It has a layer of photoconductive material that varies in resistivity with the amount of light falling on it. The layer is deposited on a transparent conducting substrate and when an image is focused on it, its resistivity varies from point to point depending on the brightness of the image. The layer is then scanned with an electron beam and the current through the layer to the tubes

Table 1: Principal TV imagers

Name	Introduced	Type	Application
Iconoscope	1939	Photoemissive	Film/live
Image orthicon	1946	Photoemissive	Live
Vidicon	1952	Photoconductive	Film/live
Plumbicon	1963	Photoconductive	Live/film
Saticon	1974	Photoconductive	Live/film
CCD	1980	Solid-state	Live/film

Figure 4: Series of MOS capacitors



output varies with the brightness. The vidicon image layer is 2/3 inch in diameter permitting use of standard lenses used in 16mm film cameras. Using different materials for the target produced the plumbicon and the saticon. Table 1 lists the principal TV imagers.

Charge-coupled devices

Fueled by the revolution in semiconductor manufacturing techniques, solid-state imaging devices such as the CCD have quickly overrun older image-tube technology and actually begun to supplant photographic media in many applications from astronomy to digital "photographic" cameras.[1]

CCDs contain many MOS (metal-oxide semiconductor) capacitors. A MOS capacitor is formed by depositing a metal electrode, insulated by a film of silicon dioxide, onto a layer of P-type silicon. If a positive voltage is applied to the metal electrode, a region of low-potential energy (depletion) is created just below this semiconductor/oxide interface. This is called a low-energy well or potential well. Any free electrons in the area will find this well extremely "attractive" and will flood into it. An analogy is that of water pouring into an empty bucket. Increasing the voltage of the electrode makes the well correspondingly deeper. The ability to store a quantity of charge is fundamental to the operation of CCD devices.

It corresponds to a memory device, but one that stores an analog quantity.

If a series of MOS capacitors are placed side by side, using a common P-type substrate, a more complex structure results. See Figure 4.

If the well under the first electrode is created by applying, say, +5 volts, electrons can be held in this well. If +10 volts is applied to the second electrode, a deeper well is formed and the electrons flow into this new bucket. If the voltage is now removed from the first electrode and the voltage on the second reduced to +5 volts, the charge will remain trapped under the second electrode. The charge has therefore been successfully moved. The significance is that if this se-

Figure 5: Frame transfer CCD

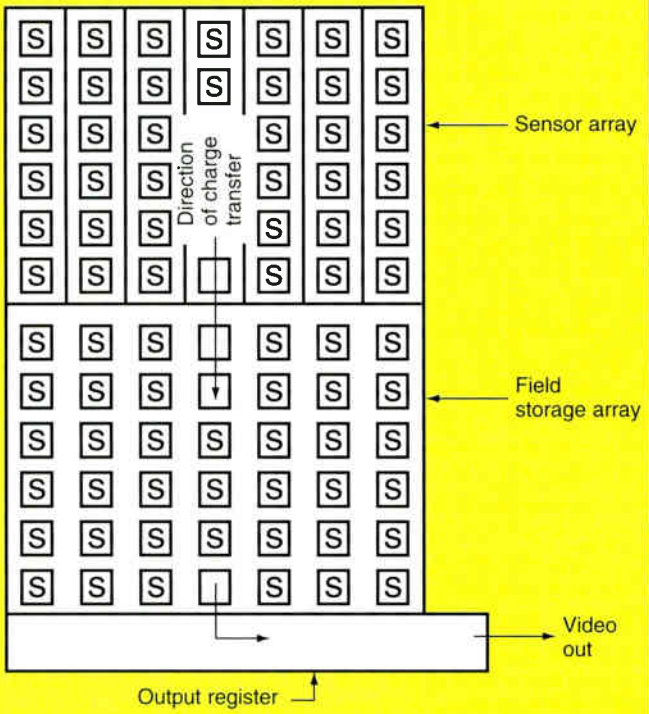


Figure 6: First color image from a Bell Labs experimental color CCD TV camera

Figure 7: Color image from a Kodak CCD digital still camera

quence is continued for all electrodes, the charge can be transferred as an independent packet along the complete length of the structure by using a train of pulses.

Silicon also can be used to create photosensors, where incident light is converted to an electronic charge — the amount of charge being proportional to the incident light. The metal electrode is replaced in this case by polysilicon, which is a transparent, highly conductive form of silicon. This acts just like a metal plate but allows light to pass through it. Therefore, it is possible to make semiconductor light sensors and to use charge coupling techniques to move charges around within the device structure.

Frame transfer (FT)

The first CCD imagers all used the frame transfer structure, which is the simplest and therefore easiest to manufacture. See Figure 5. In this structure, the silicon chip is split into two areas. The top half of the device is the imaging area — an array of photosensors. The bottom half is masked so that no light can fall on it and it forms the storage area and readout register.

A charge pattern builds up during each picture field, proportional to the incident light. During vertical blanking, the charge generated in the imaging area is clocked out very rapidly in a vertical direction into the storage area so that at the beginning of the next field the photosensors are empty again, with the storage array containing an identical charge pattern to that that was built up in the photo array. During the next field this charge is moved down, a line at a time, into the horizontal readout register and then read out at the much higher H-clock rate from the output terminal.

Every element has a dual function. During vertical transfer, each photosensor becomes part of the transfer structure and the charge from all the other elements above it will pass through it during the transfer process. If the sensor were exposed to light during the frame transfer, an additional charge would be added to all the charge packets passing through the pixels in turn. The only way to prevent this is to use a mechanical shutter mechanism to prevent illumination of the device during transfer. Some of the elegance of a solid-state imager has now been lost and because each pixel has this dual function, it is difficult to achieve good transfer efficiently.

CCDs were developed at Bell Labs and CCD imagers were first experimented with at the labs in 1971.[2] In 1972, Dr. Tompsett of Bell Labs, a coinventor of the CCD, was kind enough to send me a photo of a color image from the first experimental CCD TV camera for inclusion in a report to NASA.[3] See Figure 6.

Of course the progress since then has been enormous. See Figure 7 for an example of a color image from a Kodak CCD digital still camera.[4] The CCD here has a 1,280 x 1,024 pixel imager (1.3 million pixels). Measuring 21 mm x 17 mm, this imager is approximately half the length and width of a 35mm film frame. Its 16 micron pixels offer excellent light sensitivity.

Interline transfer (IT)

To avoid the necessity for a mechanical shutter, the interline transfer structure was developed. In this structure, separate, interleaved elements

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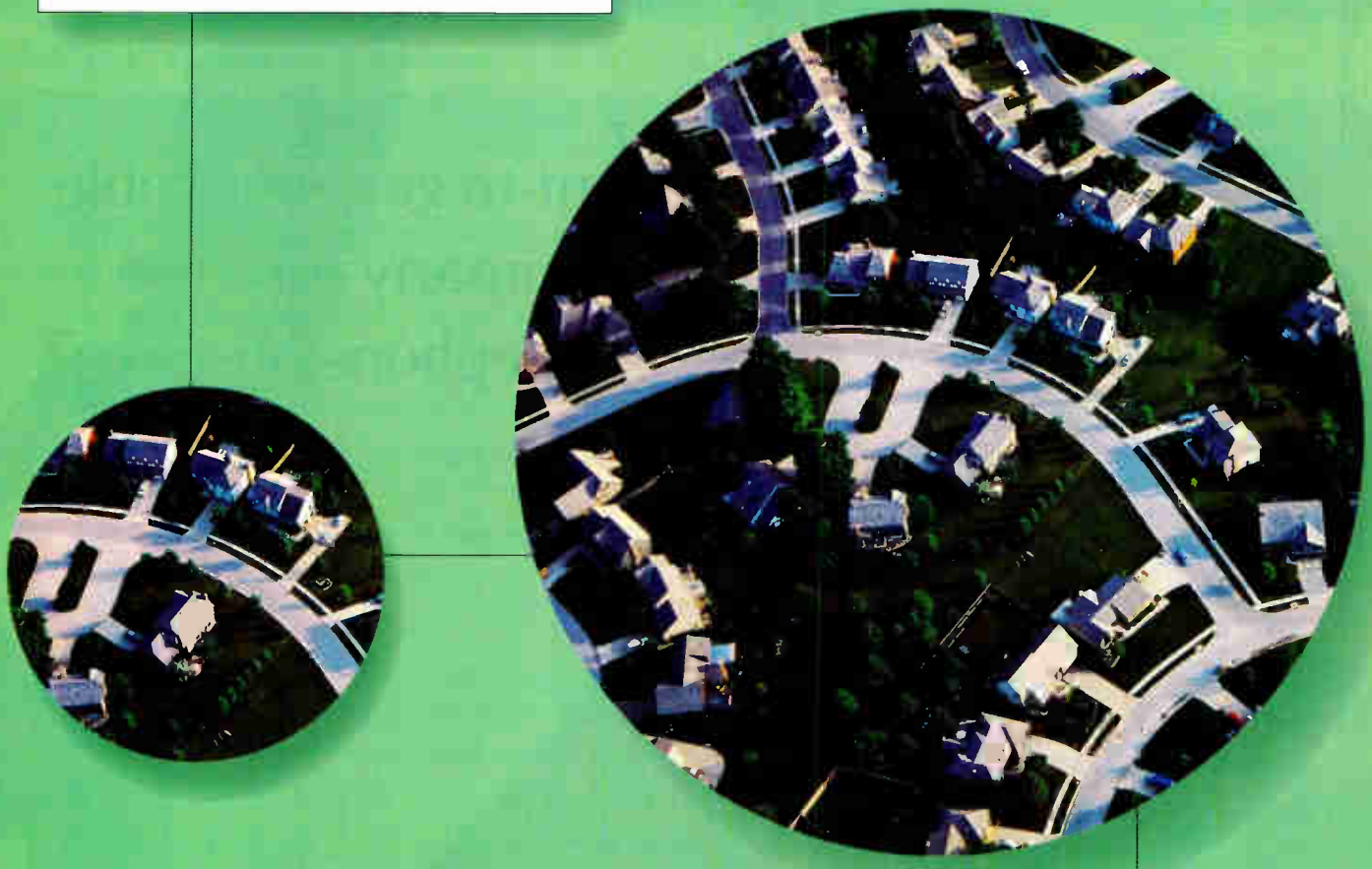

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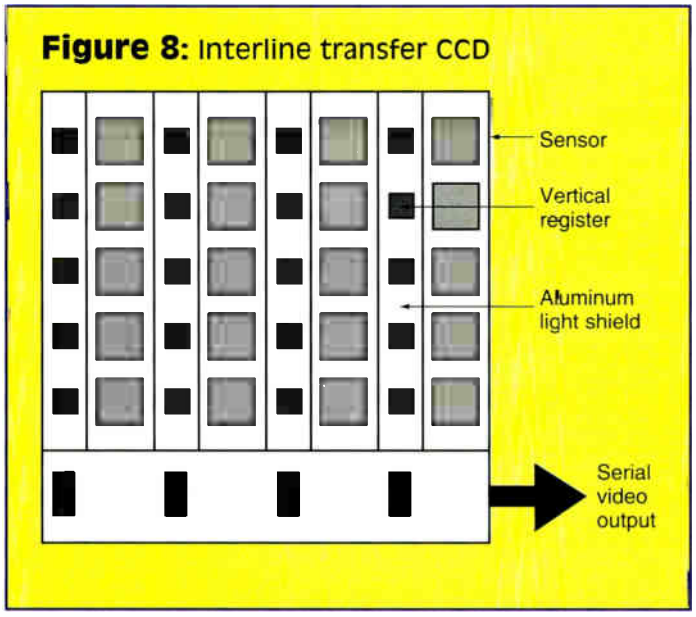
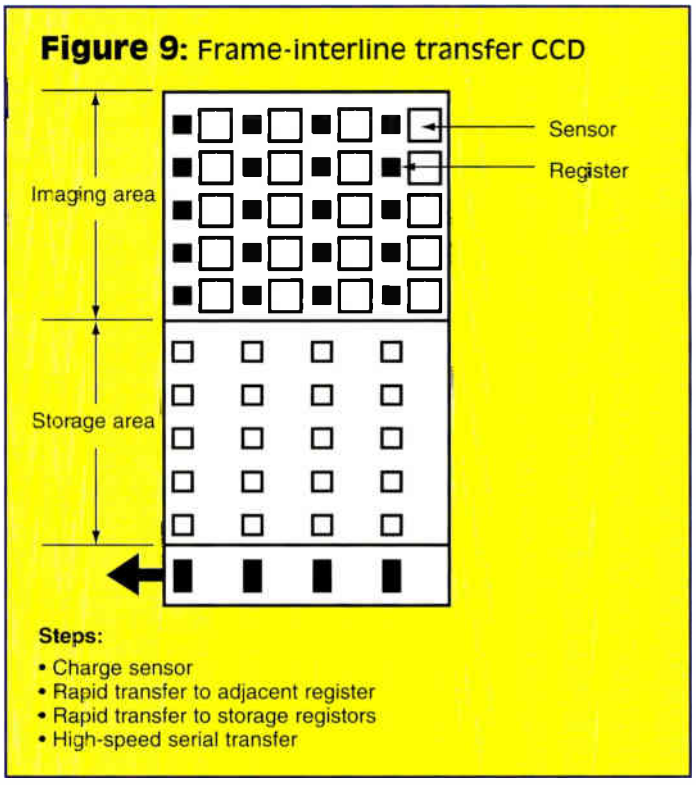




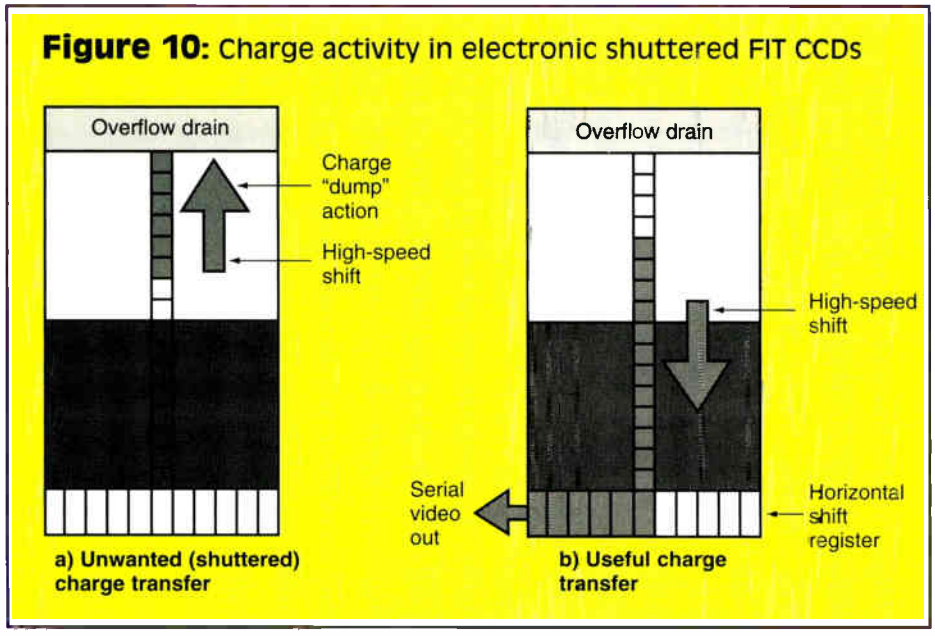
are used for photosensors and storage elements. See Figure 8. The shift registers are covered with an optically opaque aluminum mask. During field blanking all the charges generated in the photosensors are shifted sideways into the corresponding storage element. The storage array is then clocked out during the next field.

One problem that can occur with interline transfer CCDs is known as vertical smear. This is seen on pictures as a vertical line, passing through very strong highlights. In the early IT cameras it was caused by photons that penetrated very deep into the semiconductor structure. Instead of being held in the photosensors, the electrons produced leaked directly into the vertical shift register. This caused an additional small charge to be added to all the charge packets passing through. The amount of charge generated this way was extremely small in comparison to the normal signal levels, but in the presence of large overloads it could become visible as a vertical line through the highlight. Since only light at the red, longer wavelength end of the spectrum was able to penetrate deeply into silicon, the vertical smear appeared red (or pink) in color.

Frame-interline transfer CCD (FIT)

The "best of all worlds" is achieved by a marriage of both technologies. The frame-interline transfer (FIT) CCD was developed by Sony[5] to exploit the advantages of the interline transfer mechanism in overcoming vertical smear. This is accomplished by a high-speed frame transfer immediately following the transfer of the charge packets from the sensors into the adjacent registers. See Figure 9.

This dual transfer action avoids the fundamental problem of the frame transfer CCD in that the charges are "hidden" from incident light (within the light-shielded vertical registers) while they are being shifted vertically down into the storage bank of registers. Thus, no mechanical shutter is required. The inherent smear mechanism of the interline CCD, described earlier, is dramatically curtailed by the rapid vertical transfer because there is much less time for the contaminating charge developed by an incident high light to accumulate.



Electronic shutter in the CCD imager

In 1979, Sony successfully filed a patent for an FIT CCD that incorporates the innovation of an electronic variable-speed shutter. This provides a means of controlling the effective exposure time of the imager within a given TV active field without resorting to a mechanical shutter. The applications are many — from all forms of fast-moving sports, to special effects in certain production applications, to production of clean still-frame pictures for news broadcasts. Figure 10 diagrams

0 to 800 MHz in 1/20 second

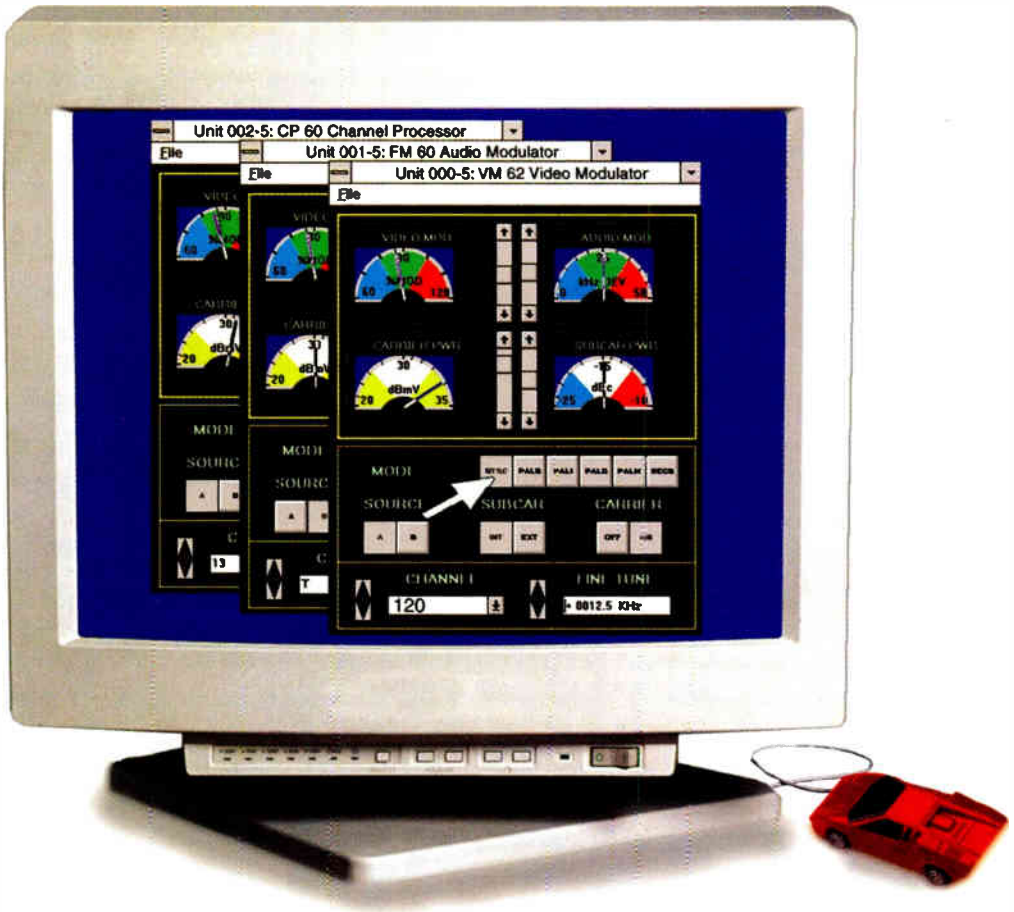


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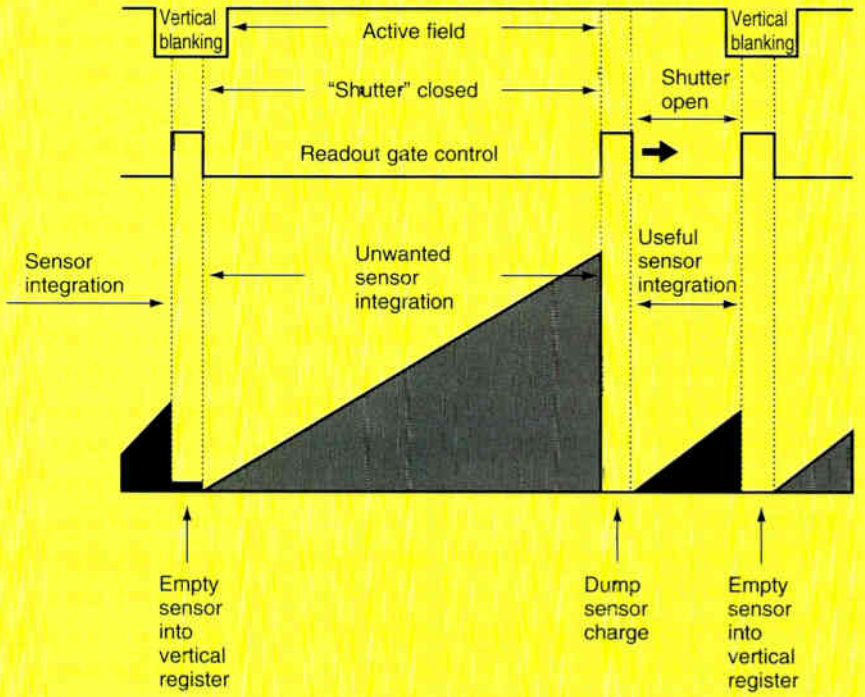
Figure 11: Electronic shutter action of an FIT CCD



the electronic shutter action of the FIT CCD.

In Figure 10a on page 32 at some defined time in the single active field all the charges that have been collected up to that point are dumped. That is, discarded as unwanted charges into a separate overflow drain. Then for the remainder of the active field the image is read out of the FIT CCD in the normal manner (Figure 10b on page 32).

Figure 11 illustrates the charge accumulation cycles as they relate to a single active TV field. The readout gate control is a pulse train that activates the interline-transfer action of rapid emptying of the sensor well into its adjacent vertical register. This takes place, as normal for the interline or FIT CCD, within each vertical interval. The charge integration of a given sensor is represented by the rising ramp.

The addition of shutter control is primarily the addition of the variable-position readout gate pulse, during the active field period. This pulse also transfers charge from the sensors into the vertical register; from there that charge is shifted upward into the overflow drain as waste. Immediately following this transfer, the sensor begins to reaccumulate charge for the remainder of that TV field.

The amount of the useful charge is proportional to the position of the shutter-control pulse. When it moves to the right, as indicated in Figure 11, the exposure time is reduced, as is the useful signal amplitude extracted from the sensor.

Thus shutter time and sensitivity are linearly related. Figure 12 shows the relationship between exposure speed and camera sensitivity, as indicated by the lens opening required to maintain constant signal amplitude for a given scene light level.

The operational control of the shutter (on the Sony BVP-50 FIT CCD camera) is via a single small switch mounted in the vicinity of the optical filter wheel control for easy access by the camera operator. The desired shutter speed is selected in seven steps: 1/100, 1/125, 1/175, 1/250, 1/500, 1/1,000, and 1/2,000 sec, by sequential action of the spring-loaded switch. Remote control of the shutter also is available at a BVP-50 camera-control unit. Figure 13 shows a photo of the Sony FIT CCD chip (ICX-028). Figure 14 on page 38 shows how three CCDs are used in a color TV camera.

Faces of the prism have dichroic filters on them. A dichroic filter is special thin film that transmits all light except a particular one that it reflects. Thus the three separate colors are reflected to

Figure 12: Shutter exposure time vs. camera sensitivity

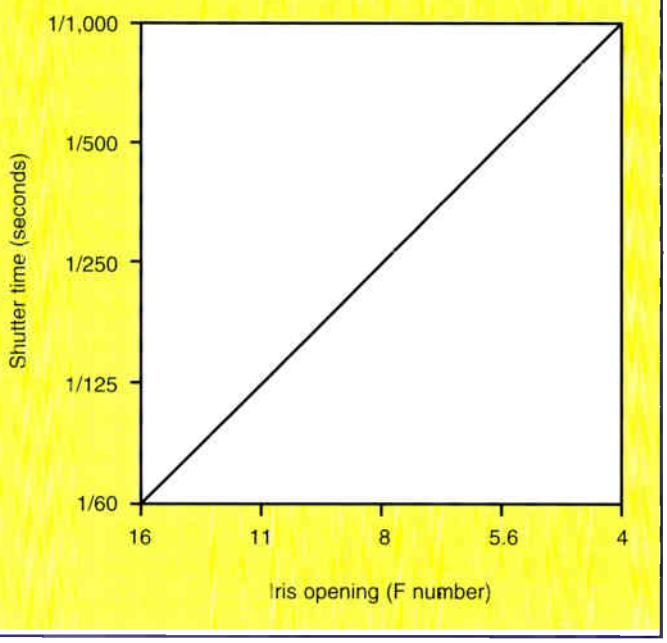
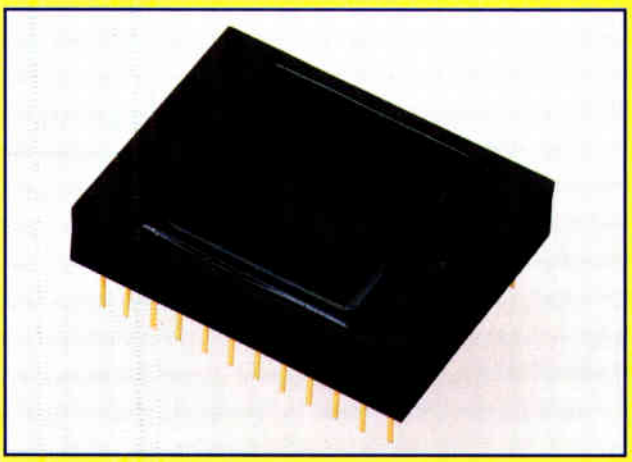
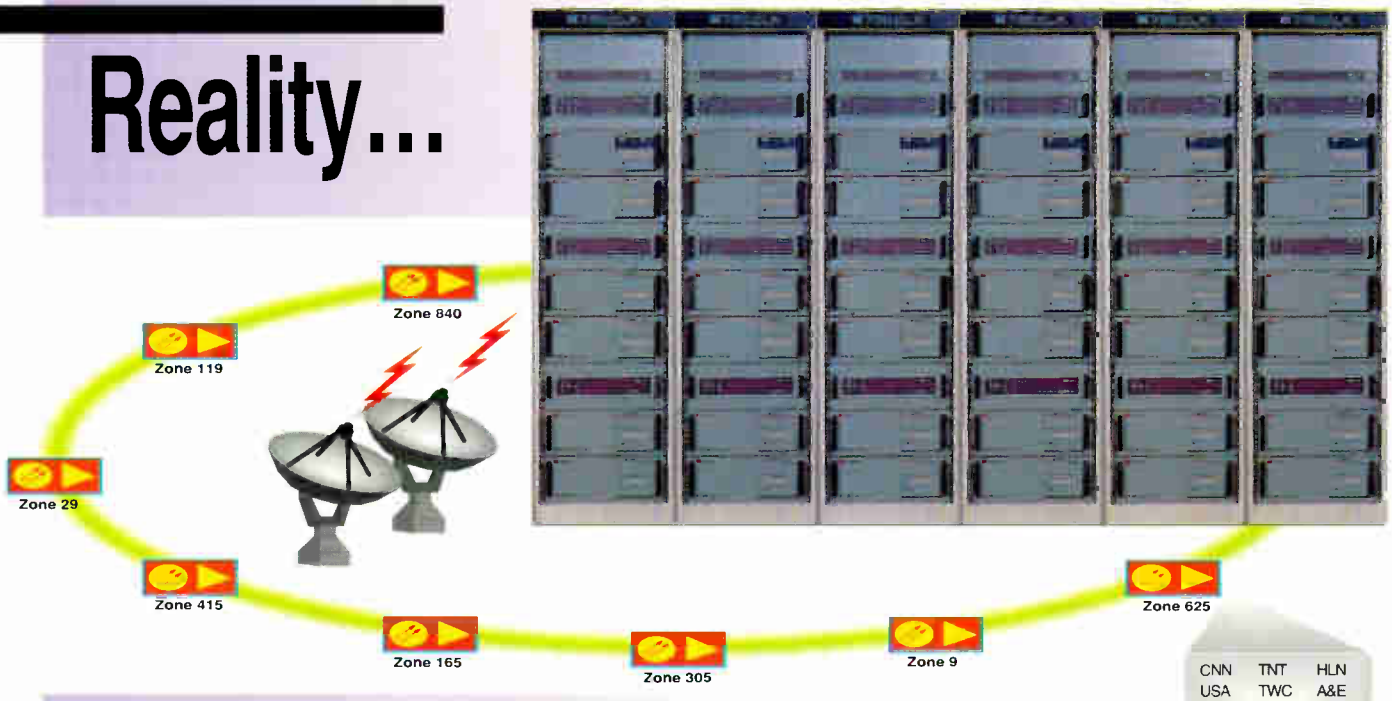


Figure 13: FIT CCD chip



Reality...



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Thomas A. Walsh, President, Channelmatic

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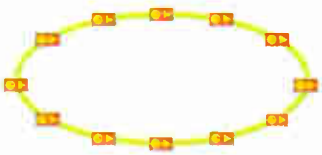

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Table 2: Summary of CCD, tube and film camera characteristics

	Tube	CCD	Film
Life expectancy	Guarantee limit 1,000 hours; typical 5,000 hours	Theoretically unlimited; 20,000-hour mean time between failure (MTBF)	No sensor; film changes for each shoot
Lag	Serious problem (Saticon); acceptable (lead oxide)	No lag	No lag
Highlight handling	Comet tail, blooming, sticking (especially Saticon), target burn (extreme cases)	Highly immune; smearing at high-level overloads (interline transfer CCD)	Highly immune; accommodates approximately 1,000:1 range
Geometric distortion	Inherently bad; correction necessary	Precise geometry inherent in construction (lens distortion not included)	Lens distortions only
Registration accuracy	Complex adjustments necessary, including microprocessor setup and diascope reference	Registration accuracy built in during assembly (lens distortion not included)	Lens aberrations only
Susceptibility to shock and vibration	Grid 4 (g_4) gives microphony; shock can distort; glass tube structure can break	Immune; exceptionally rugged	Immune
Start-up time	Filament response up to 10 seconds mandates standby/preheat	Sensibly instantaneous	Instantaneous
Susceptibility to external magnetic and electromagnetic fields	Very sensitive; shielding costs approximately $300,000 per camera	Highly immune	Totally immune at RF
Size, weight	Tube light; scan coil approximately 200 g; tube length approximately 120 mm; inconvenient	Very small, very light; allows more compact, lighter camera	Very small, very light, self-contained
Power consumption	High, because of focus coil current; High voltage for g_3, g_4; heater power; bias light power	Very low; camera power supply much less complex	Very low

three separate CCDs. Figure 15 on page 38 shows a photo of the Sony BVP-50 FIT CCD camera.

A consumer-quality camcorder (Figure 16 on page 38) does not have three separate CCDs but uses only one, an interline transfer CCD with color filter stripes in front of the chip. According to Lawrence Thorpe, vice president, Sony Camera/HDVS group, the size of the camcorder chips were originally 2/3 inch but are now moving to the 1/2-inch size.

Conclusions

The progress in TV camera imaging sensors from the iconoscope to the electronically shuttered frame-interline transfer CCD has been nothing short of phenomenal.

What's next? Well, CCDs have been incorporated into high definition TV (HDTV) cameras. However, CCDs can perform only interlace HDTV scanning, not the progressive scanning desired by many. The following are among the current flaws of the CCD chips for use in HDTV progressive scanning. The dynamic range of the progressive scanning HDTV CCD is decreased almost one-third compared to the interlaced HDTV CCD and the signal-to-noise ratio is worse. The higher clock frequency causes a higher power dissipation on the chip affecting noise and picture quality. Sony's Thorpe said that getting good results on HDTV progressive scanning from CCDs is five to 10 years

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Figure 14: Dichroic prism and three CCDs

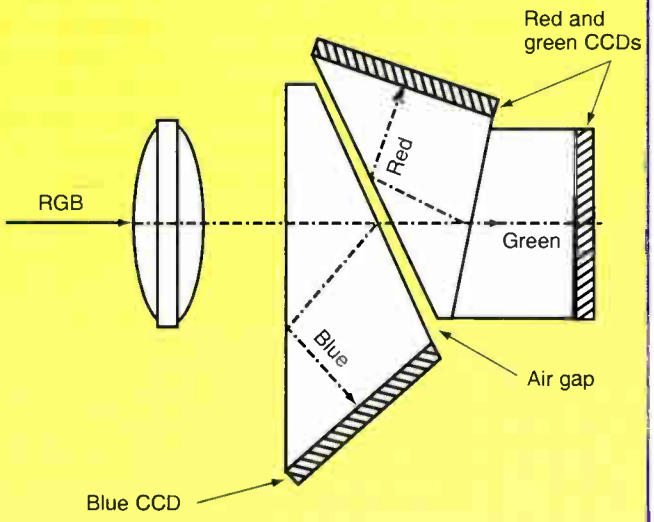

Figure 15: Sony BVP-50 FIT CCD camera

Figure 16: Sony consumer camcorder

away and the development is a multimillion dollar project.

What's next? As astronaut Neil Armstrong said: "Science has not yet mastered prophecy. We predict too much for the next year and yet far too little for the next 10." **CT**

References

[1] "The Technology of Image Capture," T. Higgins, *Laser Focus World*, December 1944.

[2] "Charge-Coupled Imaging Devices," M. Tompsett et. al., *IEEE Transactions on Electron Devices*, Volume ED-18, Number 11, November 1971.

[3] "Current State and Development Trends of Solid-State Imaging Sensors," L. Lockwood, *Report to NASA*, January 1973.

[4] "Digital still photography," L. Lockwood, *Communications Technology*, June 1992.

[5] "New Advances in CCD Imaging," L. Thorpe et. al., *SMPTE Journal*, May 1988.

[6] "The CCD Camera for Field Production Applications," P. Wonfor et. al., *SMPTE Journal*, October 1988.

[7] "Behind The Tube," A. Inglis, *Focal Press*, 1990.

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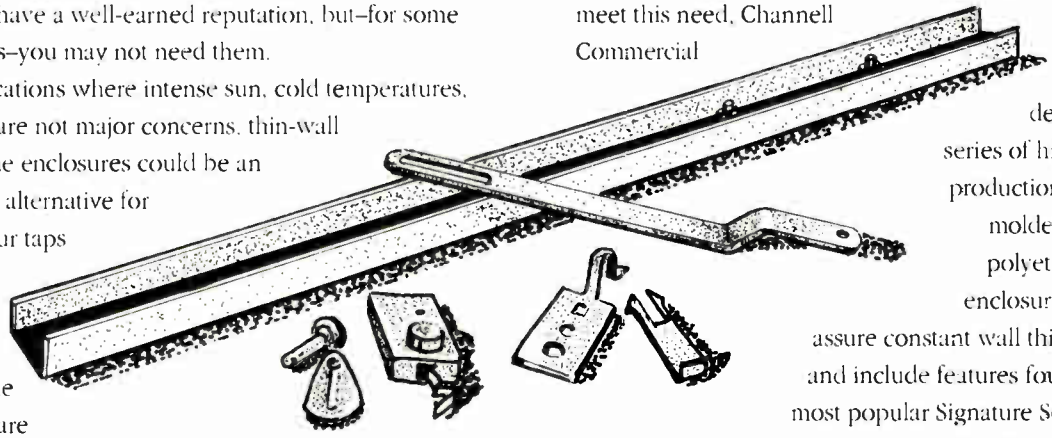
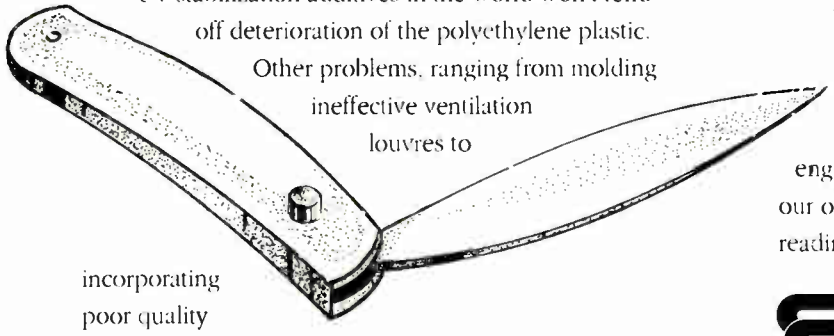


Most polyethylene enclosures are either vacuum or blow-molded, but these manufacturing methods leave a lot to be desired. A constant wall thickness cannot be assured and all the UV stabilization additives in the world won't fend off deterioration of the polyethylene plastic. Other problems, ranging from molding ineffective ventilation louvres to incorporating poor quality locking features, are associated with these techniques. And, as many system operators have found out, a simple pocketknife in the hands of the local street bully can be a polyethylene enclosure's worst nightmare.



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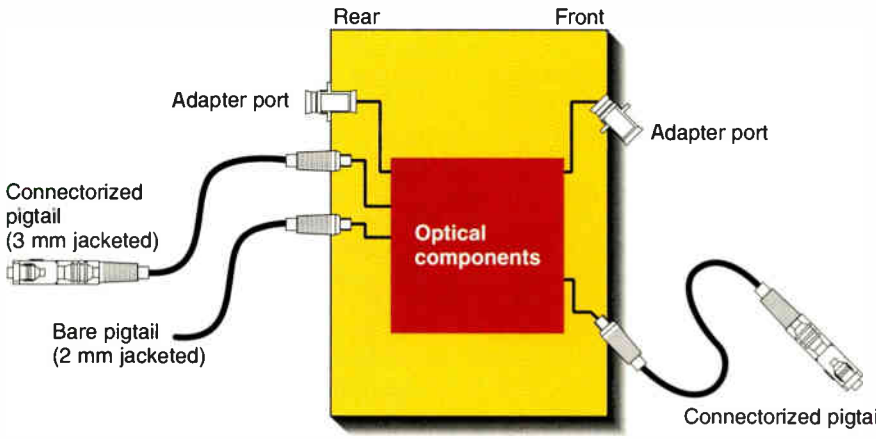
Reader Service Number 125

Open a window to the optical transport system

By Jeffrey L. Korkowski
Senior Market Manager
ADC Telecommunications Inc.

Figure 1: Input/output options for a plug-in connector module



It's a basic law of nature: You can't measure what's happening in a system without removing some energy from it. Create a perfect, leak-free system and you'll simply have to take its function on faith because you won't be able to test it. The alternative is to build in controlled leaks. A faucet is a perfect example. When it is open, it provides a useful opening into an otherwise closed system and proves that there really is water and pressure in the system. The rest of the time, for all practical purposes, it doesn't exist.

Today we're deploying optical fiber, a more nearly perfect and leak-free medium than we've ever had before. The problem is that every time we want to test a fiber run, we have to break the system, open a connection and reroute the flow to a testing instrument. It's not as troublesome as repairing a leaky kitchen drain — leaking photons don't make a mess on the floor — but it takes too much technician time and disrupts service.

Opening the system

If you plan to build access points into a system, the ideal locations are existing connection points: splices, splits and the interfaces to devices. The openings are already there and they are the natural points at which to isolate components for troubleshooting. For example, you use test points on either side of a device to test the device itself. If transmission is unobstructed at one point and impaired at the other, chances are good that the device is at fault.

This has always been standard procedure for circuit testing. Once a problem is detected, usually as a distant-end service interruption, technicians are dispatched to some point along the run where they begin testing. They open a connection — interrupting service — and reroute the signal to a testing device. If the signal tests normal, they proceed outward along the run. If the signal shows a fault, they proceed inward until the problem is isolated.

Despite improved technology, the approach hasn't changed much since the telegraph. It remains slow, intrusive and expensive. The next big step lies in a new approach to the connectors themselves. By making them do more than connect, we can open a new world of options for system design, monitoring and repair.

"Building connection points into the optical transport system enable network operators to deliver today's services and at the same time prepare for emerging services."

Evolution of network connections

In the beginning, there was the splice. It wasn't fast or easy. It wasn't cheap and it certainly wasn't foolproof. In fact, all that could be said in its defense was that it was obvious and if you did it right, it worked well. Of course, if you ever wanted that connection opened for any reason, the splice wasn't much help.

Then came interconnect. Like many new technologies, it imitated the one it replaced. Ends that would have been spliced were now connectorized and gathered together on a panel or series of panels. Interconnect saves little time at installation but is a priceless gift if you later need to open the connection. However, because half of each connection is hidden behind the panel, it limits flexibility.

The next big step was cross-connect, which actually changed the shape of the network. Connections that would otherwise be placed behind the panel are brought to the front. Cross-connect makes both sides of a connection accessible and significantly enhances the flexibility of the network.

This brings us to the current state of affairs. Connections can be made easy to open and close, easy to reach and conveniently located. That's quite an accomplishment. What more could you ask? Quite a lot, actually.

Adding value to connectors

After all the progress that's been made in connecting network elements together, a connection is still only that: a junction that has little effect on the signal crossing it. Why not do something to the signal as it passes by? After all, fiber distribution frames provide a flexible point in the optical network where connections can be easily managed and a variety of alterations to signals can take place.

Building connection points into the optical transport system enable network operators to deliver today's services and at the same time prepare for emerging

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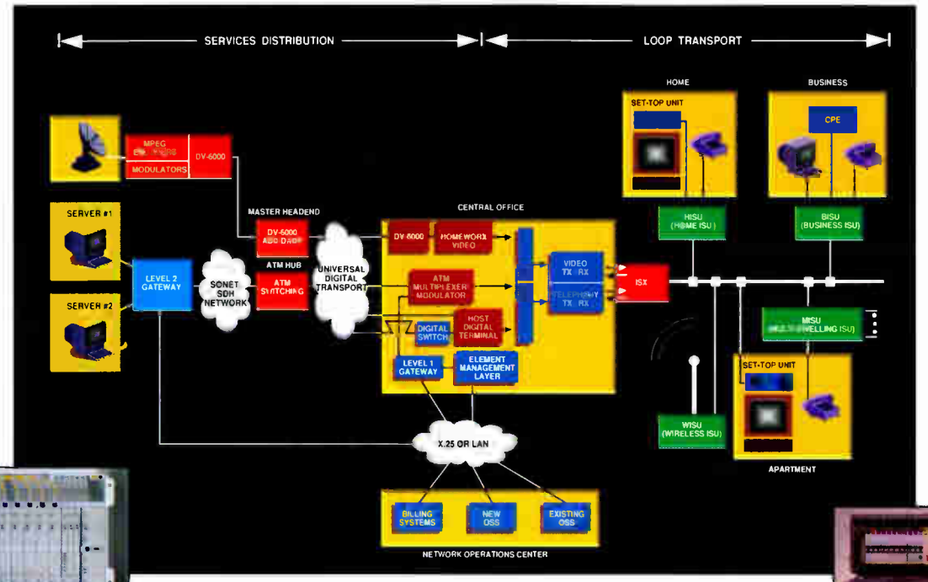

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Input Impedance	75 ohms unbalanced	75 ohms unbalanced	75 ohms unbalanced	75 ohms unbalanced
Frequency Response	±0.5 dB	±0.5 dB	±0.5 dB	±0.5 dB
Bandwidth	4.2 MHz	5.0 MHz	5.0 MHz	5.5 MHz
Differential Gain	2% max	2% max	2% max	2% max
Differential Phase	2 degree max	2 degree		2 degree max
Hum & Noise	-60 dB	-60 dB		-60 dB
AUDIO SECTION				
Input: 50 Hz-15 KHz	0 dBm (.8V)			(.8V)
Impedance	600 ohms balanced			
Frequency Response	±1.0 dB			
Frequency Tolerance, ±500 Hz	4.5 MHz	5.5 MHz		
Frequency Deviation	±25 KHz			
Harmonic Distortion	1% max	1% max		
Preemphasis	75µs	50µs		
IF SECTION				
Video IF Level	+37 dBmV +97 dBµV	+37 dBmV +97 dBµV	+37 dBmV +97 dBµV	+37 dBmV +97 dBµV
Audio IF Level	+22 dBmV +82 dBµV	+27 dBmV +87 dBµV	+27 dBmV +87 dBµV	+27 dBmV +87 dBµV
Return Loss	>14 dB	>14 dB	>14 dB	>14 dB
IF Frequency				
Video Carrier	45.75 MHz	38.9 MHz	38.0 MHz	38.9 MHz
Audio Carrier	41.25 MHz	33.4 MHz	31.5 MHz	32.9 MHz
Video-Sound Spacing	+4.5 MHz	+5.5 MHz	+6.5 MHz	+6.0 MHz
Vestigial Sideband Width	0.75 MHz	0.75 MHz	0.75 MHz	1.25 MHz
RF SECTION				
Output Frequency	470-750 MHz			
Frequency Tolerance	±2 KHz			
Output Level	+60 dBmV max			
adjustable	+120 dBµV			
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Spurious Output 470-750 MHz @+60 dBmV/+120 dBµV Output Level	<-60 dBc			
Return Loss	>14 dB			
Frequency Response	<2 dB			

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services. CATV providers can profit from taking a flexible, modular approach to managing network connections by installing modular connector systems that do more than just provide a window into the network. A system of connector modules can add value by offering a number of additional functions at network connection points.

Functional connector modules

Modular connector systems are comprised of optical components that can be mixed and matched, and inter- or cross-connected to serve specific functions in the network (Figure 1 on page 40). Individual modules can house an optical device — a splitter, coupler, wavelength division multiplexer or optical switch — within a protective case, with appropriate connectors easily accessible on the outside. The modules mount securely within a shelf in a fiber distribution frame.

Modular connector systems make sense for a number of reasons. First, network providers can simply plug in functionality when and where it is needed. Secondly, prepackaged modules save space, which often is at a premium because of the continually expanding number of equipment bay lineups being installed in headends to accommodate growing networks. Modular connector systems are designed to fit neatly into new and existing fiber frames and in some cases can even be wall-mounted. In operation they don't interfere with one another and, for access and replacement, the modules can be slipped out of the frame and replaced.

Preconfigured modules that perform a specific function save time by coming straight out of inventory and going right into service. Installers are freed from the time-consuming chore of configuring individual components, and from the occasional need to redo an installation.

In an environment that can be hard on fiber-optic components, modular connector systems can provide permanent, full-time protection. In addition to offering a protective shell for the devices, the housings ensure that connecting fibers stay in position and are not broken or unduly bent. The simple act of plugging the module into the frame locks the device — and everything connected to it — into place, so that nothing can be snagged or jostled. In close quarters, this kind of security can be crucial.

Modular connector systems enhance the ongoing management of the network. A key feature offered by some modular connectors is a clean, flat surface on the face of the modules, which is perfect for labeling and diagramming their contents and functions. When connector modules are changed, their replacements come complete with new labels and diagrams.

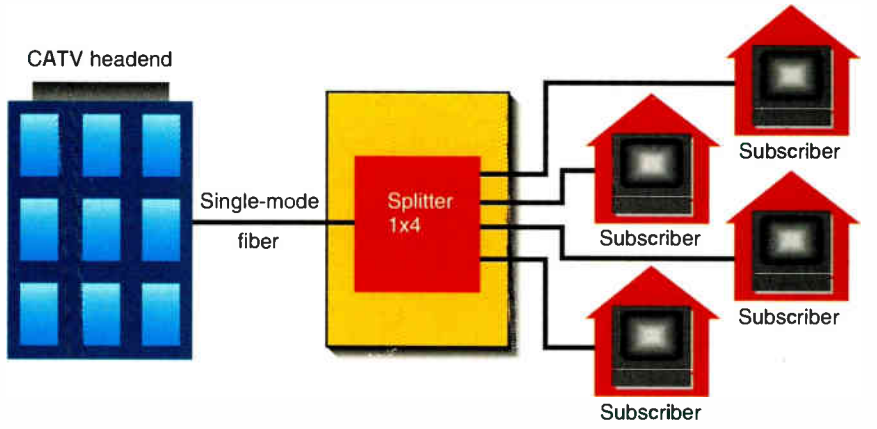
A module for every purpose

One of the most common devices in networks is the splitter. Splitter modules offer a variety of split ratios and by cross-connecting splitter modules in the distribution frame, you can realize almost any split configuration. In a matter of minutes, headend signals can be split for transport to multiple hubs or hub signals split to multiple feeders for transport to subscribers (Figure 2 on page 44).

As network loads increase, you will almost inevitably fill fiber runs to capacity at a given frequency. As an alternative to running new fiber, you can simply plug in a wavelength division multiplexer (WDM) module and send a whole new set of signals out over a second frequency, doubling the capacity of the run. The same WDM module can be used to broadcast video over existing

"The transition from a component orientation to a modular network design can be simple and painless. Modular connector systems can function side-by-side with existing infrastructure, even within a single rack."

Figure 2: Utilizing the splitter module



voice service without substantially increasing infrastructure.

One of the most important applications for modular connector systems is signal monitoring. By splitting off a small portion of the signal and sending it to monitoring ports — typically two, allowing signals to be monitored in both directions — a monitoring module allows nonintrusive testing at any time. Since the monitoring ports remain open, there's no need to move patch cords.

For more exhaustive testing, jackfield modules allow signals to be switched from the normal signal path to access ports for testing. Obviously, this is disruptive to service. An alternative is to configure a combination monitor/jackfield module, which would allow both nonintrusive and in-service testing.

For the most flexibility in testing, there are access/protect and optical digital signal cross-connect modules. These devices allow signals to be switched to an alternate route so the fibers of the primary route can be tested or offer nonintrusive monitoring with the option of switching for in-service testing.

Another nonintrusive testing option involves the WDM. While normal service continues on one frequency, you can use the other to run test signals.

Obviously, the variety of testing options dictates some decision-making regarding deployment. Cost will be a factor, both in terms of equipment cost and labor cost savings. In most cases the function of a particular facility will determine the level of testing access needed. Since connector system components are plug-in modules, no decision is final. If you need to upgrade your testing capability, unplug the old module and plug in the new one.

Today's modular connector systems can position your network for future management capabilities. For example, networks will increasingly be managed remotely. Central management systems will be used to access testing devices throughout the network. Some of the access tools will be today's modular connector systems. Others will be modules that are already under development to meet future network requirements.

Precision fit for your network

To be effective, modular connector systems have to be a precise fit, both for your application and for your architecture. Some of the features and capabilities to examine include:

- Wall-mount and rack-mount options
- Choice of chassis sizes to fit your rack system
- Choice of module densities
- Capability of mixing modules with bulkhead installations
- Interchangeability of modules to reduce inventory requirements
- Full compatibility for interconnect or cross-connect configuration
- Choice of adapters, pigtail or bare fiber connections
- Full range of splitter ratios, from 1x2 to 1x32
- Choice of unidirectional or bidirectional and standard or very high isolation WDMs

The modular future

As uncertain as many aspects of networking may be, there are some you can safely bet on. Networks will be bigger, denser and increasingly multifunctional. The market will be more competitive and your customers more demanding. Costs of construction and operation will have to be controlled in order for providers to stay profitable.

With so many complicating factors acting on the network, system management will be a driving issue. Technical personnel will have less time to sort out poorly documented installations and today's manageable equipment bay could become tomorrow's support nightmare.

Modular connector systems let you leverage support resources by simplifying installation now and accommodating future growth. Today's cost of labor-intensive installation is nonrecoverable. A system of plug-in connector modules, on the other hand, is a readily transportable asset. The modular structure will accommodate new optical devices and capabilities as they are developed and provide a sound basis for management of a changing, expanding network.

The transition from a component orientation to a modular network design can be simple and painless. Modular connector systems can function side-by-side with existing infrastructure, even within a single rack. There is no need to swap out current equipment. You can shift to a modular connector system as network advancements occur by adding specific modules with key functions and convert the existing ones only when it becomes feasible or necessary.

Modularity pays

Modular connector systems with a variety of optical components are available today. Besides speeding and simplifying installation, they allow a density that traditional installations cannot match. By reducing labor, they not only cut current costs, but those of future changes and reconfiguration. The real added value, however, is the added functionality: easy, customized splitting, multiplexing, switching and testing. These are the capabilities that will define tomorrow's network. **CT**

Here's something to remember next time you order cable.

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ALCATEL

Essential fiber know-how for the '90s

By Scott F. Andrus
Training Supervisor, Siecor Corp.

And Margot A. Botelho
Cable TV Market Manager, Corning Inc.

Training is no longer an "add-on" or a discretionary investment in technology support.

Interactivity. Telephony. Distance learning. As the cable TV industry evolves from delivering video to providing a host of future services, an important question emerges: How will cable TV engineers and technicians manage in this brave new world of broadband communications?

The era when cable TV was viewed solely as a provider of one-way video services is rapidly coming to an end. By the end of the '90s, the industry's future will be tied to the provision of interactive services from a hybrid optical fiber and coaxial cable platform.

Clearly, technical training will be essential in ensuring that cable's work force keeps pace with the changes facing the industry. Cable TV engineers and technicians must master fiber-optic skills in order to meet the requirements of providing video, telephony and data communications services.

In this current and future cable TV systems, training is no longer an "add-on" or a discretionary investment in technology support. It is a strategic imperative and a competitive necessity. Therefore, the development of a comprehensive training program should be an integral element of every cable TV operator's business plan. This article will discuss the role of fiber in broadband networks and the fundamentals of an optical fiber training program. It also will examine the critical elements of any training plan and offer some insights into selecting training that meets your system's needs.

Broadband network building block

One of the building blocks of a broadband communications network is optical fiber. The use of fiber in cable TV applications has increased dramatically in recent years. Such rapid advances occurred because fiber "proves in" on its operational benefits alone: increased channel capacity, improved reliability and reduced maintenance.

By deploying fiber, cable operators minimize their expenses today and maximize their investment for the future. Today's fiber investment also lowers costs by eliminating trunk amplifiers and other active devices in cable TV systems. And, with a continued investment in fiber, cable companies are creating an optical platform from which to launch future services.

Investing in a fiber-based platform is one thing. Leveraging that investment operationally with a thorough technical training program is another matter. Let's examine the basic elements that should be part of any fiber-optic training plan.

Fiber-optic training

Given the rapid pace of fiber deployment over the past few years, many cable TV engineers and technicians are familiar with fiber's transmission characteristics and how it works. However, are they comfortable enough with fiber to construct, maintain, troubleshoot and restore the system in an efficient manner?

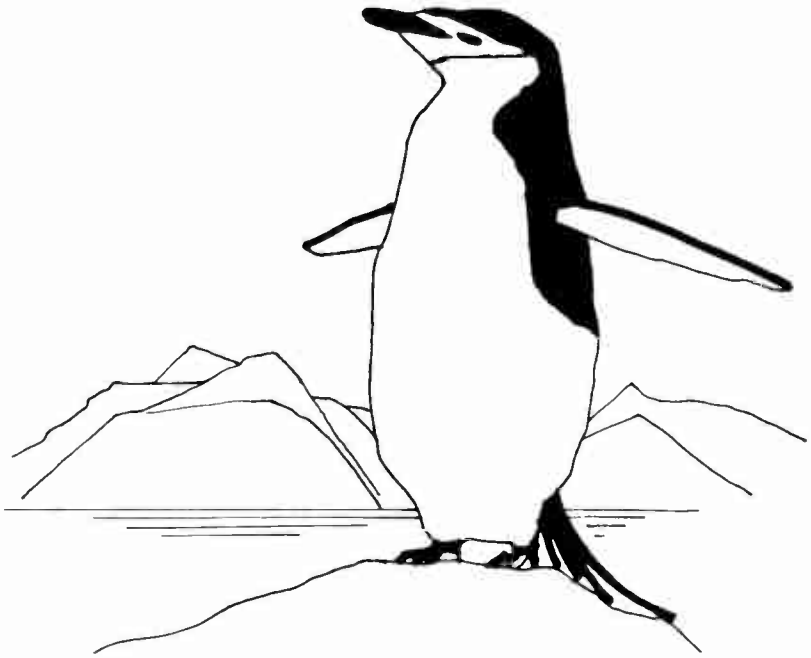
The mastering of fiber skills is an important goal that should not be overlooked. In order to accomplish such goals, a detailed training curriculum needs to be followed that involves lengthy, hands-on practice sessions with cable stripping, splicing and termination. The use of optical time domain reflectometers (OTDRs) and attenuation test sets needs to be taught. Once these skills are mastered, maintenance and restoration procedures also need to be covered.

Selecting a training program

A number of manufacturers, industry associations and consultants provide fiber-optic training programs. Before selecting a training program, research the potential educators thoroughly to ensure the training you choose will meet your organization's specific needs. The following checklist should help:

1) *Hands-on training:* Video-based and seminar training programs are often valuable sources of basic overview information and introductions to technology. These tools alone are not comprehensive enough to accomplish the goal of mastering fiber-optic skills. Any course designed for technicians should emphasize hands-on experience with equipment for installing, maintaining, troubleshooting and restoring a fiber-based system. Most effective courses will have at least 80% of the instruction as hands-on, and typically last a minimum of three to five days.

2) *Class size:* The size of the class often can determine the effectiveness of



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"A well-trained technical staff could mean the difference between thriving in the new world of voice, video and data or just surviving."

the training. Smaller classes with no more than six pupils per instructor permit more hands-on experience.

3) *Student/equipment ratios:* The availability of equipment also affects the degree of classroom participation. There should be no more than three students for each piece of equipment.

4) *Instructor qualification:* Be sure to verify the credentials of the training program's faculty. Theory as well as practical field experience is important. Many times, field engineers are the best instructors because they often rotate between the field and classroom and can simulate actual field situations for the class.

5) *Up-to-date equipment:* The most current fiber-optic products are the best training tools, since they assure technicians are learning the latest in technology. Make sure that the equipment used for instruction is from reputable manufacturers. Splicers, OTDRs and attenuation test sets all work on the same basic principles. Therefore, crossover from one manufacturer to another takes place easily.

6) *Course materials:* The instructional materials that accompany the course work also are very important, since they'll serve as a reference source once the student leaves the classroom. Often, detailed procedures for operating the equipment are included in this material.

7) *Custom designing:* Before selecting a course, research the proposed curriculum. Does a "standard" course meet your needs or is a specialized course necessary? Will the training group spend time learning your specific requirements and ensure that the course material matches those needs?

8) *Flexibility in location:* Where are the courses taught and how often? Will the instructor travel to your site to train? It may prove to be more cost-effective to train several people at your facility. On the other hand, keep in mind that leaving the workplace — be it across town or across the country — can remove the distractions of the job.

9) *Follow-up support:* In addition to providing course material, the training organization should be available to answer questions after the training has been completed.

10) *Cost:* While the fee for training is always an important consideration, it shouldn't be the sole factor in selecting a training program. Hands-on training often will cost more than seminars and videos, but if the course meets the previous criteria and the goal is to help technicians master fiber skills, the upfront investment quickly pays for itself through the immediate, improved quality of workmanship provided by trained technicians.

11) *SCTE certification:* As an added bonus, it is of value for the course to be recognized by the Society of Cable Television Engineers for Broadband Communications Technician/Engineer (BCT/E) preparation and recertification.

Ultimately, cable TV technology will continue to evolve whether a cable operator chooses to train or not. Increasingly, however, a well-trained technical staff could mean the difference between thriving in the new world of voice, video and data or just surviving.

For more information

For more information on Siecor and Corning fiber-optic training, you can use the following information:

- Siecor's training department's number is (800) 743-2671, ext. 5539 or 5560. Siecor's hands-on class, "Fiber-Optic Installation, Maintenance and Restoration for CATV Applications" is taught throughout the year for cable TV technicians and engineers. The four-day course is recognized by the SCTE as a source of preparation for the fiber-optic portion of the BCT/E Category III examination. Successful completion of the course earns four recertification units for those members holding BCT/E certification.
- Want to receive information on optical fiber and what it can mean for your cable TV system? The Corning Optical Fiber Information Center offers cable TV-specific literature, videotapes and trade articles on fiber-optic technology. Call (800) 525-2524 and a Corning information specialist will get you what you're looking for, or put you in touch with a technical expert. These materials are easy to order through the center and they're free. **CT**

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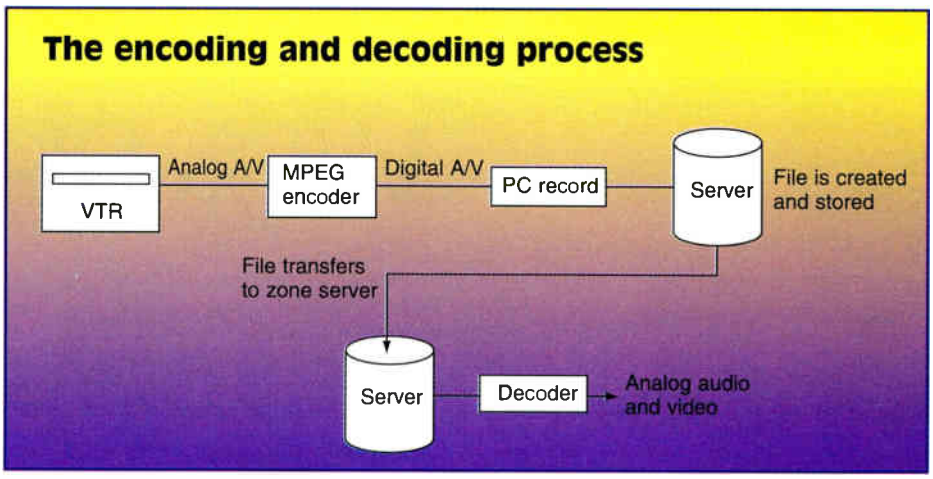
Reader Service Number 11

Advantages of digital ad insertion

By Chris Brechin
Marketing Manager, Digital Video Compression
Scientific-Atlanta



Digital ad insertion is taking off. Each week there's more news about the sale or installation of another digital ad insertion system. In fact, these installations are one reason why 1995 cable ad sales are likely to increase another 15% to 20% over 1994's. Many of these installations have replaced tape-based insertion systems with the inherent advantages of digitally based advertising.

The benefits of digital video and audio over analog technologies are many. Overall, this new technology provides greater flexibility, better responsiveness, higher presentation quality, superior dependability and improved zoning capability over conventional tape-based analog systems. The core technology involved in digital ad insertion is the set of digital video and audio compression techniques adopted as part of the worldwide standard called MPEG.

The move to digital compression

The Moving Picture Experts Group was formed in 1988 to establish a standard for the compressed representation of moving pictures. The activities of the MPEG video group was concentrated in two areas: MPEG-1, which is optimized for noninterlaced source material; and MPEG-2, which is optimized for interlaced source material. Essentially all of the digital ad insertion systems today are MPEG-1-based because equipment employing this standard is readily available now. MPEG-2 possesses some advantages, but the standard's recent ratification in November 1994 is one reason why this technology will not be readily available for ad insertion applications until next autumn or winter.

MPEG-1 was originally intended for use with digital storage media operating at rates up to about 3 megabits per second. However, the syntax of MPEG-1 allows it to be used at rates up to some 104 Mbps. The newer standard, MPEG-2, is optimized for higher data rate interlaced video applications, primarily in the 3 to 12 Mbps range. Conceptually, the MPEG-2 algorithms are very similar to MPEG-1.

Both MPEG-1 and MPEG-2 support a variety of spatial and temporal resolutions. Consequently, both algorithms can be used in 525-line, 30 frames per second (fps), and 625-line, 25 fps applications. An essential characteristic of both algorithms is their flexibility. This flexibility allows future improvements in performance to be obtained by upgrading just the encoder. No changes to the installed decoder base are required. In fact, MPEG-1 video can be decoded and displayed by MPEG-2 equipment, although the reverse is not true.

Naturally, potential digital ad insertion equipment operators

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"(Digital) technology provides greater flexibility, better responsiveness, higher presentation quality, superior dependability and improved zoning capability over conventional tape-based analog systems."

want to understand the advantages of waiting for the introduction of MPEG-2-based systems. The answer is clearly one of missed opportunity (since waiting on the new technology can be uncertain) vs. systems that are available today to provide high-quality audio and video at CCIR-601 resolutions and bit rates up to 8.5 Mbps. Also, one should remember that these insertion systems are "closed" because that video is fed into the encoders as analog inputs (creating digital files) and then are replayed through MPEG decoders that return the material back to their original analog form. Because compatibility is not a question in these closed systems, taking advantage of the capabilities available today is paramount.

How it works

The majority of today's digital ad insertion systems are based on the digital storage and retrieval (DSR) system, which is simply depicted in the accompanying figure on page 50. DSR consists of a stand-alone MPEG encoder and a PC-based decoder, which are employed by various ad insertion systems. To create an audio/video file, analog audio and video (usually composite or component) are fed into the encoder. Both inputs are then digitized, compressed and streamed into a separate PC-based "record" board that stores the information on a digital server or other standard digital storage devices. Files will vary in size based on the specified data rate (from 2.5 to 8.5 Mbps) and the desired video resolution (either 704, 544 or 352x480). Typically, a 30-second spot will be encoded at 6.3 Mbps at a 704x480 pixel resolution, which occupies some 23 MB of disk storage. At this point, the file can be transported using available bandwidth over any digital network.

Playback of the video and audio is initiated by the control software that retrieves the file and feeds it into the MPEG decoder. The decoder automatically detects the appropriate bit rate and video resolution so special setup is not required. The bit stream is then returned back to a baseband NTSC signal. DSR applications are numerous, but the most prevalent one is digital ad insertion.

An ad insertion system solution requires a substantial investment in the control software. The actual playback mechanism is based on a cue tone that is generated by the network. Typically, they occur some four to seven seconds before station break to allow commercial videotape recorders (VTRs) to roll up to speed. The notification time is quite long for a digital system since it can start a spot within milliseconds of initiation. After detection, the digital file bit stream is started, the ad is decoded, and the baseband signal is fed to a switch or router to insert the commercial onto the correct channel.

One feature of the control software is verification that a commercial had run completely and cleanly before being billed for the service. Spots that are garbled or interrupted must be rerun successfully and are often referred to as "make-goods." Digital ad insertion systems accommodate verification by using the digital stream itself to verify success-

ful playback. The last software function is feeding the verification data back to billing software to automatically invoice the customer.

The advantages

Digital ad insertion provides numerous advantages over conventional tape-based analog systems. For one, automation is inherently easier. The random access provided by digital technology is far superior to tape-based systems that require placing ads in series or very close proximity. In fact, a 90-second break is often supported by two VTRs — one to play the first spot and then fast-forward to the third commercial while the second one plays its spot.

As one can imagine, tape-based systems inserting into more than four to six different channels are quite complicated. However, this capability is quite routine for digital ad insertion systems. Many of the digital ad insertion systems offered today allow coverage of all of the 25 or so different cable channels that allow local insertion.

What's more, these systems allow simultaneous play of different spots in different zones. This advantages cannot be overemphasized as advertisers continue to push for more finely targeted segments. In fact, an advertiser is more likely to pay a premium for a target that has less waste associated with it. Advertisers realize that a well-focused message delivered to the right consumer is significantly more cost-efficient than mass-marketed messages. Consequently, systems that can deliver their message to the target demography with the most impact will receive the most advertising dollars.

To achieve the same type of targeting using current analog methods would require shuttling tapes between headends and making duplicate copies (which reduces the video quality of the spots). But with digital video compression, ad spots can be moved over wide area networks (WANs) so that ads within an interconnect or over a cable plant with multiple headends can be staged to fit local demographics. Every copy that is staged is a perfect "digital" copy of the original spot.

Another advantage of a digital ad insertion system is the improved turnaround times. Often, they are shortened from 48 hours to less than eight. One reason is the elimination of much of the compiling process required with tape-based spots. Ad systems often take several days each week to duplicate and transfer spots to match the week's schedule. However, by using the random access provided by digital technology along with WAN-based distribution, spots can be quickly substituted and rescheduled. This flexibility is an important advantage especially for movie theaters, grocery stores, electronic merchants and other retailers who need to add, change or remove advertisements quickly.

Digitally based systems eliminate one of the big issues with VTRs — reliability. With fewer moving parts, these systems are much more reliable, which in turn reduces the number of missed spots, garbled breaks and clipped endings. What's more, analog tape will lose resolution and quality over its life, but digital spots will remain flawless for a very long time. Since the spot is a file, rewinding is not necessary and it allows an instantaneous start. This capability allows reaction well within the four- to six-second cue tone "warning" given by programmers like ESPN or CNN. In fact, some tape-based machines have trouble coming up that quickly.

Software is a major component of the digital ad insertion system. Its role includes managing the increased inventory and traffic. For example, a 12-network system used in four different zones will translate into as many as 32,256 insertions

"Digital insertion of analog spots will be used for a number years although packet-based delivery will create an eventual new micro-targeting capability that promises even stronger results for operators."

per week (i.e., 4 spots/hour x 24 hours x 7 days x 12 channels x 4 zones = 32,256 spots). A system must manage these opportunities, run the ad and verify that it was shown successfully. Other considerations include handling "make-goods" automatically with software that bills the client upon successful completion of the spot.

The future

Clearly, the future of digital ad insertion points to the eventual delivery of digital video all the way to the home. The ad insertion in this future system will then provide "true" digital insertion into a digital stream delivered to the home. There are two important points: 1) analog services will not simply disappear but have a long life, and 2) "packet-based" digital ad insertion will allow true micro-targeting.

One reason for this continued use of analog technology is that very few of us ever throw out a TV set — we just move it to another room. Thus, to provide entertainment to these viewers, analog services will continue to be required many years to come. Ad insertion systems placing spots onto these channels will be the same equipment purchased today using the MPEG standard. It is quite likely that in the future many national spots will be delivered as MPEG files, but local ads will still require creation, encoding and storage for playback. Along with these analog services, there will develop a parallel tier providing digital broadcast and interactive digital services.

Advanced digital delivery capabilities allowed through packet-based delivery — such as MPEG transport or asynchronous transfer mode (ATM) — will create a new micro-targeting tool for advertisers. By simply profiling a household (using the same kinds of direct marketing tools available today), advertisers will target a specific audience. Programming breaks will then be preceded by digital instructions to each digital home communication terminal (HCT) directing it to the appropriate channel and bit stream carrying the advertising message tailored to each household. The possibilities will be almost unlimited in giving advertisers the tools to send specific messages to receptive and likely buyers.

Conclusion

Digital ad insertion opens up a significant, unregulated revenue source for cable operators. Its flexibility, responsiveness, quality, dependability and targeting capability is superior to conventional tape-based analog systems. Using the worldwide MPEG standard ensures future support and expansion capability without having to wait on the development of the next generation of equipment. Clearly, digital insertion of analog spots will be used for a number years although packet-based delivery will create an eventual new micro-targeting capability that promises even stronger results for operators. **CT**

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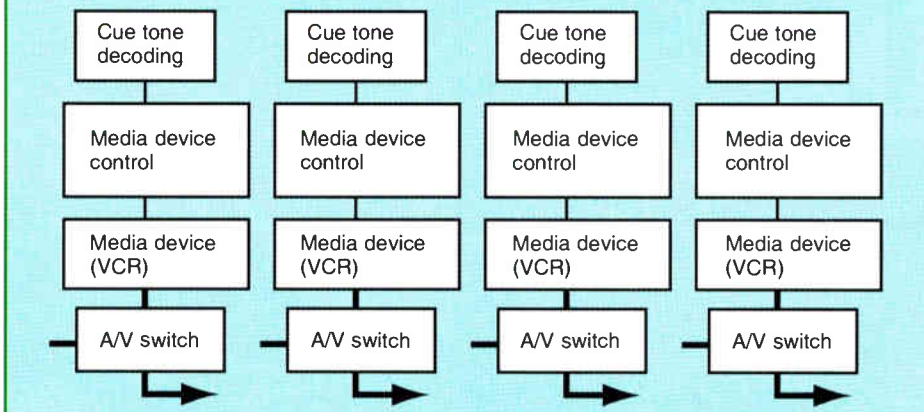
C9517-2

Ad insertion system architecture

By Thomas A. Walsh
President, Channelmatic Inc.

Figure 1: Modular sequential (analog)

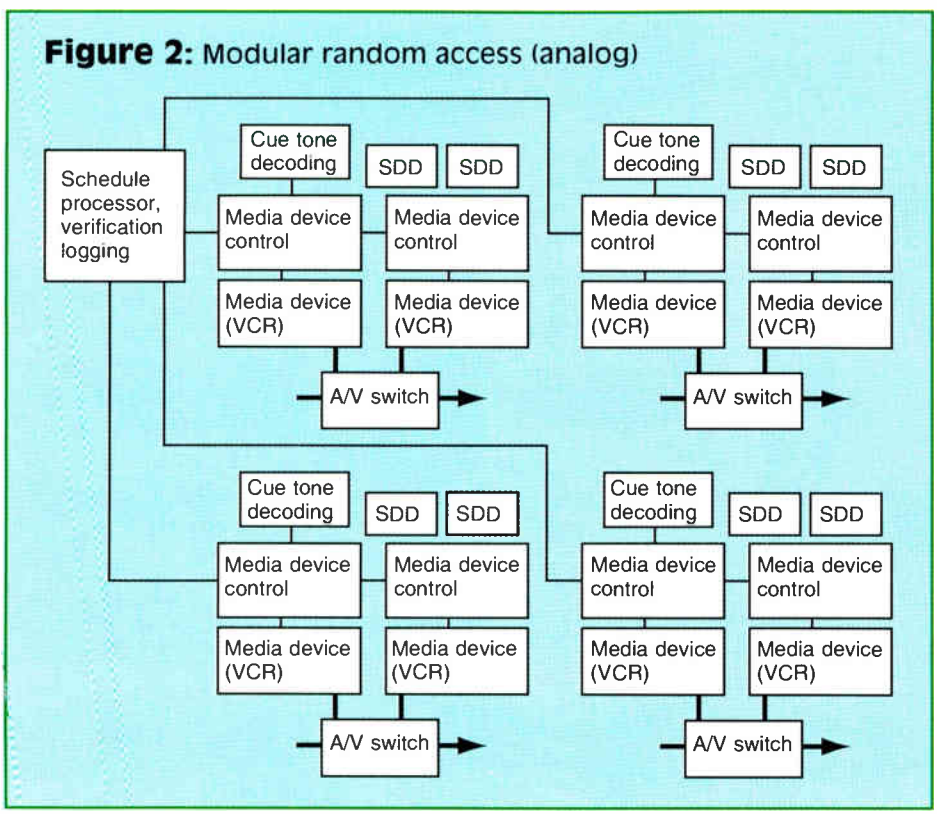


The first system used to automatically insert local advertisements for cable TV was developed in the late '70s. At that time, CATV local ad insertion was a business not taken seriously by most cable operators. To make this business possible, an economical yet surprisingly sophisticated system needed to be developed. The insertion had to be done in a broadcast TV fashion at an affordable, professional equipment price.

Since that time, many companies have developed various types of ad insertion systems. Each architecture was developed to provide a specific set of benefits. The ad insertion system architect must not only provide the features necessary to insert commercials but must do so under constraints of cost, serviceability, size, expandability, redundancy and ease of use.

The architect must prioritize the importance of design features because many times trade-offs had to be made. For example, if scheduling flexibility was considered to be the most important element in the design, the approach taken might have a negative impact on the system's complexity and ease of service. Many times the architect doesn't realize the impact of the trade-offs until the systems have been in use for a period of time.

Figure 2: Modular random access (analog)



Modular sequential

To provide an affordable solution that was expandable, the first system was developed in a modular fashion. Insertion functions consisted of audio/video switching, DTMF cue tone decoding, and tone-based VCR control. Three modules were developed — one for each function. Even though only one cable network offered local avails at the time, it was envisioned that many channels would follow. The modular design allowed an operator to expand one channel at a time. The first architecture proved to be ideal for the infant business and CATV local advertising became a reality. (See Figure 1.)

This first system was limited because the sequence of spot playback was dictated by where the spots were edited on the tape. Any change in the order of insertion required the tape to be re-edited. The desire to reduce editing time and to

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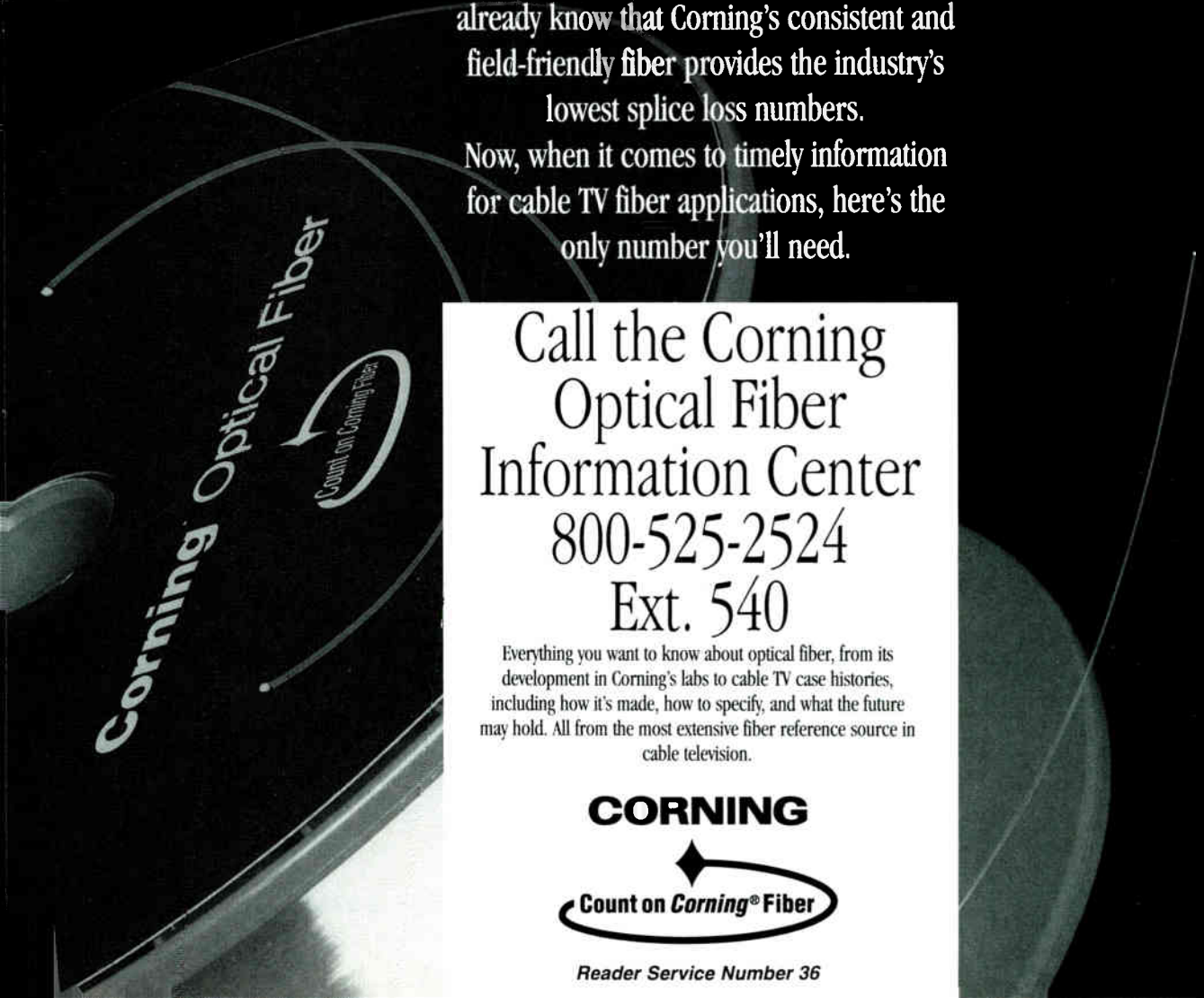

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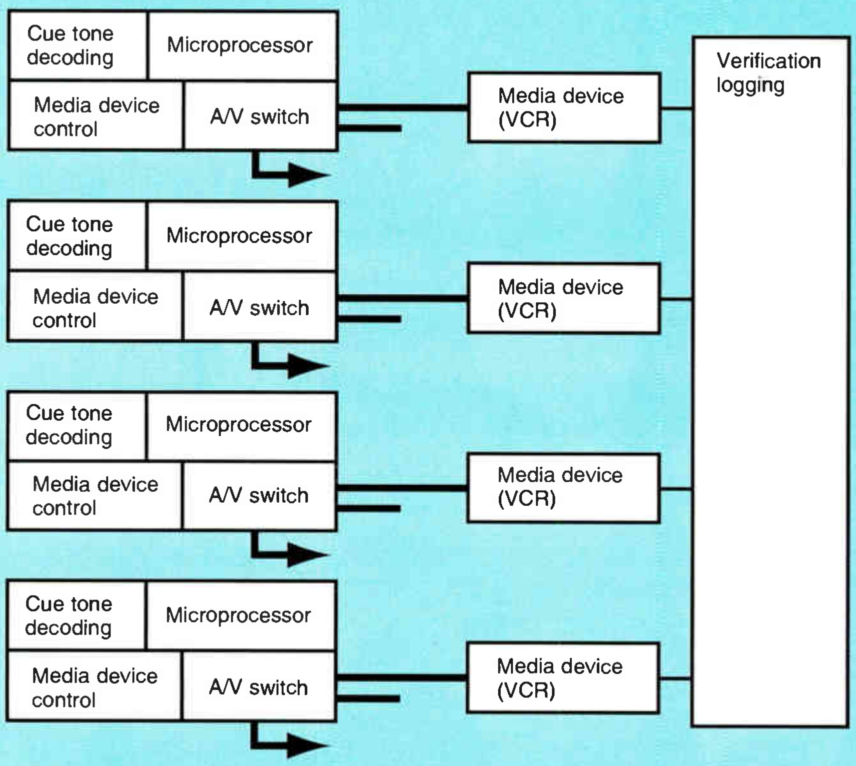
Figure 3: Component sequential (analog)



"Recent breakthroughs in compressed digital video have created many exciting opportunities for the future. Along with the opportunities also is an element of risk."

make it easier to insert specific spots in specific programs created the demand for a next-generation system. Also, the need for spot verification was addressed.

Modular random access

The modular random access system was designed to insert specific spots into specific network programs. Sophisticated real-time scheduling and automatic videotape cueing were primary design considerations. Microcomputers and software were first introduced to maintain schedules and accurately locate spots on a videotape. The audio/video switch module and cue tone decoder modules remained unchanged. The VCR control module was given the ability to cue a videocassette player to any preprogrammed position on the tape. A serial data decoder module was added to decode FSK (frequency shift keying) data stored on the tape used for verification and spot location. (See Figure 2 on page 56.)

Like the sequential modular system, a set of modules performed insertion functions for a particular network. Additional modules could be purchased to add networks.

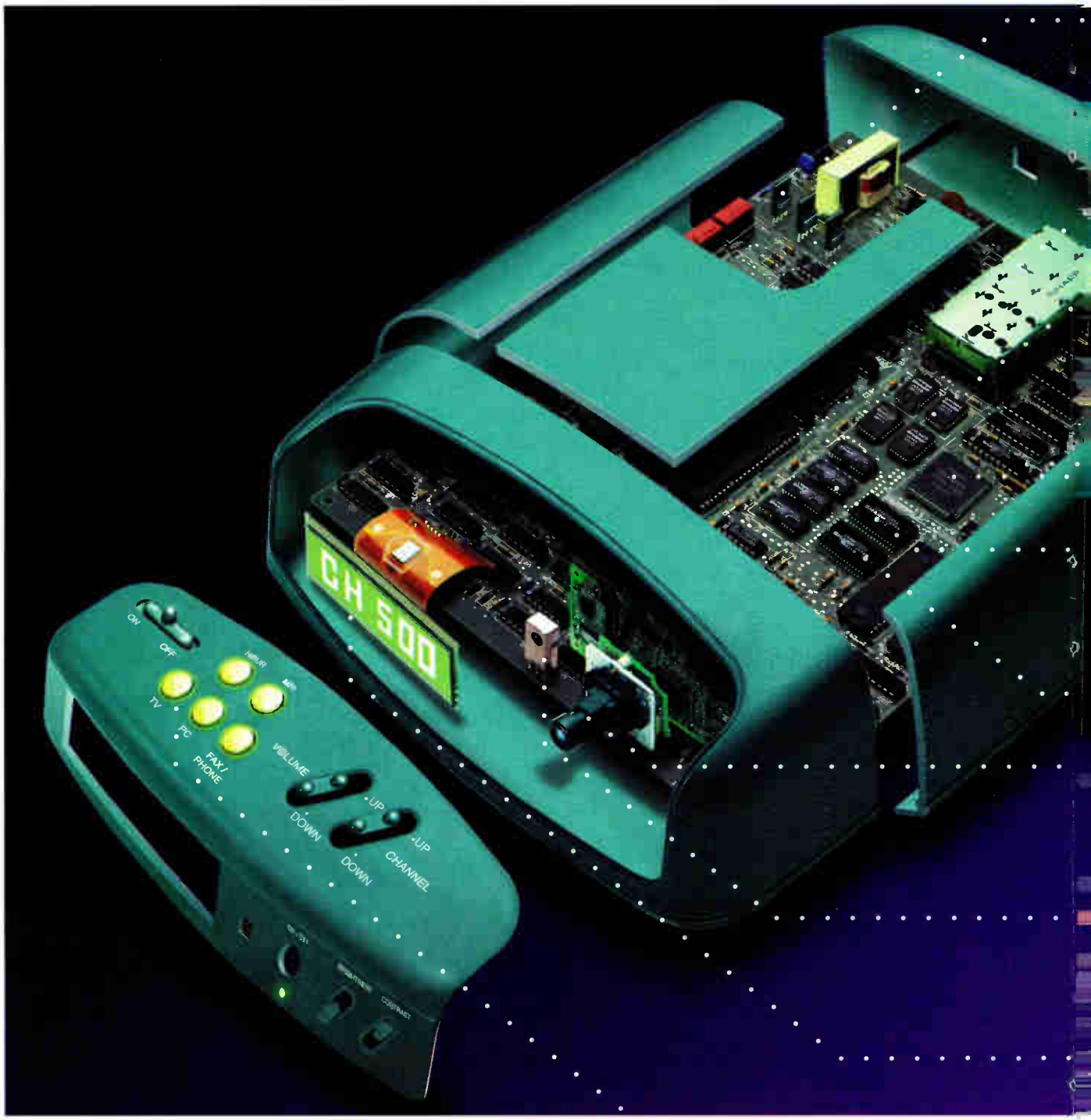
The modular system was very flexible and cost-effective, but it did have some drawbacks. The modules were easily accessible to unqualified operation personnel. In an effort to make repairs or expand the systems, modules were damaged and incorrectly installed.

Another weakness in the architecture was a reduction in reliability because of the mechanical connections of many removable modules. To make an ad insertion system easier to maintain and to minimize the need for on-site troubleshooting, the component sequential and component random access systems were developed.

Component sequential and random access

The component ad insertion systems retained the flexibility of the modular systems by providing one or two chan-

Interactive TV: If you've got the vision, we've g



Everyone likes to talk about interactive TV; but only a relatively few really appreciate everything that still has to go into it—from the standards to the infrastructure to the integration required to meet mass market price points.

—t o S h a r p

;ot the guts.

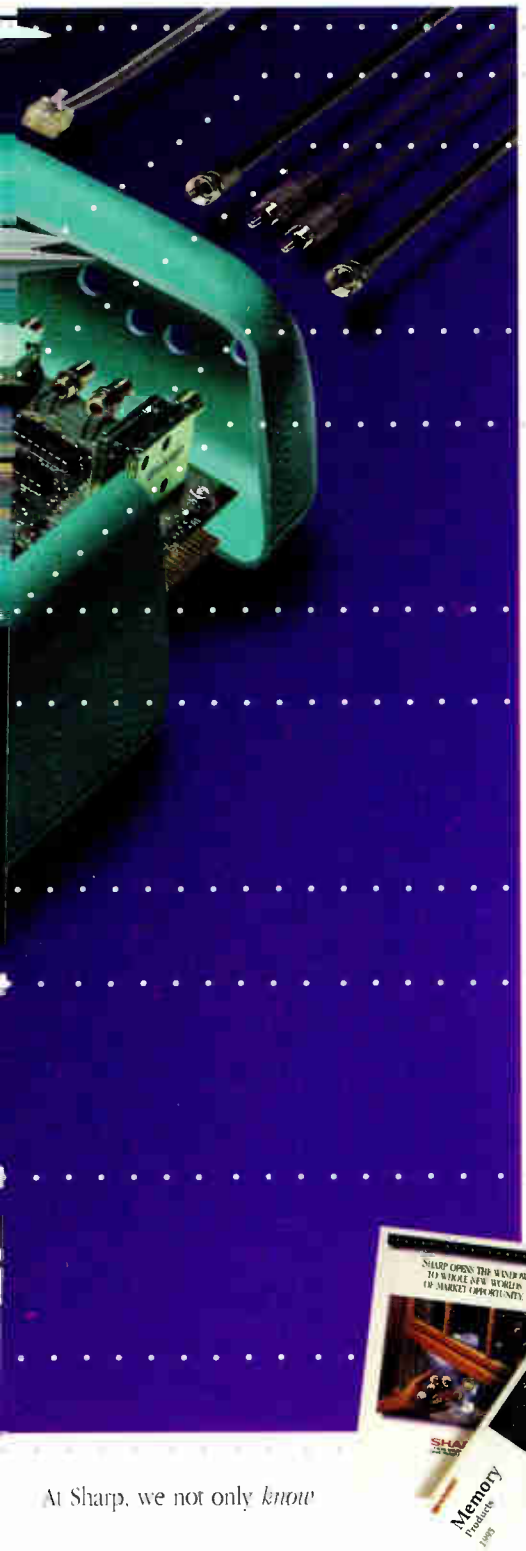


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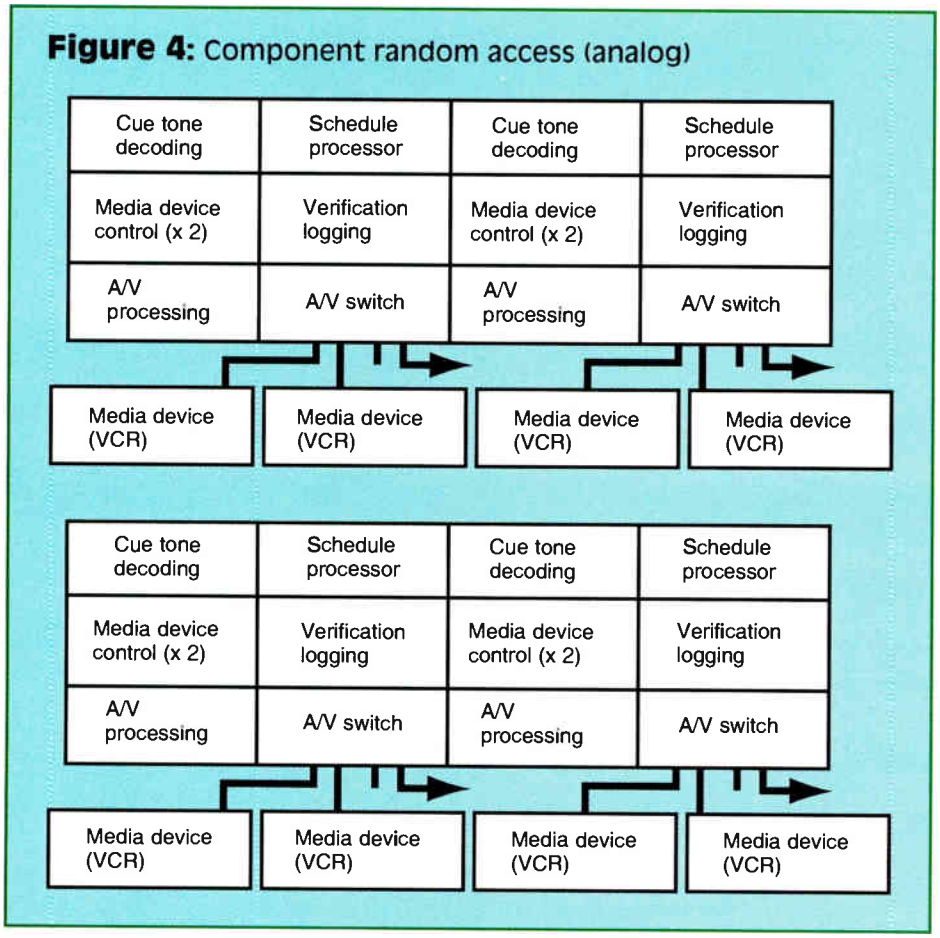
Figure 4: Component random access (analog)



nels of insertion in a single self-contained rack-mount chassis. Each unit contained all the elements required for ad insertion. The circuits of the individual modules were consolidated on several larger boards, which reduced cost and increased reliability.

When a failure occurred, the operator would not have to fumble around with modules. He would simply replace the failed chassis with a spare unit. The failed unit would then be returned to the factory for repair by experienced personnel. (See Figure 3 on page 59.) Units were developed for lower cost sequential playback and more expensive units for random access. The components could be networked together so they could be operated from one central control device.

In addition to consolidating circuitry, one microprocessor was given control of the whole insertion process for each network. This allowed for the addition of features such as software-controlled audio level adjustment, video quality sampling, flexible scheduling and more detailed status and logging. (See Figure 4.)

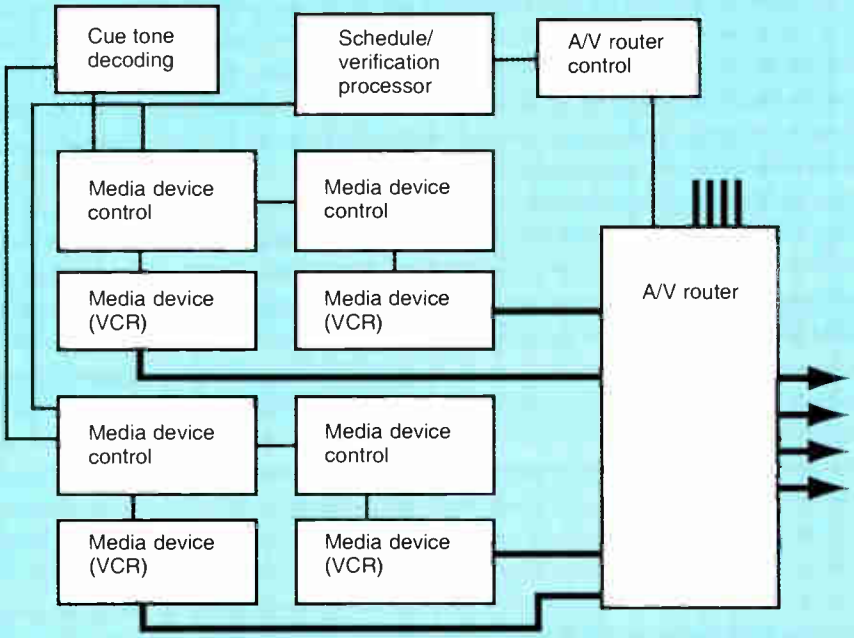
Compiled sequential and random access

Some cable operators didn't trust the complexity of switching from VCR to VCR while being on-air. These operators adapted the use of a tape compiler designed for the broadcast industry to edit sequential tapes on a daily basis. They took comfort in knowing that a simpler form of insertion architecture was used on-air. The more complex compiling was done off-line. This method of insertion was only used by a minority of cable operators. Most had a great deal of success with the online random access systems, which minimized tape editing.

Improved compilers were later developed to enable the operator to automatically compile random access tapes. The use of these compilers reduced operator error and increased tape editing capacities. An advantage of using a compiler was that fixed program insertion could be done with the use of only one VCR per channel. A weakness of the compiled sequential process was the tremendous amount of editing required to build a new tape every day for each network. This editing load created exceptional wear on the VCRs used in the compiler and on the library tapes where source spots were stored.

Due to this heavy burden on machine and videotape, regular and quality maintenance was required. Lack of regular maintenance and poorly trained and

Figure 5: Router-based random access (analog)



managed operators spelled disaster for the compiler-based insertion operation.

Routing switcher-based random access

A typical random access ad insertion system required the use of two to four VCRs per CATV network. A VCR was used for each break in a playback sequence. Several vendors attempted to reduce the number of VCRs required by using an audio/video routing switcher to share the VCRs across multiple channels. The goal of this architecture was noble but the execution was very difficult. The difficult part in making a system like this work is the "smarts" required to have the right VCR, with the right ad copy, available at the right time. The varied and changing local break times and large variety of ad copy made it very difficult to come up with the perfect combination of VCRs containing the correct ad copy. If each VCR contained

Figure 6: Server break-buffer (digital)

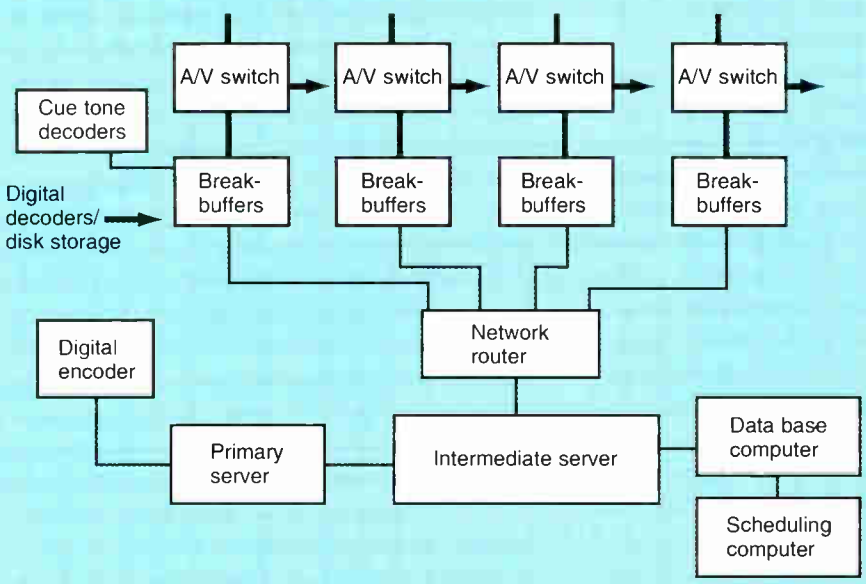
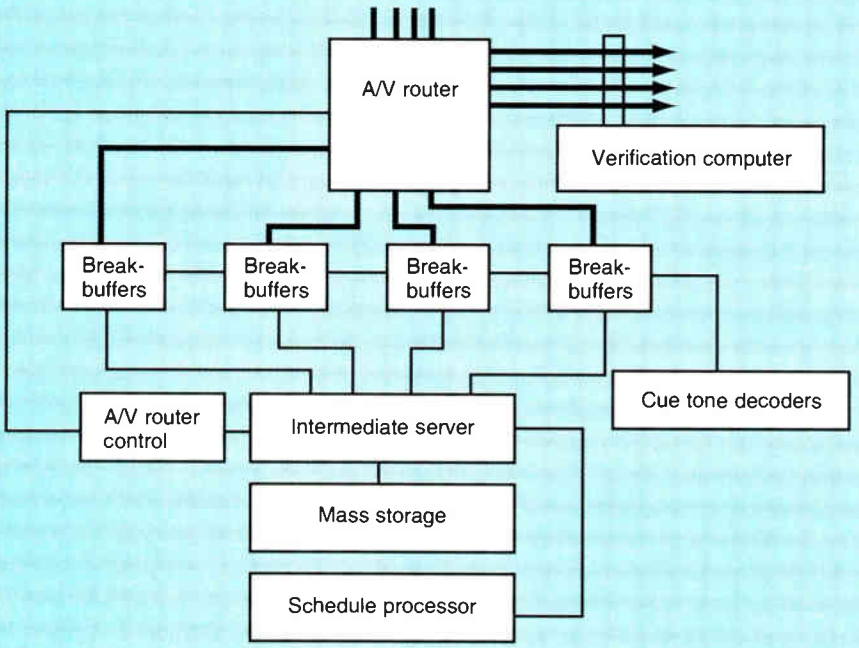


Figure 7: Server break-buffer router (digital)



the same ad copy the system online spot capacity was limited to 100 spots. (See Figure 5 on page 63.)

With this type of architecture, a central schedule processor and control computer were required. Having to rely on one computer and a sophisticated software package to operate the entire system created the opportunity for catastrophic failure. A single failure of a single component would bring the whole system down and no spots would run on any channel.

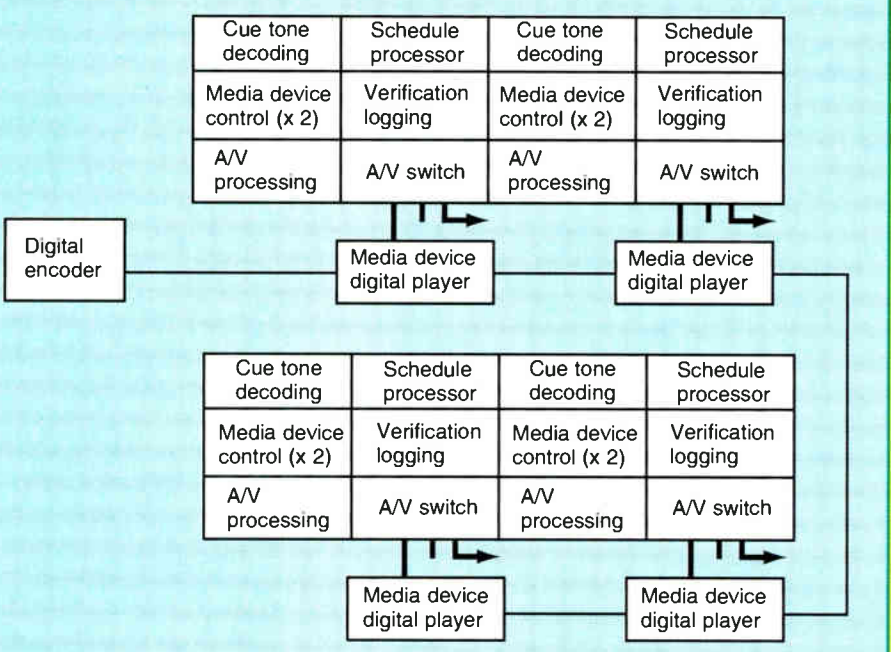
Compressed digital audio/video system

During the past two years various types of digital audio/video-based ad insertion systems have been developed. Some of these systems have been operational for nearly a year and we are beginning to see the results of different architectural choices. Designs have been influenced by ad sales management's desire to reduce system cost and size while providing scheduling flexibility and overall improved picture quality and reliability. Also, a prime design criteria is having the ability to air a last-minute spot within a few hours.

Some systems are using MPEG-1 compression while others are using MPEG-1.5. The use of MPEG-1 has proven to provide improved picture quality over fourth-generation U-matic VCR quality. In addition to improved picture quality, MPEG-1 users gain a big advantage in the speed and efficiency of spot distribution because of reduced file sizes. A 30-second MPEG-1 file requires from 7 to 12 megabytes of disk space. The same file using MPEG-1.5 requires 30 megabytes of disk space.

MPEG-1.5 users are enjoying the Betacam-like quality at an affordable price. Tape-based random access insertion requires two to four VCRs per channel. Digital playback devices offer the ability to play files back-to-back from one device. This reduction in hardware offers a much-reduced cost per channel. Using Betacam VCRs for cable ad insertion playback has been cost-prohibitive. Betacam is being widely used in the tape editing and compiling side of insertion and is an ideal source machine for MPEG compression workstations.

Figure 8: Component random access (digital)

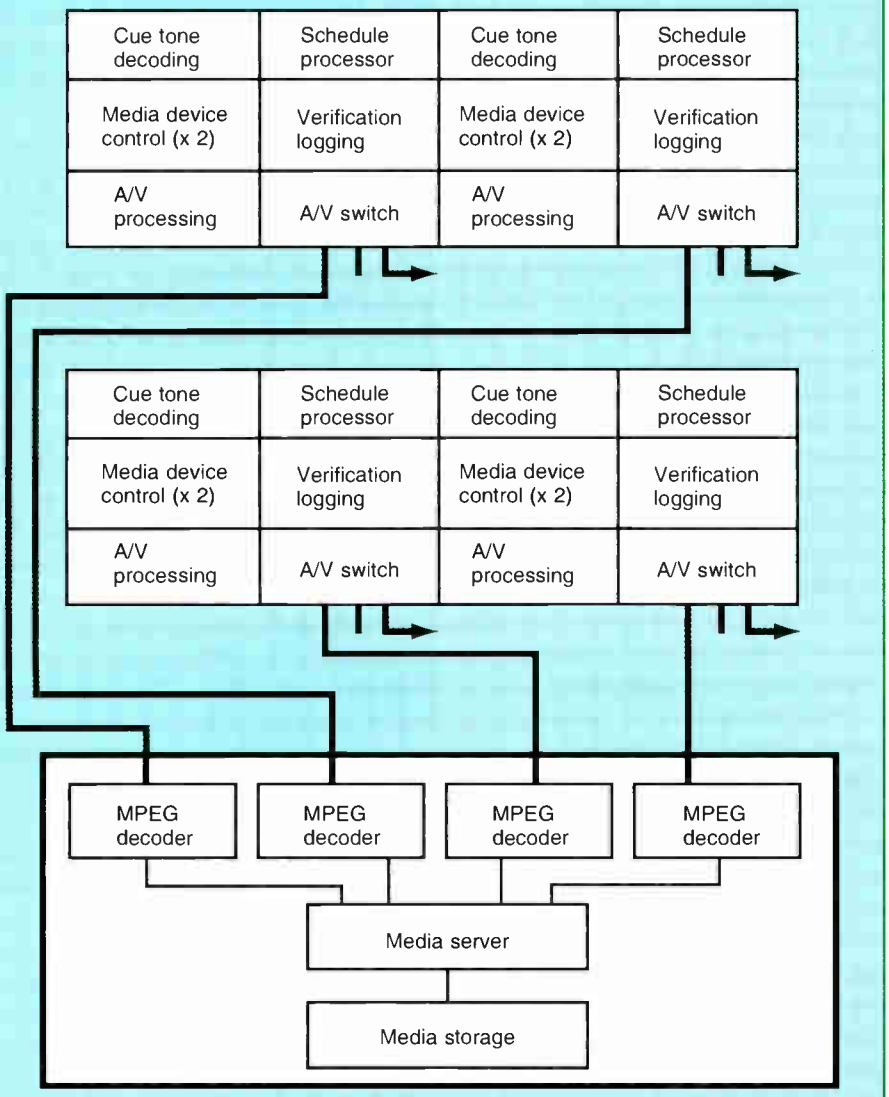


Server break-buffer (digital)

One of the first digital ad insertion systems uses an architecture referred to as server break-buffer. This system has individual computers for the staging and playback of digital spot files. The spot inventory resides on a central storage and distribution server. The spots are delivered to the break-buffers as they are needed. Schedule processing is handled by a central scheduling computer. Schedules are received by the traffic management system and stored in a large data base. The data base continually monitors the current time and looks for spots that need to be played. The break-buffers are connected to analog audio/video switchers that insert the decoded spot-files into the analog program streams. (See Figure 6 on page 63.)

The server break-buffer's primary design focus is scheduling flexibility. A central data base and scheduling software package is constantly watching the time and then commands the spots to be cued in the break-buffers just prior to playback. The just-in-time cueing facilitates last-minute schedule changes.

Figure 9: Component random access with video server media source (digital)



The spot can be aired in the time it takes to transfer the files from the central server to the play buffers.

This method does allow scheduling flexibility, but requires an excessive amount of disk storage. Spots are first stored in a primary server, a copy is made to a secondary server, and a final copy is placed in each buffer to be played back. Thus it takes three or more copies of a spot that take up to 30 megabytes of memory per copy.

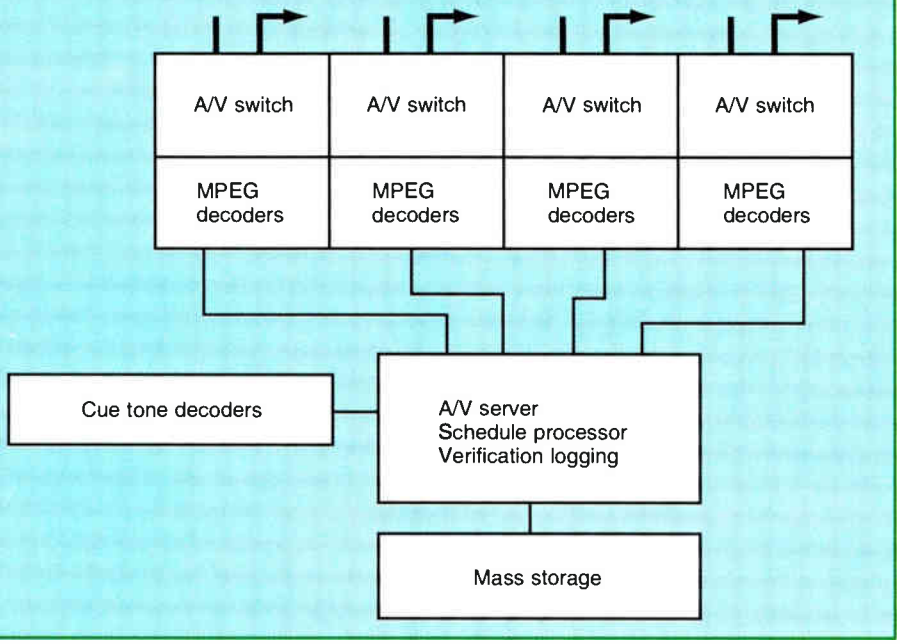
It is very risky to design an online revenue-producing TV system with many single components required for total system operation. Each link in a chain has a certain probability of failure. The total chain's chance of failure is the sum of each link's probability of failure. Thus, the chance of failure is magnified by each critical component. This system has multiple links. The central server, the secondary server, the data base scheduling computer and the network switching hubs are all critical components.

The ability to quickly diagnose a problem is very important with this type of system. When so many components are interrelated, identifying a failure is not so obvious. There is seldom a "smoking gun." Having nine different critical components in a system would require keeping one or more spares for each component. This could be quite expensive.

Server break-buffer router

An adaptation of the server break-buffer is a replacement of the individual switchers with a router. The router adds a level of complexity to the system, but

Figure 10: Integrated true video server (digital)



creates more flexibility and the ability to play spots from any break-buffer into any channel. If a break-buffer fails another break-buffer could be selected to insert on a particular channel.

This design offers the advantage of sharing break-buffers among channels. This reduces the number break-buffers required for a particular system. To operate in this manner does create a risk of network avail collision if the system is not properly planned or if networks change insertion time formats.

The system design also has some of the drawbacks of the previously mentioned server break-buffer design such as multiple single points of failure. (See Figure 7 on page 64.)

Component digital insertion

The component digital insertion system uses a similar architecture as the component tape-based system. As with the tape-based system, the component digital insertion system consists of redundant sets of equipment dedicated to individual or small groups of networks. (See Figure 8 on page 64.)

The component digital inserter has separate individual low-cost file servers controlled by a device that executes a schedule, decodes cue tones, performs audio/video switching and logs the spots run. Spots are loaded on the servers and can be shared across channels by automatic network transfers. No central storage servers are needed thus saving cost and eliminating single points of total system failure. For rapid recovery from failure, a back-up copy of a file can be automatically placed on a separate drive than the original copy. Failed digital players can be replaced by a spare and an automatic self-healing process can be executed.

The component digital architecture provides individual channel integrity because a failure in one insertion component will only effect the related network. The other networks can continue to operate with no loss of revenue. Another benefit of the component digital insertion system, is the ease at which the system can be serviced. Sources of problems can be quickly be identified. If a problem is noticed on a particular channel, the operator can immediately direct his attention to the equipment operating that channel. Because the system is constructed of smaller redundant components, spares can be stocked and put in service quickly when needed.

A central communication device is used to allow periodic schedule, verification and status information to be sent or retrieved from each control unit. This central communication device facilitates last-minute changes without being a critical online component required for hour-by-hour insertion.

In the component digital insertion architecture, application-specific hardware and software are packaged separately from the digital media source. This allows the system to be easily upgraded as media sources improve.

True video server

The video server with component control and switching combines the most cost-effective digital storage and playback with the most fail-safe control and switching architecture. A true video server is a device that can play a single digital spot file on multiple channels without making memory-intensive copies of the files. This ability drastically reduces the total system disk storage requirements. Also, the use of a single powerful computer is more cost-effective than having a break-buffer dedicated to each channel.

Having a central server does bring up the issue of a single point of failure. This type of architecture works best in a large system where spare or redundant servers could be afforded. The use of a RAID (redundant array of inexpensive drives) mass storage system eliminates the chance of a spot failing because of disk drive error while on-air. Redundant computer boards and power supplies minimize the chance of total system failure. (See Figure 9 on page 65.)

Integrated true video server

The integrated true video server will someday be the most ideal ad insertion system architecture. Not only is memory saved by eliminating the need for redundant files but separate scheduling and data base computers are eliminated. The central computer handles all spot file serving, scheduling, logging and switcher control.

This architecture pushes the current state-of-art of digital file-serving. Servers that could handle the complete insertion task are just being developed and are very expensive. This will be an ideal design for future large systems and someday, as costs fall, for all systems. (See Figure 10.)

Conclusions

Ad insertion systems have changed from generation to generation based upon the needs of the industry. As new technology developed, vendors have used it to improve ad insertion products. Recent breakthroughs in compressed digital video have created many exciting opportunities for the future. Along with the opportunities also is an element of risk. Rapidly evolving technology also means rapid obsolescence. The potential for technology traps are very real. Fifteen vendors have come and gone during the past 10 years. Without spare parts and ongoing service, even the most clever of systems is useless. **CT**

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Reader Service Number 51

Balancing act: Digital ad insertion over multiple zones

By R. James Kelso
Director of Engineering Operations, Advertising Sales
Cox Cable Communications

The future is zoned. Honest. And it's not just for telephony, personal communications services (PCS) and near-video-on-demand (NVOD) either. The future is zoned for cable ad insertion.

Zoning is a tremendous opportunity for cable ad sales. It makes cable advertising accessible to new levels of clientele, relieves pressure on inventory and significantly enhances cable's "targeted marketing" sales pitch. And that's just for starters. In its ultimate form, zoned ad insertion could let cable begin taking a bite out of the multimillion dollar direct mail marketplace. But zoning doesn't come cheap.

Zoning an ad sales operation can easily run to $250,000 per zone in capital costs alone. Add in the cost of keeping the zones supplied with commercials, either by bicycling tapes for analog systems, or via DS1s, DS3s or other forms of networking for digital, and the monthly outgo related to zoning becomes very significant.

These costs can be mitigated, however, with planning and a determined balancing of capital and networking costs. This article will show you how.

What is zoning?

From an ad sales perspective, zoning is the act of cutting up a marketplace so that different advertisements may appear in different sections of the market. This allows the media, in our case cable, to provide tightly targeted advertising to clients, which allows the advertiser to get results without wasting money reaching people who are not interested, cannot afford or do not need the product.

"By zoning, cable opens itself to new classes of advertisers, provides better service to existing ones, and offers a compelling service that competitors (namely broadcast) cannot duplicate."

For some products, zoning is not appropriate. Take toothpaste, for instance. We all use (or at least most of us use) toothpaste. Geography and demography make little difference. Say, however, that the product is a supermarket and that the advertiser's goal is to get people to come to his supermarket instead of others. There may be geographic factors that limit the number of people willing to come to that supermarket in the first place. For example, there may be a river or an interstate that people are unwilling to go to the trouble to cross to do their shopping. There certainly is a distance limitation. In a suburban setting, how many people are willing to drive 10 miles to go to a particular supermarket, passing three others on the way? In this instance, advertising to only a particular zone and perhaps using the money saved to produce more ads or advertise more frequently may make some sense.

The bottom line is that advertisers spend significant amounts of money to determine not only who their customers are but also where they come from. Then they purchase their media based on who can best satisfy their needs. By zoning, cable opens itself to new classes of advertisers, provides better service to existing ones, and offers a compelling service that competitors (namely broadcast) cannot duplicate.

Designing digital zoned insertion

This article will focus primarily on the design of a multiple-zone digital insertion system. We will not address analog zoning. Analog zoning presents its own set of complications that are outside the scope of this article. Further, for installations of any size (more than four or five zones), digital insertion will be cheaper (in terms of annualized costs) and significantly less masochistic than deployment of analog.

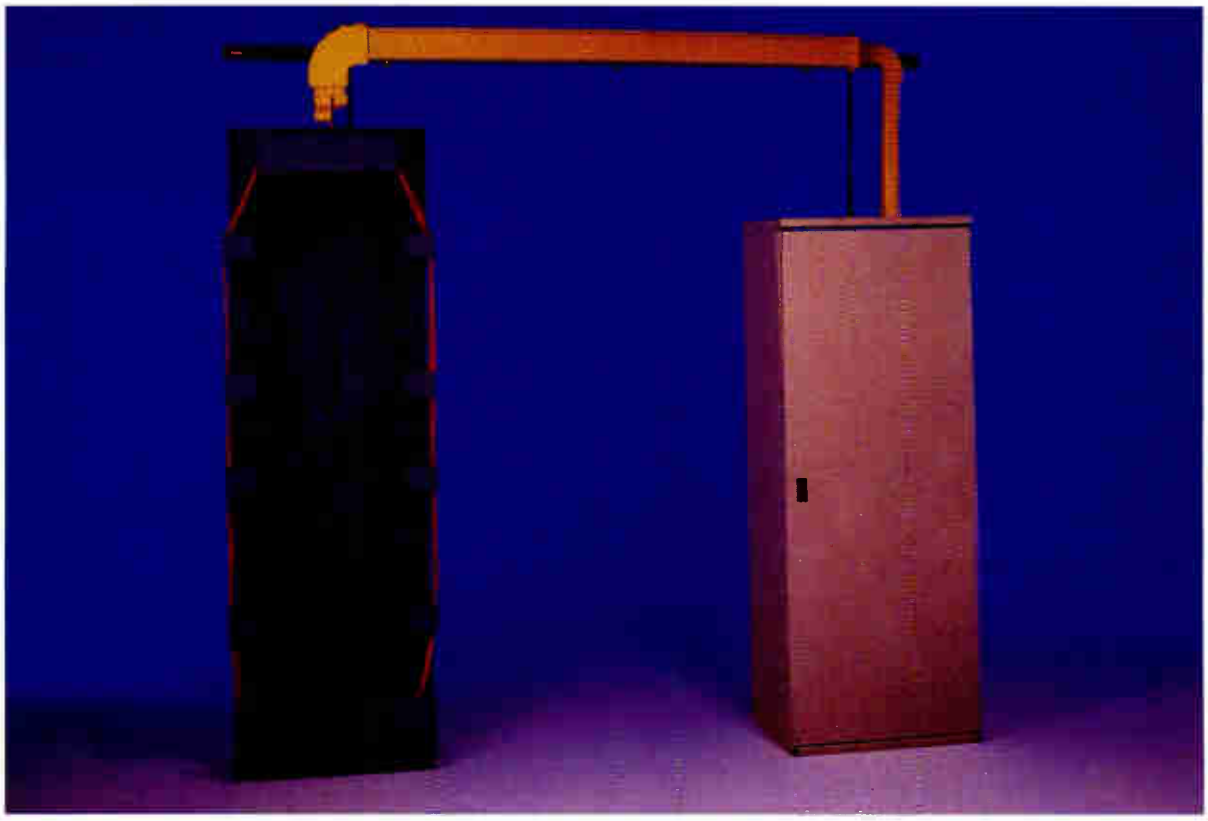
There are three primary factors to consider when designing a zoned digital insertion system: point of insertion, storage hierarchy and networking costs. By balancing these three factors, you can minimize the effective cost of zoning.

Point of insertion

Despite the impact it can have on your cost, point of insertion is a fairly straightforward issue. Today, all of the available ad insertion equipment inserts only into baseband audio and video. The insertion point for a zoned system should therefore be the deepest possible point in your system where baseband audio and video are available. If you have subheadends where this is the case, you may already have natural zones. If this only occurs in the master headend, you will need additional modulators and transport gear for each zone. This can get expensive.

For discussion purposes, let's call the former situation, where subheadends exist and zone-specific insertions can be performed in each subheadend, a

Fiber Optic Cable Management Products



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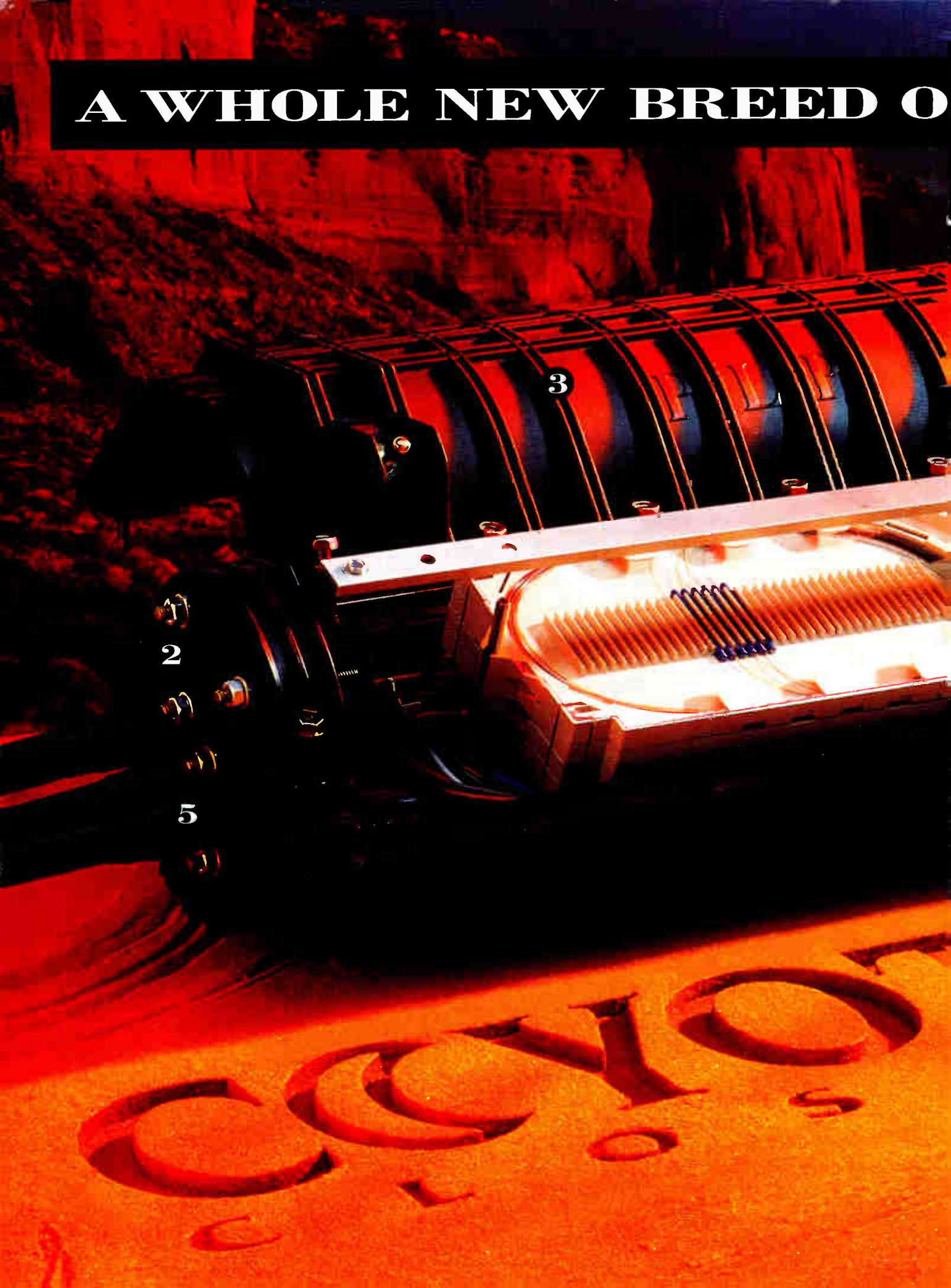
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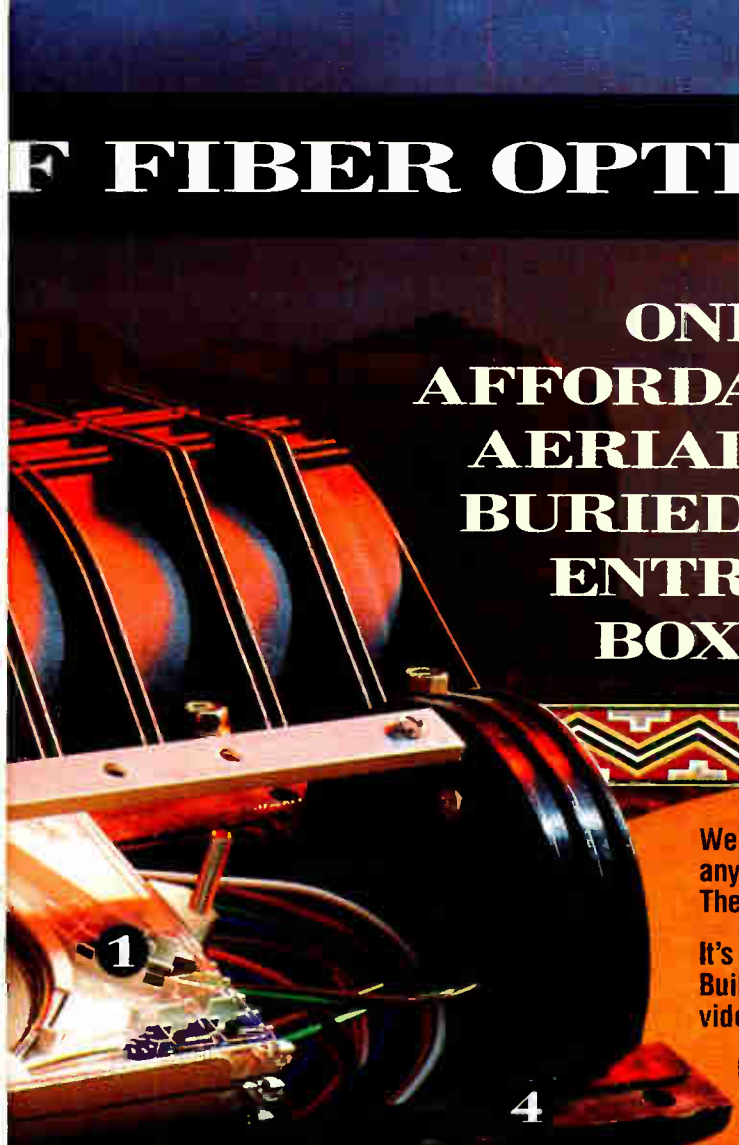

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distributed configuration. This solution does not require additional modulators, etc., but does pose its own challenges in terms of networking because the various subheadends must be connected to the library server (which we'll discuss later). Note that this same solution would apply to situations where multiple headends, perhaps across multiple MSOs, are being sold by a single ad sales operation that wishes to air different commercials in each headend's (or MSO's) territory.

The latter and more common situation we'll refer to as a single-location solution. In this case, the entire system is served by a single headend and zoning must be accomplished by the use of not only additional insertion gear, but additional modulators, a complicated combining network and discrete lasers. This solution is much simpler in terms of networking, but obviously has significant expenses tied to the additional modulators, lasers, etc.

Storage hierarchy

Storage hierarchy is a somewhat more complicated topic. The amount of storage deployed in the system and where it is deployed plays a significant role in determining the cost of your system, and getting it just right requires a fair amount of thought.

Let's look at the need for storage. First and foremost, a digital insertion system requires some form of library to store spots between the time they are encoded and the time they are needed for playback. These libraries are usually large, storing 1,000 or 1,500 commercials.

Second, a digital insertion system needs a smaller amount of storage for each playback unit. This storage is used to temporarily store commercials needed for the next insertion event so they will be readily accessible and the information can be spooled to the decompression card at high speed and without interruption.

This is, however, temporary storage only and must be updated after each commercial break with the material needed for the next one. In a small system, the playback units might be updated directly from the spot library. As systems become larger, though, this becomes impractical as the library's ability to keep up with the demand for new spots becomes compromised.

In such systems, a third level of "intermediate" storage is used. This storage takes the form of a secondary or zone server that sits between the library server and the playback units. One zone server is used for every 10-20 networks and this allows the demands for new commercial breaks to be spread out over multiple units rather than overwhelming the library server. This system works because commercials are frequently similar across the various networks and while each insertion unit needs its own copy, the commercial only needs to be moved from the library to the zone server once. One transfer from the library server to the zone server services multiple transfers between the zone server and the individual insertion units.

Picture, for example, a system with three zones and 15 channels per zone. Such a system might have one library server, and three zone servers. Each zone server would have playback units attached to it providing commercial insertion for that zone. The zone servers each keep 15 playback units updated and ready to play. They, in turn, are supplied with single copies of the various spots by the library server. In this manner, the library server only has to talk to three servers, copying a spot a maxi-

"The task when building a distributed system is to identify the combination of bandwidth and zone storage that minimizes your networking costs without sending your hardware costs through the roof."

mum of three times, rather than trying to keep up with 45 different insertion units.

Networking cost

Some network connection obviously has to exist between the zone server and its insertion units as well as between the master server and each zone. Further, the network connections have to have sufficient bandwidth to ensure that the servers do not fall behind in their update tasks. This is where our third factor — networking cost — comes into play.

If you have a single-location system, where all of the pieces are in one headend, networking cost really isn't an issue. You may spend a few thousand on high-speed FDDI cards and fiber to connect the servers, but there will be no recurring cost.

However, if you have a distributed system, with subheadends, you will need a larger-scale method of interconnecting the single library server with the various zone servers. To accomplish this, you will either need to commandeer some dark fibers on the cable system or you will have to go outside to the local common carrier to obtain the network pipes you need. Unfortunately, this can cost anywhere from less than $500 per month for a DS1 to more than $5,000 per month for a long-haul DS3.

In a distributed system, the frequency with which the zone servers need to be updated will dictate the size of the network connection needed. If it turns out that you need a network of DS3s to keep your system running, you may find yourself reconsidering the whole proposition. This, however, is where the balancing concept comes into play.

Simply stated, you can increase the amount of storage in the zone servers to reduce the frequency of updates and reduce the size of your network pipes accordingly. For instance, if the zone server has enough storage to handle an entire day's worth of spots, then updates from the master server will only be required on a daily basis and only new or changed video will need to be transferred. Further, you will have an entire day to accomplish the update. This allows for lower bandwidth and therefore lower cost connections between the library and zone servers, perhaps as small as a single DS1. Conversely, if the zone server only has enough storage to hold, say, the next six hours worth of spots, updates will have to come much more frequently. It may be necessary to resend spots that had been used earlier in the day but not within the last six hours. This configuration would require a higher bandwidth connection.

The task when building a distributed system is to identify the combination of bandwidth and zone storage that minimizes your networking costs without sending your hardware costs through the roof. To do this, first determine the absolute minimum network bandwidth required. While no good rule of thumb exists for determining the minimum network bandwidth required, common sense can help make the determination.

Begin by looking at the number of new spots that come in to the operation on a daily basis. The library server will need at least enough bandwidth to move one copy of every new spot out to each zone server, assuming that all new spots air the next day. Leave yourself significant headroom in this figure. You now have the first component of minimum bandwidth.

The second part of the determination is to evaluate how many other spots already on the system will need to be changed out on a day-to-day basis. This is a tough number to get your arms around, but by involving the traffic staff, you may be able to get a rough approximation. Again, leave significant room for error in this figure.

Lastly, evaluate the amount of housekeeping traffic that will have to flow across the network on a daily basis. Individual digital insertion vendors can give you a good idea of what this number looks like. Combine the three components and you will have your absolute minimum bandwidth.

Note that we have assumed in determining the minimum that updates will only occur daily. If you wish to be able to change out spots more frequently, you will need to account for that in your calculations.

Compare the minimum bandwidth required against the various networking options available to you. If you find that you have excess capacity, you may be able to reduce the size of the storage devices in the zone servers. If you do not have enough capacity, you will need to look for another networking method.

From here you can begin to compare costs and look at the cheapest method of implementing zoned insertion. Allow plenty of headroom in terms of network bandwidth but try to minimize recurring costs. By balancing bandwidth and storage you should be able to zone in a reasonably inexpensive fashion.

Summary

One last tip: Learn from the mistakes of those who went before you. Ask your insertion vendor about configurations that have worked well for their previous clients and about those that haven't. Involve the company heavily in the planning process. While it is important to understand the issue and your options, be sure to draw on your vendor's experience as well. By doing both, you can create a zoned digital insertion system that is a revenue enhancement rather than an expense anchor. **CT**

Testing digital video — Part 1

Part 1 of this article will deal with measuring power and interference in digital video. New measures of digital modulation quality will be introduced and explored in Part 2.

By Helen Chen
Development Engineer
Hewlett-Packard Microwave Instrument Division

Digital transmission is the key enabling technology that will allow cable systems to deliver a multitude of emerging services. High spectral efficiency, robust resistance to ingress and high flexibility permit the installation of premium digital services such as video-on-demand (VOD), personal communications services (PCS) or commercial data transport. Subscribers will view these new capabilities with new expectations of high-value, dependable service. As telcos and cable companies compete to deliver digital services, a key differentiator will be the quality and reliability of service. →

"Providing emerging digital video services will require not only power and interference tests but also direct measures of the integrity of the transmitted data."

Figure 1: Block diagram of a digital modulator

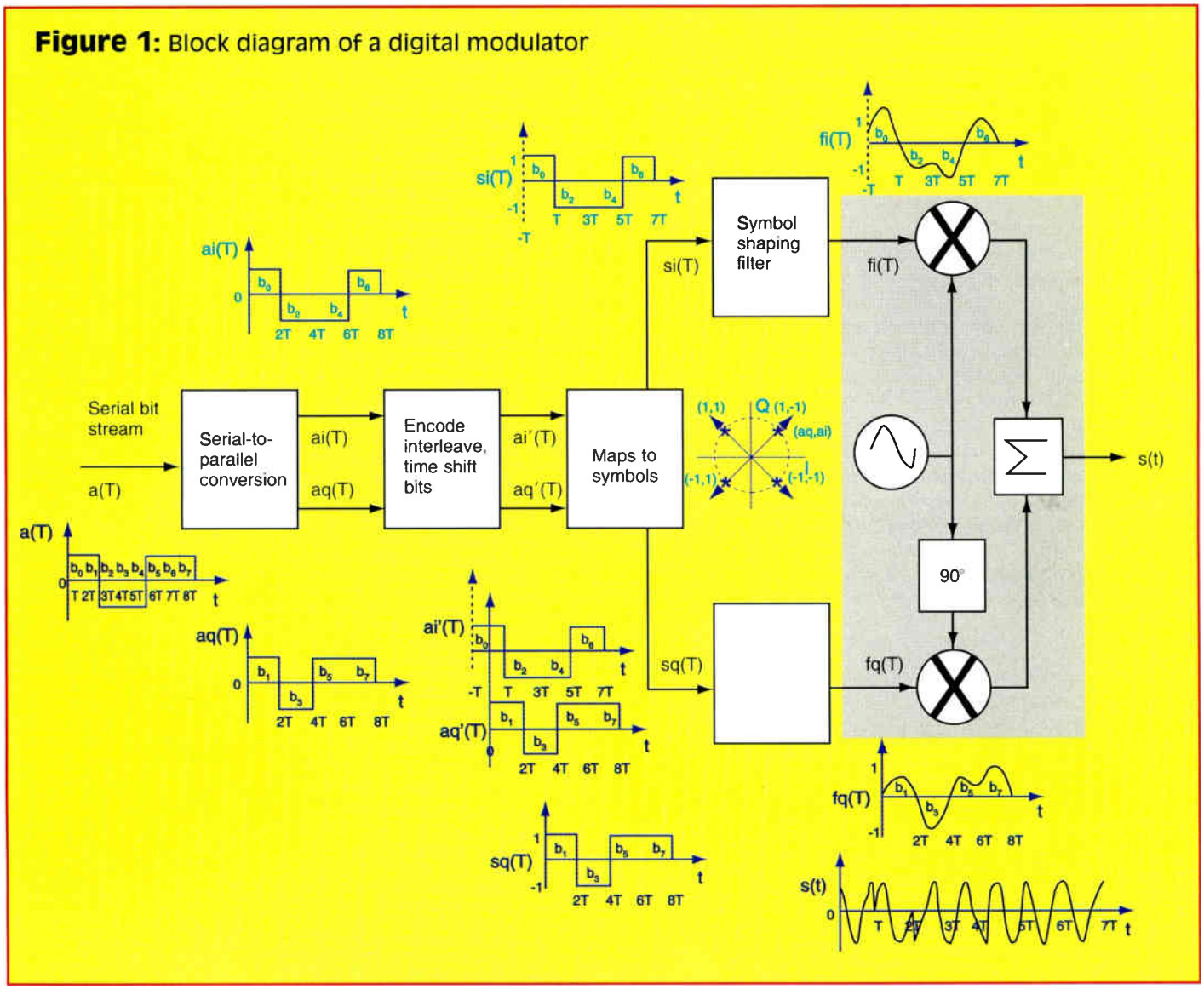

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Figure 2: Unfiltered 64-QAM at 4.167 Msymbols per second

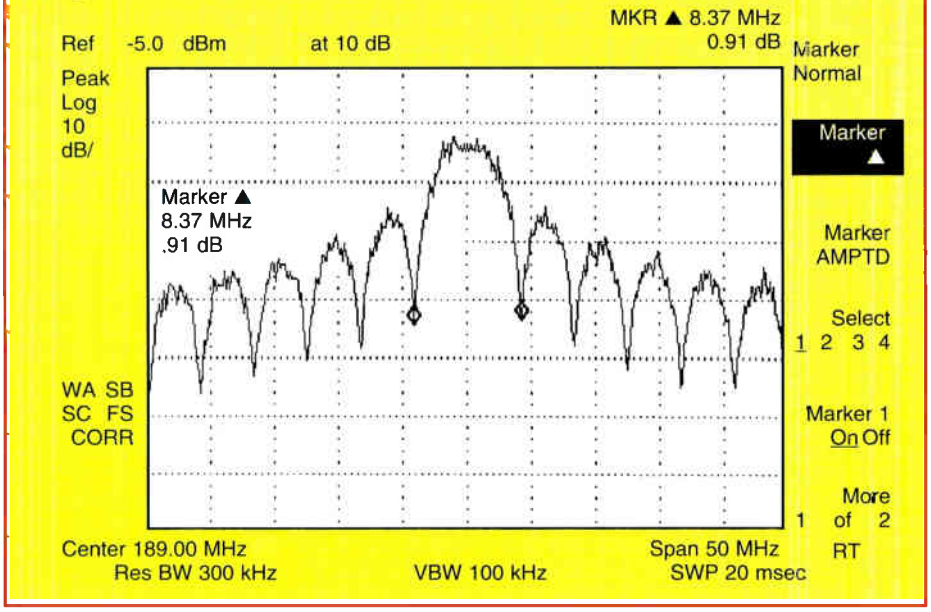
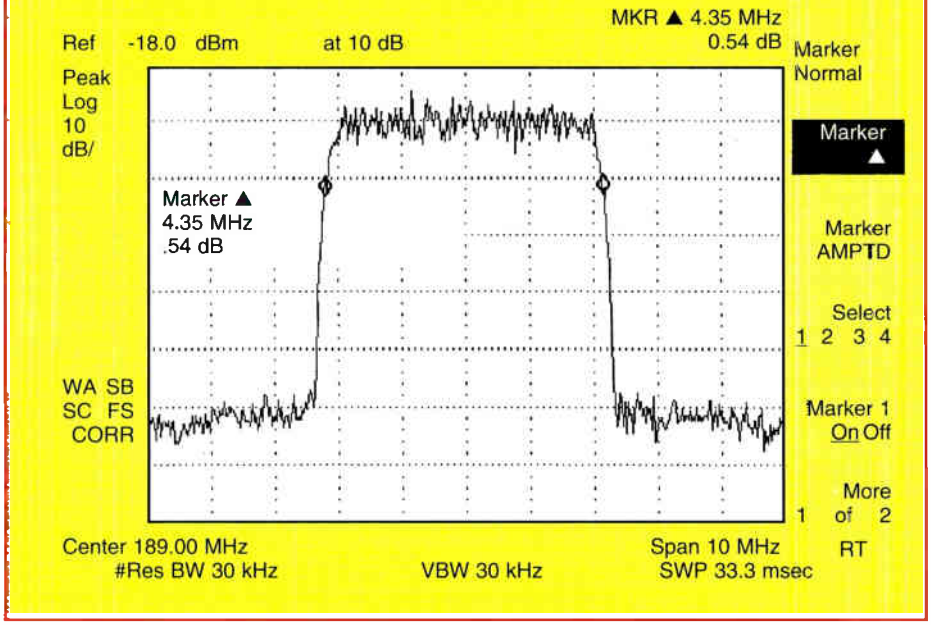


Figure 3: Spectral sidebars removed



Ensuring the quality of service requires testing digitally modulated signals. As in an analog cable TV system, power and interference measurements are essential to maintaining digital cable TV services. Although the effects are different from impairments on an analog TV signal, amplifier compression and spurious interference will degrade digital video signals.

Evaluating the digital portions of a cable system will include extending the traditional tests of the analog TV signal. In this article, we'll explore the key features of a digitally modulated signal, looking at basic characteristics in the time and frequency domains. These key characteristics define new considerations when measuring average power, peak power and spurious interference of digital transmissions. Correctly measuring the power and spectrum of digital video and audio requires consideration of the features of digital modulation.

Forming a digital video signal

All digital modulation formats define how bits correspond to carrier phase and amplitude and how transitions between bits are made. Digital modulation formats often associated with cable systems are 16 vestigial sideband (16-VSB), 64 quadrature amplitude modulation (64-QAM), and offset quadrature phase shift keying (OQPSK). These formats share common characteristics in the time and frequency domains, driving common needs for measuring power and interference. A general block diagram for a digital modulator is shown in Figure 1 on page 76. Example waveforms for OQPSK are also shown in Figure 1 for each point in the modulator. Cable digital audio services are often delivered to the headend using the OQPSK format.

A serial digital bit stream, a(T), contains digitized program information. In the first stage of the modulator, a(T) is split into parallel bit streams. For OQPSK, two parallel streams are formed, corresponding to $2^2 = 4$ possible symbols. The two parallel bit streams, ai(T) and aq(T), may then be encoded, interleaved and time-shifted. This data manipulation adds error correction and influences the shape of the modulated signal spectrum.

In OQPSK, the parallel bit streams are shifted by one bit period, limiting the maximum phase change of the carrier as the bits are transmitted. The one bit offset limits the OQPSK carrier phase to an increase or decrease of 90° in each symbol period, limiting the spectral sidelobes of the signal. Next, the bit pairs, ai'(T) and aq'(T), are mapped to corresponding symbols in the in-phase and quadrature (I/Q) plane. These vectors, si(T) and sq(T), are the baseband in-phase (I) and quadrature (Q) components of the digital modulation.

At this point, the symbols are filtered with a shaping filter to control the spectrum of the modulated signal. Commonly used filters are raised cosine, root raised cosine or Gaussian shapes. In vestigial sideband formats, such as 16-VSB, vestigial sideband filtering may be incorporated at this point. The filtered baseband I/Q signals, fi(T) and fq(T) are sent to a quadrature modulator and transmitted.

Key features of digital modulation

In the frequency domain, digital modulation produces a noise-like spectrum. This spectrum's bandwidth depends on the symbol rate, coding and filtering used. Figure 2 shows the spectrum of unfiltered 64-QAM at 4.167 Msymbols per second (25 Mbits per second). After filtering with a raised cosine filter (alpha = 0.1), the spectral sidelobes are removed, as shown in Figure 3. The spectrum of the filtered

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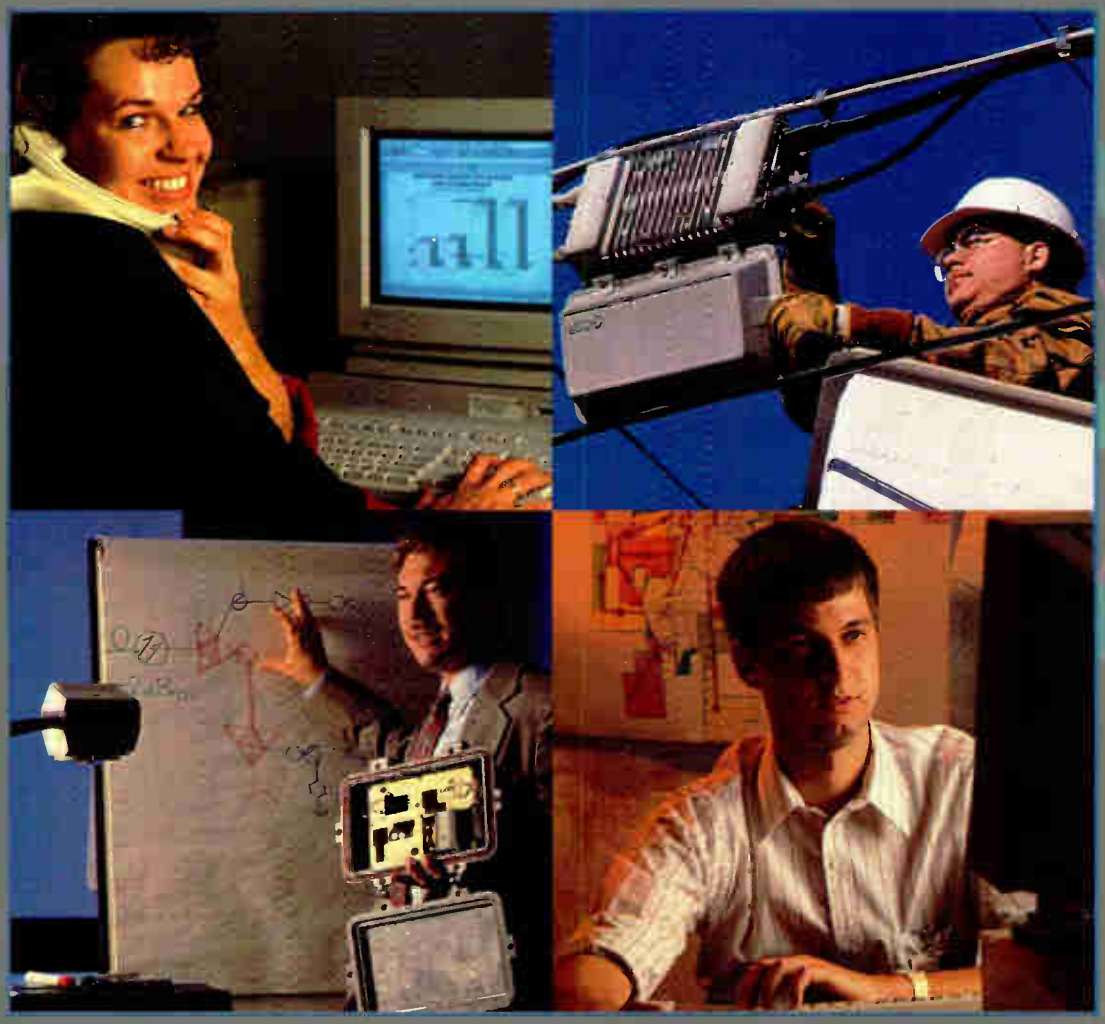

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Figure 4: Time domain picture of 16-VSB signal

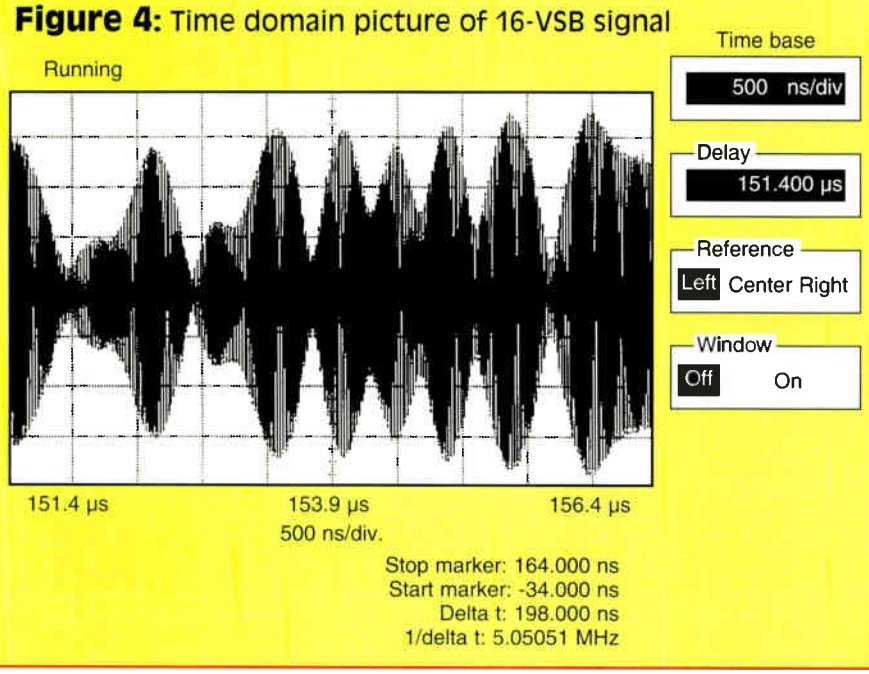
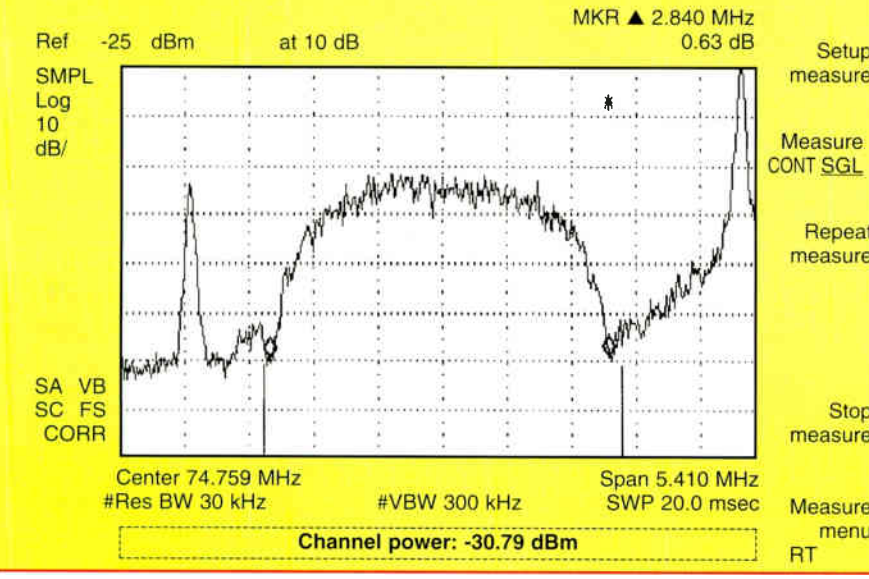


Figure 5: Automatic average power measurement



64-QAM is restricted to about 4.5 MHz.

Note that the broadband digital video signal is susceptible to spurious interference across the entire channel bandwidth making control of analog and digital transmission spurs critical. Proper symbol filtering avoids spilling interference from a digital channel into adjacent video channels. Measuring spectral spillover into adjacent channels is a good way of confirming properly filtered digital modulation.

In the time domain, digital modulation results in amplitude and phase variations that depend on the data sequence. Since the data is usually randomized, amplitude and phase changes are random.

Figure 4 shows a time domain picture of a 16-VSB signal, showing the random occurrence of signal peaks over a 25-symbol transmission. Peak signal excursions are controlled by the format mapping and filtering. Interaction of the exact symbol sequence with the shaping filters often yields a peak amplitude that is much higher than the average amplitude. Peak power of digital transmissions can be 6 to 10 dB higher than the average power. Preventing amplifier compression (and the resulting intermodulation interference in the cable system) requires reducing the average transmission power to accommodate peak powers. Proper adjustment of signal levels requires measuring peak and average power.

Measuring average power

Maintaining the proper average transmission power is a key adjustment made in cable systems for digital as well as analog signals. Unlike the narrowband measurement of analog visual carrier level, testing average power of a digital transmission is a wide bandwidth measurement.

One method of measuring average digital video power is to use a filter and a power meter. The filter must be flat across the entire channel bandwidth (6 MHz wide in the United States). A sharp filter roll-off will remove undesired contributions from adjacent channels. Rejection in the stopband should be at least 50 to 60 dB. The digital video signal is applied to the filter and power sensor, reading the true average power. This method is accurate and inexpensive.

Note that the power meter or signal level meter must have sufficient bandwidth and frequency range to handle 6 MHz wide signals at up to the highest carrier in the cable system, optimally up to a 1 GHz carrier frequency. One filter is required for each channel to be tested, unless a tunable channel filter is available.

A second way of measuring average power uses a spectrum analyzer. Average channel power measurement begins with obtaining a swept trace of the spectrum, centered about the carrier frequency. This is a job the spectrum analyzer is optimized to perform. A spectrum analyzer trace is constructed from a series of readings of the power level at small discrete steps in frequency. Average power is calculated by averaging the power values at each frequency in the trace within the desired channel.

Note that the spectrum analyzer may not have traditional square-sided, flat-topped filters used to measure noise-like signals. The calculated average power must be corrected for the shape of the filters actually used in the analyzer. This is typically done automatically within the spectrum analyzer. Figure 5 shows an automatic average power measurement in a spectrum analyzer on a cable digital audio signal. Power readings in the portion of the trace between the two vertical lines at the bottom of the screen are used to obtain a true power average. Instrument software optimizes the accuracy of the measurement, adjusting the spectrum analyzer settings

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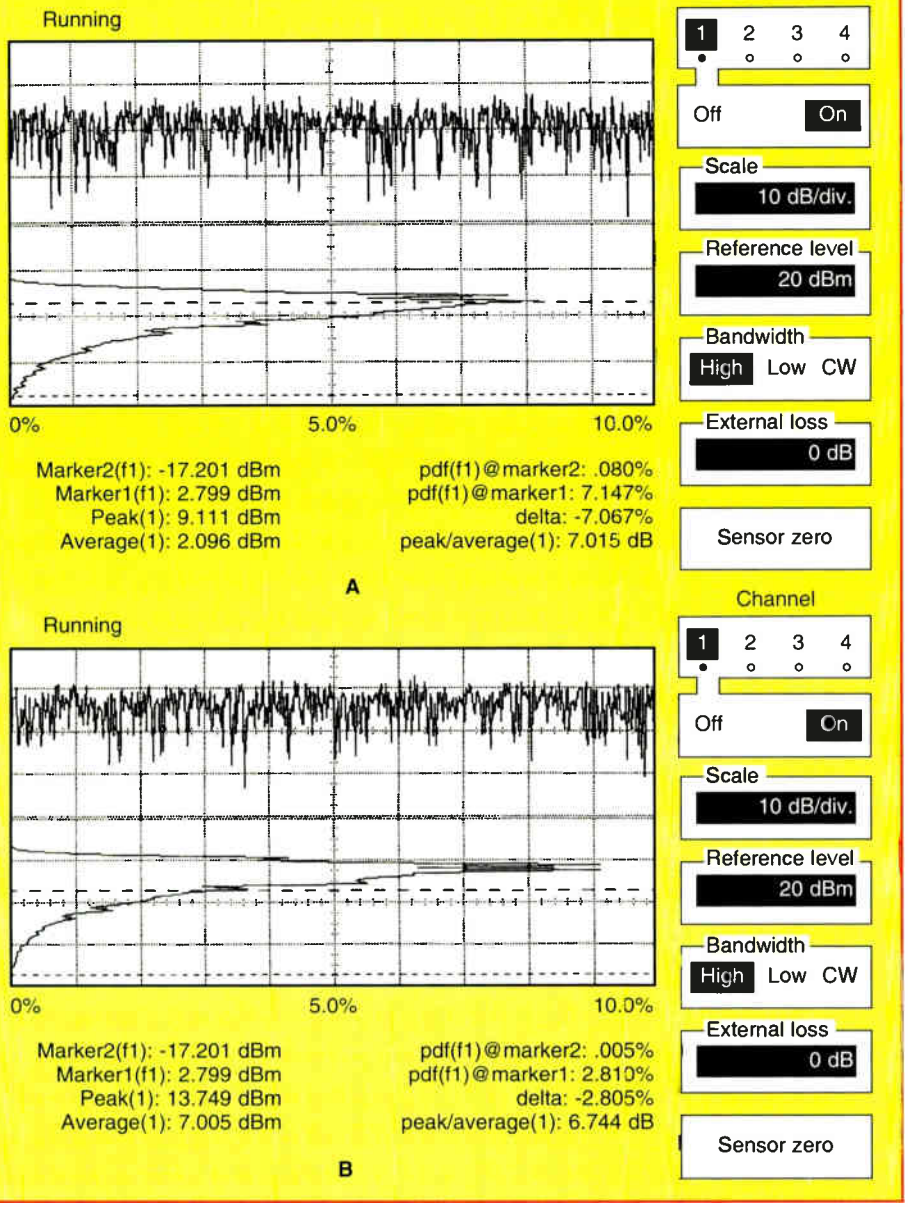
Figure 6: Peak power meter measurements



and applying the internal filter correction. This simple method of measurement can be used across the full frequency range of the spectrum analyzer over any desired bandwidth, eliminating the need for external channel filters. The accuracy of the power reading can be optimized to within ±0.5 dB, slightly less accurate than a well-calibrated power or signal level meter.

Measuring peak power

Proper adjustment of a digital transmission system includes measuring both peak and average power. A good peak-to-average ratio is an indicator of accurate, linear digital modulation. Unlike the analog video horizontal sync tip, a digital video signal has random amplitude peaks of very short duration, depending on the symbol rate and data sequence. Measuring peak power on a digital transmission requires an instrument fast enough to accurately catch the signal peak. The measurement must be made over a relatively long time interval to be certain of catching intermittent peak power points. Testing peak power requires assessing the acceptable level of certainty that the measurement is long enough to catch signal peaks.

Peak power is typically measured using a peak power meter. The peak power meter samples the signal rapidly, repeatedly taking snapshots of the signal. The instrument sorts the samples, displaying the distribution of the amplitude variations of the digitally modulated signal.

The upper display in Figure 6A shows a high-quality 16-VSB modulated signal measured on a peak power meter. The instrument displays the sampled snapshot in the upper window and the accumulated power distribution over many snapshots in the lower window. The peak-to-average ratio is 7.015 dB, after acquiring 140,000 samples over four minutes. Figure 6B displays the same measurement on a slightly compressed 16-VSB signal. The 5 dB of gain was added with an amplifier, yielding a 5 dB rise in the average power. The peak power rises only 4.64 dB because of compression of the signal peaks. Note the compression of the peak-to-average ratio to 6.744 dB over a 4-minute measurement interval.

As the digital formats for cable transmission develop, the correct peak-to-average power ratio for each format will be defined. Choices on symbol shaping filters and clock/carrier synchronization strategies will affect the exact peak-to-average ratio for both 16-VSB and 64-QAM formats. Cable operators will need this information to adjust amplifier cascades to accommodate digital video.

Spurious interference

Optimizing the cable system to serve the maximum number of subscribers usually means setting power levels to accept a known level of signal distortion. Analog video distortion yields intermodulation products, narrowband spurs spread across the cable channels. The digital video signal is sensitive to discrete spurs across the entire signal bandwidth — nearly 6 MHz. Spurs can add phase rotation to the digital modulation phase shifts, causing the demodulator to misinterpret the received phase, yielding symbol errors. The picture artifacts caused by spurious interference to a digital transmission depend on the exact format used. Traditional spurious tests, such as composite second order (CSO) and composite triple beat (CTB), will be essential to maintaining a high-quality environment for digital video transmissions.

If power levels are set to distort digital video signals, digital transmissions will spill noise-like interference into adjacent NTSC channels. The exact effect of this excess noise depends on the location of the noise relative to the visual and aural carriers. A weighting curve for digital interference across an analog channel must be developed to specify the acceptable level of digital spurious spillover. Experiments on perceptible digital noise levels at various locations

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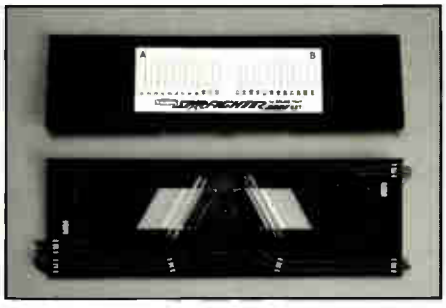

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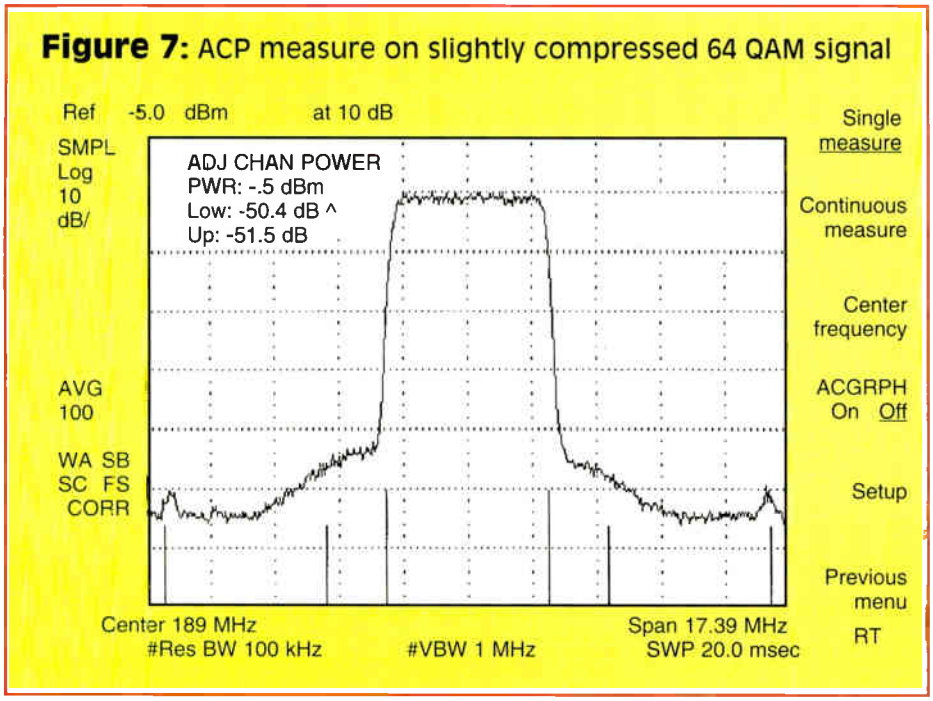
Figure 7: ACP measure on slightly compressed 64 QAM signal



"New metrics such as bit error rate, modulation error vector measurement or eye diagrams may become standard cable test strategy."

in an NTSC channel can establish these test limits. Cable operators can then use these limits to adjust the digital video levels in their systems.

Measuring adjacent channel power

The consequences of digital video distortion can be seen in the frequency domain. Very low distortion levels cause the spectrum of a digital video transmission to spill into adjacent channels, interfering with both digital and analog services. If the adjacent channel does not contain an active transmission, measuring out-of-channel interference can be a sensitive detector of low level distortion. Measuring out-of-channel power can be done using the same methods as those used in measuring average in-channel power. Adjacent channel power (ACP) is a measure of the amount of power spilled into adjacent channels. ACP can be measured either as a ratio to total average power or as an absolute power level.

Use either the spectrum analyzer or a filter and power meter to measure the average power of the digital transmission. If the spectrum analyzer is used, the analyzer is then tuned to the upper or lower adjacent channel. If a power meter is used, the channel filter is exchanged for a filter centered about the upper or lower adjacent channels. The average power in the adjacent channel is obtained, and compared to the in-channel power.

Figure 7 shows the ACP measurement on a slightly compressed 64-QAM signal using a spectrum analyzer. Note the graphical display of spillover in the adjacent channel. A weighting curve may be automatically applied in the analyzer to assess the real impact of digital noise on an adjacent transmission.

Conclusions

Testing cable TV digital transmissions is essential to realizing the benefits of the new services, regardless of the digital modulation formats used. Optimizing the cable plant to deliver reliable, high-quality digital service to the maximum number of subscribers requires the cable operator to accurately measure the characteristics of digital and analog signals. Average power and peak power tests must correctly measure digitally modulated signals. CSO and CTB measurements are used to assess analog-to-digital spurious interference. An adjacent channel power test can quantify digital-to-analog interference. The instruments used to measure analog signals can be adapted to digital video transmissions.

Providing emerging digital video services will require not only power and interference tests but also direct measures of the integrity of the transmitted data. New metrics such as bit error rate, modulation error vector measurement or eye diagrams may become standard cable test strategy. **CT**

References

1) *HP 8591C Cable TV Analyzer Cable TV Measurements User's Guide*, HP Part Number 08591-90105.

2) Thomas, Jeffrey L., *Cable Television Proof-of-Performance*, PTR Prentice Hall, 1995.

3) Chen, Helen, "Time Division Multiple Access (TDMA) Transmitters: Characterizing Power, Timing, and Modulation Accuracy," 1993 Wireless Communications Symposium, Hewlett-Packard, pages 93-118.

4) "Grand Alliance HDTV System Specification," Version 1.0, April 14, 1994.

5) Pasupathy, Subarayan. "Minimum Shift Keying: A Spectrally Efficient Modulation," *IEEE Communications Magazine*, Volume 17, Number 4, July 1979, pages 14-22.

6) *Working Draft Standard IEEE BTS Committee G2.2. Draft for Standard Test Methods for Measuring Digitally Modulated Signals in Television Transmission Systems*, pages 1,380-1,381.

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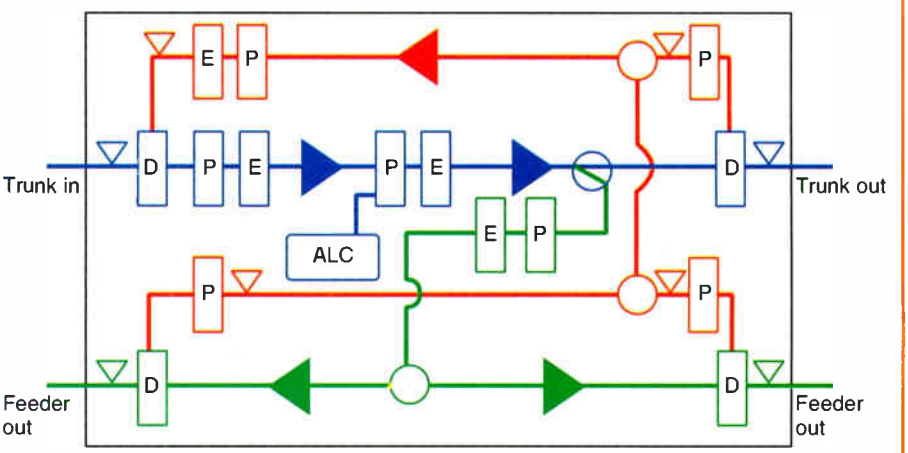
Modern amplifiers for modern systems

By David L. Franklin
Senior Project Engineer, Time Warner Cable

Time Warner Cable has been in the process of upgrading a significant amount of its plant for the last couple of years. Our upgrades have, of course, included great quantities of optical cables that extend deeply into the plants providing the appropriate RF spectrums to relatively short amplifier cascades (typically six amplifiers or less). These amplifiers constitute the "last mile" of our plants, even in the modern hybrid fiber/coax (HFC) style architectures and contribute greatly to the system's end-of-line performance and overall reliability.

In the process of our upgrades we determined that we needed to redefine the form and features of the required amplifiers in order to improve their reliability and performance and to reduce basic equipment costs. This article will introduce the reader to some of our ideas concerning these issues.

Figure 1: Time Warner's Type 1 amplifier



P = Pad/pin diode attenuator
E = Equalizer
D = Diplex filter
▽ = Test point
ALC = Automatic level control
Blue = Trunk path
Green = Feeder path
Red = Return path

Amplifier types and functions

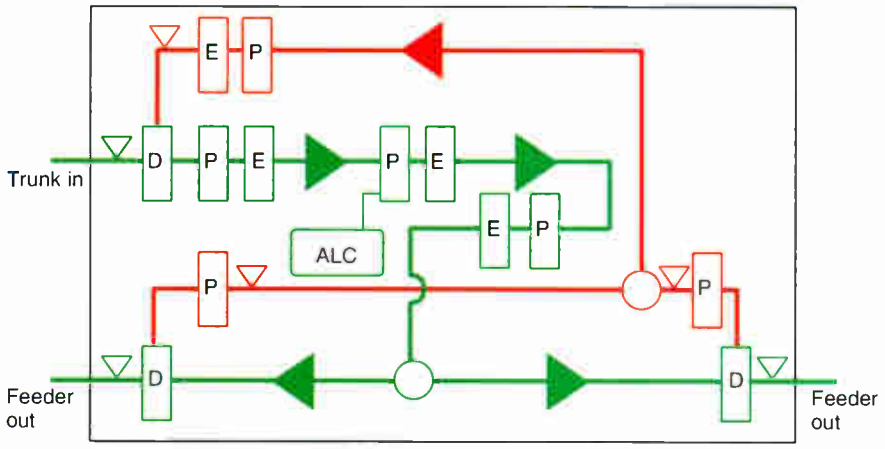
Type	Function
1	Trunk and bridger (two ports) with automatic level control and return amplifier
2	Terminating bridger (two ports) with automatic level control and return amplifier
3A	Line extender with automatic level control and return amplifier
3T	Line extender with thermal level control and return amplifier
3M	Line extender with manual level control and return amplifier
4	Trunk-only with automatic level control and return amplifier

Type designations

We began by identifying amplifiers by "types" to differentiate them from the standard models then available. The functions to be performed by individual type of amplifier really did not change all that much, but some limitations were established in order to achieve the certain cost targets.

The accompanying table lists our "type" designations and the functions performed by each. Figures 1 (this page), 2 (page 88) and 3 (page 91) are simplified block diagrams of amplifier configurations. There is no figure for the Type 4 configuration because it is really just a clone of Type 3A, using the same hy-

Figure 2: Time Warner's Type 2 amplifier



P = Pad/pin diode attenuator
E = Equalizer
D = Diplex filter
▽ = Test point
ALC = Automatic level control
Green = Feeder path
Red = Return path

brids and automatic level control (ALC) circuitry.

The Type 1 amplifier has one output for trunk system needs, meaning that it generally operates at a lower signal level than the two feeder outputs. Trunk outputs are normally in the range of +37 to +40 dBmV while the feeder ports each deliver approximately +44 to +48 dBmV. The same feeder operational levels apply to the Type 2 amplifier, which can be used as either a terminating bridger or an intermediate bridger with an external splitter or coupler used to provide input signals. Line extender output levels are usually set to levels similar to those for the feeder ports of the Type 1 and Type 2 amplifiers.

Expressing signal levels has become somewhat more complex than it was before because with the advent of new signaling technologies we now anticipate having a "hybrid" spectrum that will be comprised of the traditional NTSC, amplitude modulation vestigial sideband (AM VSB) encoded RF signals up to about 550 MHz and digital signals, using any number of different modulation schemes, including quadrature phase shift keying (QPSK), quadrature amplitude modulation (QAM), vestigial sideband (VSB), etc., between 550 and 750 MHz.

These "digital" signals do not have a carrier, so to speak, and will appear to be operated at levels somewhat below that of a normal RF TV channel, depending upon the modulation used. We often specify signal levels and slopes between 55.25 MHz and 547.25 MHz, which we assume to be the lowest and

highest NTSC video carrier frequencies on the system.

The declaration of levels and slopes is further complicated by the fact that two different types of equalizers exist — one for use in optical nodes and headend amplifiers (where one finds very little cable and almost no temperature variation before the amplifiers), the other for true coaxial plant.

The first kind is termed a "linear" equalizer, the second type is called a "cable" equalizer (being based upon the $\sqrt{f}$ effect of cable losses). These two equalizer types exhibit different loss characteristics, especially between 547.25 MHz and 750 MHz. A "linear" equalizer yields a difference of approximately 2.4 dB between the two frequencies while a "cable" equalizer demonstrates a difference of 3.5 dB or so. As you can tell, it is a very complicated subject and deserves some careful and thoughtful analysis. All levels given here relate to the signal that would exist at 750 MHz if we actually had an analog RF channel there. Our typical operational levels, assuming 750 MHz "cable" equalizers in the coaxial plant, reflect an output of approximately 37 dBmV at trunk ports and 43 dBmV at feeder and line extender output ports. We specify a 9 dB operational slope between 55.25 MHz and 547.25 MHz. The level at 750 MHz will be some 3.5 dB higher, as explained earlier. We often use a standard modulator operating at 745.25 MHz during initial upgrade activities to assist in system setup and testing.

Unified chassis

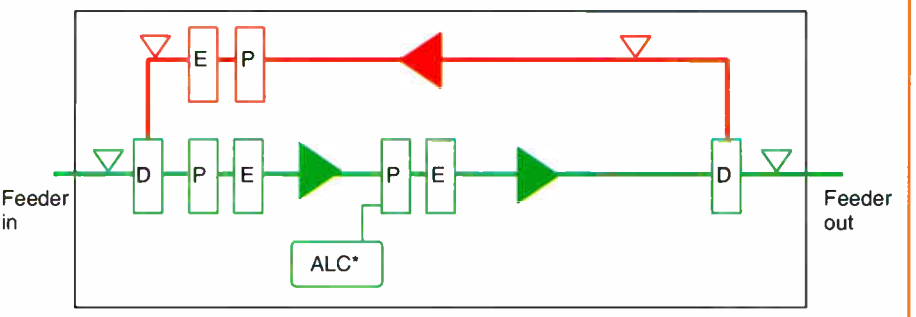
One of the most important features of our amplifier definition is the simplicity in design and mechanical configuration. We eliminated the "motherboard" approach with its associated modules and need for complex interconnecting infrastructure, and combined all functions onto a single, unified chassis. This change was aimed at reducing the amount of connectors, plugs, jumpers, wires and cable assemblies that had previously been required. This effort alone has greatly improved the MTBF of our amplifiers. Conceptually, these amplifiers are not much different from prior generations of "mini-trunk" stations, except that the housings are a little larger.

This reduction in complexity provides benefits for both equipment manufacturers and system operators. For the manufacturer, it reduces the total number of components needed as well as the labor of assembling the parts into a useful product, making it easier to produce. For the operator, it reduces the amount and types of equipment needed, the time required to configure the amplifier and the time required to set up the amplifiers during installation, service and maintenance activities. Training issues also are reduced and the "spares" inventory requirements are lessened.

Of course, all of these benefits have a downside — the basic amplifier does not have the high level of flexibility of its predecessor. We did not eliminate all potential for options but we did restrict it to a severe degree. The amplifiers come with two feeder ports and no more. If more than two feeders are required, we must use an external splitter or directional coupler. (We have accepted some alternative configurations with three available feeder ports). The amplifiers do not allow for bandwidth options such as mid or high splits. We do not believe that the common amplifier will ever need such options. The forward bandwidth is set at 54 to 750 MHz and the reverse bandwidth operates from 5 to 40 MHz (the appropriate diplex filters are built

"Because we fully intend to have our plants capable of 100% return we do not feel that we can continue to employ the old methods of setting levels in two-way plants."

Figure 3: Time Warner's Type 3 amplifier



P = Pad/pin diode attenuator
E = Equalizer
D = Diplex filter
▽ = Test point
Green = Feeder path
Red = Return path
*(ALC) = Optional and also may be manual (3m) or thermal (3T)

onto the amplifier's chassis). Every trunk and bridger amplifier is equipped with an ALC circuit and every amplifier including line extenders (LEs) have an active return path amplifier. These standard configurations eliminate much of the inherent confusion in designing and operating modern systems.

Pads and equalizers

In our efforts to achieve the greatest possible degree of simplification we adopted a long and well-established approach to "level and slope" controls — we use plug-in pads and equalizers for all such functions. We have at least two pad and equalizer locations in every amplifier, one each before the first hybrid (input) and one each between the first and the second hybrids (interstage). We use the first equalizer (input equalizer) to ensure a relatively flat input to the first gain block. A pad of appropriate value is used in the first pad location wherever the input signal level exceeds the designed operational requirements. The interstage pad location generally contains a "zero" pad while the interstage equalizer location is used to set the proper output slope. The two positions allow us to balance the amplifier's operational levels for the best compromise between noise and distortion performance.

Of course, the obvious benefit of using pads and equalizers is the simplicity of the circuits themselves when compared to a potentiometer or trimmer capacitor. The simple circuit is less costly to manufacture and is very repeatable. Operationally, the proper pad and equalizer values can be established by design and can be indicated on system maps. Significant variances from the design value may well indicate a system problem.

Variable controls, on the other hand, are not really predictable nor can the set positions be ascertained easily. In fact, some variable controls may have enough range to allow a technician to mask a system problem, albeit inadvertently, by permitting an amplifier to be set to the desired output levels in spite of an inadequate input level. All things considered, the pad and equalizer approach just seems to make a lot of sense to us.

Slope-compensated ALC

We eliminated the requirement for an "automatic level and slope" control system to use two pilot signals. The relationship between a cable span's losses and its change in slope is pretty well known and relatively easy to predict. With these facts it became apparent that a single pilot system could accomplish both ALC and automatic slope compensation, at least to a reasonable degree.

Also, since the cascade requirements were so limited, the total amount of change in the signal's slope to be expected would likely be small, at least when compared to the requirements of a traditional tree-and-branch architecture. Obviously, a single pilot circuit is easier to build and less expensive than a two-pilot circuit. The degree of control is not as great but, as stated earlier, the need for such control is not as great either.

It is anticipated that with the development and deployment of digital signal delivery mechanisms it may be more desirable to add "channels" into this domain in the future. We determined to use a pilot frequency below the 450 MHz spectrum limit in order to provide for an eventual reduction in analog channel carriage if such should ever be needed. Our standard pilot frequency is 433.25 MHz. Because it is difficult to design and build a "sharp" filter within this frequency range (one having a high "Q"), the high pilot is actually sensitive to the loss of the two upper and lower adjacent channels. The total impact is small but noticeable.

While we are on the subject of amplifier gain control, it should be mentioned that some of our manufacturers have developed an "active thermal" control module that works almost as well as

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their ALC circuits but at a lower total cost. We use these thermal controls in our line extenders, primarily in the first and third LEs in a cascade. We use a true ALC circuit in the second LE station. Of course, for underground plants we generally forgo all level control and use manual amplifiers.

Return system requirements

Our specifications call for a return amplifier for every amplifier station we install. Additionally, our specifications call for the diplex filter to be built onto the "unified" chassis. Our standard return spectrum is specified to be between 5 and 40 MHz.

One of the more unique features of our amplifier specifications is the requirement for individual pad locations in each of the amplifier's return paths. Type 3 amplifiers only have one path but a Type 2 has two possible routes and a Type 1 has three. Our objective is to be able to "balance" the return signal levels, at least to as great a degree as possible.

We anticipate having an average return signal level of +45 dBmV at the side of the house and at least +17 dBmV at each return input port of an amplifier. We hope to be able to operate our return plants on a "station gain" concept, quite similar to the methodology used for operating the forward plant. Each station should have an operational gain of some 18 dB that, if the proper input level requirements are met, will allow us to run the reverse output level at +35 dBmV. It is certainly true that the return path will have more variances in levels than we normally encounter in the forward direction but, based upon some limited design studies, we believe the variance can be controlled to a range of approximately ±3 dB.

The advantage of this approach is simpler system operations. Because we fully intend to have our plants capable of 100% return we do not feel that we can continue to employ the old methods of setting levels in two-way plants. Traditionally, such methods required two people or, at best, one person with a TV set, a signal level meter and a signal generator using a dedicated RF channel on the forward portion of the system. With the nodal architecture, and marketing's insatiable appetite for spectrum, we simply do not believe such methods to be viable.

Conclusion

This article has presented an overview of some of Time Warner Cable's thoughts regarding the operational requirements for modern amplifiers. There are many other aspects of the plant's and equipment's specifications that still need to be discussed. System powering is a very important topic that warrants immediate, intense study and widespread industry discussion. Equipment performance specifications need to be better defined and explained in detail, especially those relating to changes in signal modulation and transmission schemes.

The ideas expressed here are predicated upon the belief that they offer the best hope for a usable, reliable, cost-effective product. I, for one, would welcome a greater degree of discussion regarding the concepts presented, especially from the vendor community. There is not a lot of information being disseminated as to the reasons why manufacturers build their products the way they do, but the amplifier is still a fundamental device within the CATV plant and deserves to have its features and functions explained properly. **CT**

Bonding the installation

By Pam Nobles
Senior Staff Engineer/Technical Training
Jones Intercable

The curse of every installer: "Why bond? How should I bring a substandard bond up to spec? What exactly is allowed by the National Electrical Code (NEC)?" These and other questions will be answered in this article, which is designed to simplify the installer's job.

Before launching into the procedures of how to bond the installation, it is helpful to understand how these steps are derived from the following national guidelines.

National Electrical Code

The purpose of the NEC is "the practical safeguarding of persons and property from hazards arising from the use of electricity." The NEC handbook (often called simply the NEC) is not a "law," but a guideline of practices. The NEC, being just a guideline, must be adopted by your state, county or town in order for it to be enforced. Not all communities adopt the NEC, and some adopt it but have additional requirements that are stricter. Also, all locations may not have adopted the NEC in its most recent form, which may cause some confusion.

There is some flexibility as to how the code is interpreted. The electrical inspectors of each community or municipality are the total authority locally when it comes to how to bond. This is why it is important to have good communications between the cable operator and the inspector.

National Electrical Safety Code

The purpose of the National Electrical Safety Code (NESC) is to outline safety regulations and procedures issued by the American National Standards Institute (ANSI) for the practical safeguarding of persons during the installation, operation and maintenance of electric supply and communications lines and their associated equipment. Many of the cable clearances are derived from the NESC. As with the NEC, the NESC needs to be adopted by the state, county or town in order for it to become "the law."

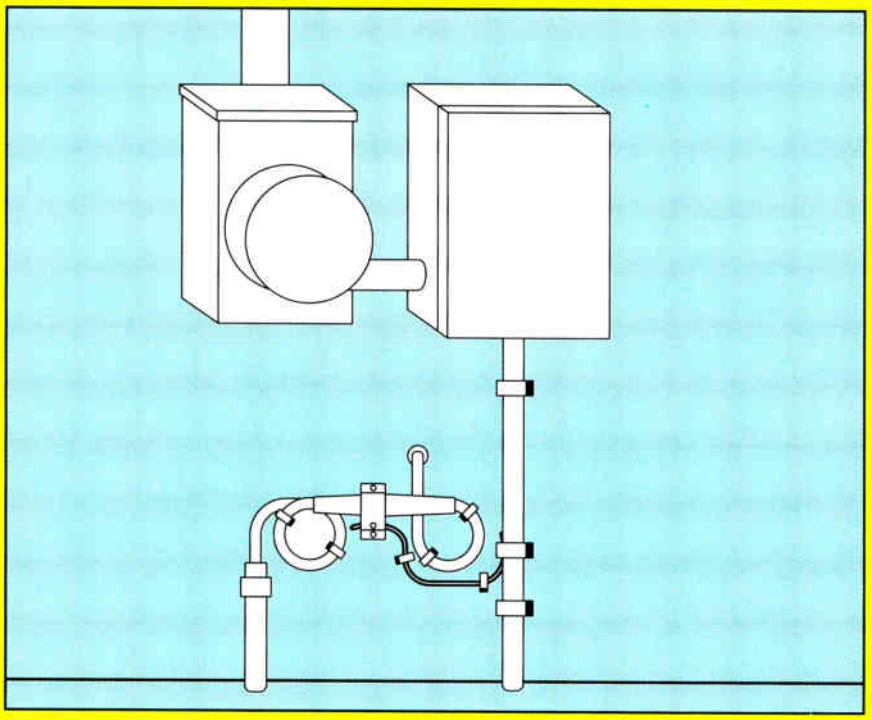
Some states or communities may adopt or develop procedures that are stricter than these recommended codes. For example, in California, GEO 95 pertains to aerial and GEO 128 to underground installations.

Article 250 of the NEC describes the general requirements for grounding. Article 800 deals with communications circuits. Article 820 specifically covers coaxial cable distribution systems. A complete handbook should be on file in your system's office. If you are unable to obtain the NEC locally, you can contact: The National Fire Protection Association, 1 Battermarch Park, P.O. Box 9146, Quincy, MS 02269-9959; phone, (800) 344-3555.

The NESC can be obtained by calling the Institute of Electrical and Electronics Engineers at (800) 678-4333.

The information that follows is based upon the 1993 NEC edition. However, due to differences in the NEC and local rules, it is important that you are familiar with both. The next edition of the NEC will be available February 1996.

Figure 1: Bond to the power service grounding conductor



Guidelines for bonding the installation

The purpose of bonding cable is to limit potentially lethal voltages that may be present on the cable from external sources such as electric power lines, downed poles or lightning strikes. Utilities entering a customer's house must be bonded together to reduce the overall resistance to ground and to equalize the voltage potentials that might appear between cable sheaths or the outermost conductive layer of

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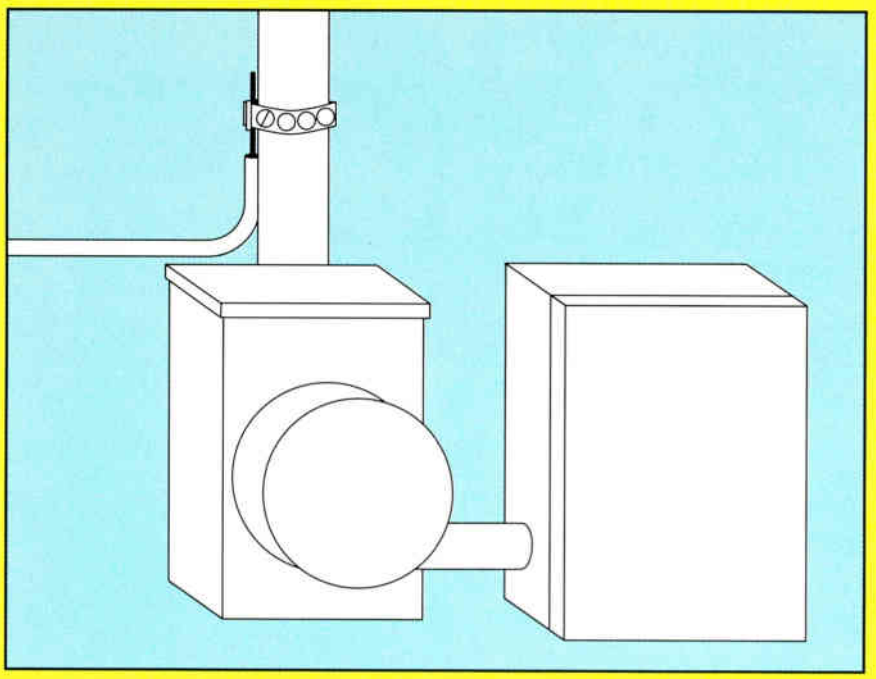
Figure 2: Bond to the power service metal conduit



the cable and other utilities.

The CATV ground block or splitter must have a provision for ground wire attachment. This is the only secure and approved means of positively bonding the cable to earth ground and to the house common electrode system prior to its entry into the home. Many municipalities are now requiring that the ground block be UL-listed. The ground block also provides a test location outside the customer's house for signal level readings.

Ground vs. bond

A "ground" is a connection to earth or a conductor serving as earth potential and can be intentional or accidental. "Effectively grounded" means intentionally connected to earth through ground connection(s) of low impedance and having current-carrying capacity to prevent the buildup of voltages. The ground wire should be insulated, be made of copper or other corrosion-resistant conductive material and according to the NEC, not be smaller than 14-gauge.

A "bond" is the interconnection through good conductors of CATV with phone and power to eliminate ground potential differences. The NEC requires that the bonding conductor be 6-gauge wire or larger. When two or more electrodes are effectively bonded together, they are treated as a single electrode system.

Grounding is the act of rerouting electrical current. Technically, installers are "bonding" the drop when they connect their ground wire to the connection point. This gets even more confusing when referring to "ground blocks" and "ground wire" instead of "bond blocks" or "bond wire." For the purposes of this article, this process will be referred to as "bonding the installation."

Building the electrode system

The preferred method for CATV to bond is to the building or structure grounding electrode system by connecting to the power system. The ground wire should be connected to the nearest accessible location on the building's electrode system. This generally refers to the power service external to any enclosures, including the ground wire. The service equipment enclosure itself can be used if a connection is provided and if this is allowable by your local electric inspector. However, never tamper with or alter the power company's equipment in any way. Some utilities discourage the use of meter box clamps so it is important to communicate with the local utilities. Unpowered CATV equipment or equipment powered through the coaxial cable shall be considered grounded where connected to the metallic cable shield.

Even though CATV cable isn't carrying electrical current that could damage the customer's property, it's a perfect path for outside electrical current to enter the house from lightning strikes and other ways (like coming into contact with an energized power line because of a downed pole or broken line). If lightning strikes something that's designed to carry electricity very efficiently such as t˚he CATV aerial cable, it may travel along that cable for several miles. So cable companies make sure there is a path provided from the cable right into the ground through bonding so the power from the lightning is less likely to damage the system.

The installer is concerned with how to do the same thing to protect the customer's house. When the power company puts its service in, it ties its lines to a metal rod driven into the ground. This helps to dissipate a power surge by guiding the electricity safely down into the ground before it enters the house.

The path to the ground is made up of materials that allow the electricity to flow with very little resistance. In other words, it's made up of good conductors, primarily copper wire. Electricity and lightning look for the path of least resistance. We provide that path into the ground where the electricity won't do any harm.

CATV used to run ground wire to its own ground rod, just like the power company. But, what can happen is this: Suppose there's a power surge or lightning hits the power company's lines. Assume the cable company just put in a brand new ground rod. Since the new ground rod hasn't oxidized, the metal may be a better conductor than the ground rod the power company put in five years ago. What can happen is the power surge goes through the power company's lines, possibly through the TV set and VCR and comes down the cable TV lines to the cable company's ground rod because it was the better conductor.

Whenever the CATV cable and the power company's cable are using different grounds, there is the risk of voltage traveling through the cable into the customer's equipment. Therefore, it is essential to ensure the CATV equipment is properly bonded to the building electrode system and thus to the power ground.

Bonding procedures

The drop cable must be bonded at the building as close to the point of cable entry as practical. Ideally, this will be near the power service entry since the bond connection will be made di-

rectly to the power company's electrode.

Make sure the customer understands where the installation box and cable will be located and that he is comfortable with it. If the customer has a problem with the plan, the installer will need to discuss other options such as relocating the installation box or cable entrance.

Ideal situations aren't the only ones encountered, so the installer has to use a lot of common sense. The NEC outlines numerous bonding methods. For the installer, three methods should apply in the majority of situations:

- Bond to the power service grounding conductor. (See Figure 1 on page 94.)
- Bond to the power service metal conduit. (See Figure 2.)
- Bond to the cold water piping system as a last resort.

Metal water piping system

The guidelines say bonding to a cold water pipe is acceptable. In the past, it has been a reasonable alternative, but it should only be used if absolutely necessary. There are three things to check when using a cold water pipe. One, make sure the pipe is metal all the way to the ground. Sometimes plastic pipe is used inside the house. Two, check that there's a bonding jumper around the water meter since the meter itself might contain nonmetal parts. Three, the cold water pipe should be properly bonded to the power. Hopefully this bonding can be seen (typically in the basement of the house).

Therefore, bonding to the interior metal cold water piping system is an option only if it is impossible to bond to the building grounding electrode system. If this is the case, the installer must verify the following:

- The metal underground water pipe must be in direct contact with the earth for 10 feet or more and be electrically continuous.
- The water meter (which may not be a continuous conductor) must be bypassed with a No. 6 bonding jumper.
- The water pipe must be bonded to the grounding electrode conductor. However, note that the only time it would be acceptable to bond cable drops to the cold water pipes is if the power company's connection to the water pipe is made within 5 feet of where the pipe enters the building on the interior of the building.

"Installers are 'bonding' the drop when they connect their ground wire to the connection point. This gets even more confusing when referring to 'ground blocks' and 'ground wire' instead of 'bond blocks' or 'bond wire.' "

Wire

There are two types of wire used in bonding: insulated copper wire (typically 12- or 14-gauge) referred to as "ground wire" and No. 6 bare copper bonding jumper.

The ground wire should be insulated, be made of copper or other corrosion-resistant conductive material and, according to the NEC, not be smaller than 14-gauge. The wire must have a current-carrying capacity approximately equal to that of the outer conductor of the coaxial cable. Charts are available to check the current carrying capacity and determine what size ground wire to use. Depending upon the cable size and percentage of braid, 12-gauge or larger may be required.

The ground wire is run from the ground block or splitter to the bonding connection. A No. 6 bonding jumper is used for connecting electrodes such as ground rods. You normally wouldn't want to connect ground rods together in a new installation (since CATV installers won't be driving a ground rod) but it may be the best solution if the ground rod already exists.

All bonds should be as short and as straight as practical. Long wires with sharp bends are not as effective in carrying the high voltage associated with power lines or lightning to earth ground and should be avoided.

For an effective bond, metal must touch metal with a tight connection. Always scrape away any paint or dirt. Using the proper grounding connector, make a nice firm connection between the two wires or wire and conduit.

Never use, loosen or remove anyone else's bond (for example, the telephone company's). This would leave them unprotected and the cable company responsible for any damage that might occur.

Special cases

It should be possible to satisfy the majority of conditions by following the preceding bonding procedures. If this is not possible, the installer should contact the supervisor for assistance. When faced with special cases, it may be best that a representative from your system discuss the matter with the local electrical inspector. This way, a consensus can be reached that would be satisfactory to both of you.

When faced with the decision of running a large quantity of ground wire vs. wrapping the house with coaxial cable, it is usually best to wrap the house with cable.

As mentioned earlier, driving a separate ground rod for CATV is not an acceptable alternative. If separate ground rods have been used in the past, it is important that the installation be brought up to current specifications. An acceptable way to do this is to use the 6-gauge bonding jumper to connect electrodes. However, if the installer is close enough to the power system to connect the number 6-wire to it, could the ground

duces a step transition in phase.

Another way to avoid problems is to anticipate the causes from a knowledge of what the digital signal can tolerate. For example, if agile modulators are used, they must stay in their frequency band when powered on or off. Otherwise, errors in neighboring digital carriers may result.

Performance improvements

Other suggestions to improve the performance of digital signals are:

1) Carefully specify and test the equipment purchased from vendors. This especially applies to modems. Consumer-purchased equipment, such as high definition TV (HDTV) sets, will be outside the direct control of the cable operator but will hopefully meet some minimum industry standards.

2) Train the technicians and installers in the new digital technology.

3) Maintain a tight plant. Fortunately, this is already being done to limit egress. Leaky plant will allow ingress from over-the-air signals and impulsive noise.

4) Send pristine-quality digital carriers from the headend. The satellite link margins must be high enough for virtually error-free data. If a broadcast HDTV signal is picked up from an over-the-air antenna, the data should ideally be regenerated before retransmission on the cable. (Regeneration is the process of demodulation, error correction and remodulation.) If it is economically feasible, it is even better to run a fiber or microwave link to the broadcaster's facility: Signals will not improve as they pass through the cable system!

"One problem manifests itself rather quickly: When a digital receiver is not working, it will not normally give a clear indication of why it is not working."

5) Check that the house wiring is sufficient before installing a digital converter. This means, at a minimum, checking levels and checking that the home wiring system is tight against ingress from over-the-air signals. If ingress is present, the problem may not necessarily be the house wiring. Some consumer devices connected to the cable act as antennas injecting over-the-air signals and impulse noise into the home cable wiring. This problem frequently has its origin in the same place as direct pickup (DPU) interference caused by poor tuner shielding in TV and FM radio receivers. Splitters will be a source of problems if their performance is poor in the frequency range employed. Return loss and port-to-port isolation are two especially important parameters.

6) Check that the installed receiver is operating with sufficient margin before leaving the site. This was done during CableLabs testing of the Grand Alliance 16-VSB transmission system in the Charlotte, NC, area by summing additional random noise with the tuned carrier. The locally injected noise source is increased until the receiver just fails (e.g., the picture freezes). The margin can then be computed since the technician knows the strength of the signal and the density of the locally injected random noise.

7) Choose the channel frequencies for digital carriers wisely. Don't put digital carriers with inadequate margin in the roll-off, or collocated with a strong UHF or VHF broadcast channel.

8) Use noninvasive sweep equipment or passive monitoring of signal levels. Sweeping through a data carrier, at a level strong enough to determine the channel frequency response under the data carrier generally disrupts the data.

9) The proposed digital carriers should be improved with test signals and/or in-service monitoring to aid diagnosis of channel impairments. One such improvement might include a reference signal or monitoring equalizer state for determining echoes to find the channel frequency or impulse response. Another improvement could be a quiet period (meaning a reference carrier level without data for some brief time interval) for measuring levels of interference. These modifications have an equivalent in the vertical blanking interval (VBI) signals used by NTSC.

10) Supply techs with a digital monitor/receivers. The digital monitor/receiver product concept was used in some form by most of the advanced TV (ATV) proponents at the Advanced Television Testing Center. It is a data receiver, hooked to a computer and/or an oscilloscope, that reports what it is experiencing. Data available may include an eye diagram and/or a constellation diagram, a signal-to-noise (S/N) reading, a lock indicator for carrier and data clocks, digital filter tap values, bit or block error data, AGC and AFT (automatic fine tuning) voltage levels, and a time record of performance. Providing technicians with a compact version of this product will help them diagnose problems in the field.

11) Have data transmission systems that are reconfigurable to the channel they are filling. For example, a 64-QAM signal can drop down to 16-QAM by using only one-fourth of the states. This results in approximately 6 dB improvement in carrier-to-noise (C/N) performance, with a resultant loss of one-third of the data capacity. Likewise, 16-VSB can revert to a 4-VSB signal. These systems can be built for a small incremental cost over fixed systems. This feature can be used to maintain data quality levels while a plant is being rebuilt, awaiting a rebuild, or while technicians are maintaining or servicing the plant, with such activities as opening housings, adjusting levels, tightening fittings, etc.

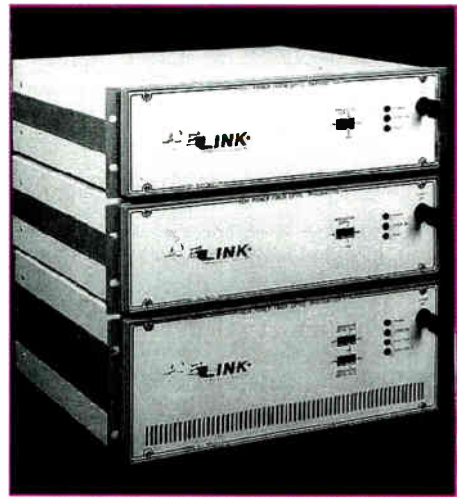
12) Use the upstream return path (where available) for reporting problems with the downstream signals found by converter boxes or end-of-line monitors. This will allow both quick detection of new problems and preventive maintenance.

13) Diagnostic codes on converter boxes can relate useful information to customer service representatives (CSRs). Converter boxes now frequently have this function. More functions can be added for digital converters.

14) Test equipment vendors need to supply cost-effective diagnostic equipment for cable technical personnel. Equipment will be needed to characterize a cable channel both before carrying data and while the channel is in use. **CT**

The CableLabs report on digital characterization will soon be available to CableLabs members.

PRODUCT NEWS



Fiber data link transmitters

AEL Industries introduced a line of high-power broadband laser transmitters for CATV and cellular systems applications. The 1,300 nm units use high-power YAG lasers; 1,550 nm models also are offered. All models feature external modulation.

Proprietary temperature compensation techniques ensure modulation stability, while predistortion signal conditioning provides enhanced performance and maximum dynamic range, according to the company. The links are capable of instantaneous bandwidths up to 6 GHz for flexibility in wideband information transfer. Variable configurations allow network designers to optimize system architectures for various power levels or number of outputs (two, four or eight simultaneous outputs).

According to the company, the high power 1,300 nm model transmits up to 45 km over single-mode cable without optical amplification, which makes possible novel, long distance system architecture design.

Reader service #312

Interactive TV sourcebook

Broadcast Information Bureau published the 1995 "Interactive Television Sourcebook," which includes detailed profiles on all major interactive players, content providers, equipment makers, software vendors and test sites.

The reference book includes the following researched information on interactive TV: detailed profiles on the 50 most active companies in the industry; news abstracts showing activities of hundreds of companies; listings of all providers of video dialtone services, video hardware and software, physical plants and infrastructure, as well as industry consultants and law firms; listings of all IDTV license winners and updated information on all test sites; information on current and upcoming programs; and a glossary of terms. Subscribers to the annual publication also will receive a monthly fax update of interactive news at no extra charge.

Reader service #304

Optical power meter

Photon Kinetics announced the 7700C high power fiber-optic power meter designed specifically for CATV applications and other applications where it is necessary to measure the output power of high power sources. The rugged, field portable unit is designed to measure either the absolute or relative power of light from a fiber-optic cable.

Features include simple two-button operation, large LCD display and a universal connector interface that allows the user to test either terminated or unterminated fiber-optic cables. The measurement range is +20 to -35 dBm. The unit can operate either with alkaline batteries or with an AC adapter.

Reader service #311 →

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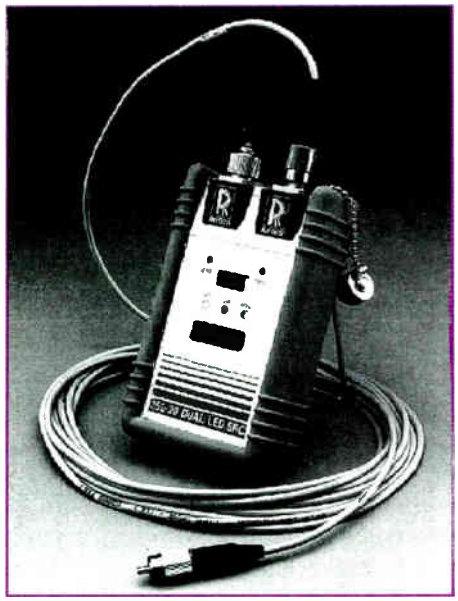


Dual wavelength LED

The new 252 Series dual wavelength LED source from RIFOCS is small, rugged and designed for use in installing, maintaining and researching telephony, datacom, CATV, FDDI and other fiber-optic links. It provides two calibrated outputs at 850 and 1,300 nm, both in CW and modulated output mode.

The unit features a universal connector interface to accommodate all industry standard connector types. The output of Model 252 A has a near equilibrium mode distribution and excellent long-term stability, according to the company. The unit features three modulation frequencies (270 Hz, 1 kHz and 2 kHz), over 20 hours of battery life, and is available with a fixed connector interface (FC, ST, SC).

Reader service #310

Optical transmitters

Harmonic Lightwaves announced new versions of its YAGLink and PWR-Link optical transmitters that are specifically optimized for 110-channel analog operation.

The HLT 6700-FA AM transmitter and PWL 4700-FA DFB laser transmitter provide improved carrier-to-noise (C/N) performance when carrying 110 channels. The units yield 1 dB higher C/N than their predecessors, which are optimized for 80-channel loading.

By taking advantage of the unique 10 log cascading rule for composite triple beat (CTB), the HLT 6700-FA can deliver up to 55 dB C/N fully loaded with 110 channels, providing improved picture quality over a transmitter optimized for 80 channels, according to the company. Similarly, the PWL 4700-FA can deliver up to 52 dB C/N with 110-channel loading.

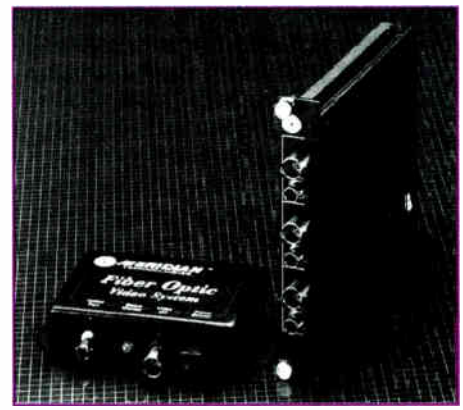
Reader service #306

Back reflection testers

EXFO added two single wavelength models to its BRT-320A Series of back reflection testers. These fiber-optic test instruments measure optical return loss at 1,310 or 1,550 nm. Used to determine both the reflectance of individual components and total link loss, the units can help identify potential return loss problems upon system installation before they cause transmitter instability and degrade performance.

By providing a better control over bit error rates, the company says these instruments can contribute to the success of wide-scale fiber deployment projects, as well as prove themselves valuable to component manufacturers who need to characterize the return loss of their products.

Reader service #307



FM fiber-optic video system

Meridian Technologies introduced the Series 140/190 frequency-modulated fiber-optic video transmission system. Multimode versions employ 850 and 1,300 nm LEDs. Laser-based single-mode versions meet RS-250C medium haul. Specifications include 10 MHz video bandwidth, >60 dB signal-to-noise ratio, 25-36 dB optical budget (up to 120 km) and 25 dB optical dynamic range.

Stand-alone modules are powered by 12 VDC or 24 VAC. Triple-channel card units are rack-mountable in EIA 19-inch x 3U x 18 slots or 6U x 36 slots subracks and feature SpectraSmart, a microprocessor-based link status monitoring, diagnostics and network management.

Reader service #308

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REAL TIME MPEG-1 AND MPEG-2 ENCODING

Vela Research MPEG-2 Encoders are capable of real time compression of video information into either the MPEG-1 ISO 11172 standard or the MPEG-2 ISO 13818 standard. This feature allows full inter-operability with the next generation of MPEG-2- compliant decoder technology while offering full compatibility with today's MPEG-1- based PC and CD technologies.

VERSATILITY

Vela's MPEG encoders accept a variety of video standards such as NTSC and PAL, and input signal formats that include composite, S-Video, Y/U/V or Digital D-1. This flexibility eliminates the need for expensive digital conversion electronics necessary to interface much of today's analog composite and component equipment to tomorrow's digital MPEG encoding technology. The encoders support resolutions from SIF to ITU-R 601 at data rates from 1.158Mb/sec. to 15Mb/sec. A variety of audio signal formats are available from analog inputs to digital inputs based on the AES/EBU standards. The encoding workstation can be directly interfaced with computer/ networking equipment such as Ethernet, Fast Ethernet, FDDI, CDDI, ATM and SCSI-2.

PROFESSIONAL WORKSTATION INCLUDED

Vela Research MPEG encoder systems were designed and developed by digital encoding professionals with the video production professional in mind. An example of this attention to professional needs is found in the full-featured workstation included with the encoder. The workstation allows for complete external control of a variety of VTRs, VCRs and laser disc players with on-screen controls for fast-forward, rewind, stop, play, cue and shuttle to timecode number. The internal 36GB disk capacity provides for capture and storage of compressed digital video files for later distribution.

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13	39	65	91	117	143	169	195	221	247	273	299
14	40	66	92	118	144	170	196	222	248	274	300
15	41	67	93	119	145	171	197	223	249	275	301
16	42	68	94	120	146	172	198	224	250	276	302
17	43	69	95	121	147	173	199	225	251	277	303
18	44	70	96	122	148	174	200	226	252	278	304
19	45	71	97	123	149	175	201	227	253	279	305
20	46	72	98	124	150	176	202	228	254	280	306
21	47	73	99	125	151	177	203	229	255	281	307
22	48	74	100	126	152	178	204	230	256	282	308
23	49	75	101	127	153	179	205	231	257	283	309
24	50	76	102	128	154	180	206	232	258	284	310
25	51	77	103	129	155	181	207	233	259	285	311
26	52	78	104	130	156	182	208	234	260	286	312

A. Are you a member of the SCTE (Society of Cable Television Engineers)?
01. ___ yes
02. ___ no

B. Please check the category that best describes your firm's primary business (check only 1):
Cable TV Systems Operations
03. ___ Independent Cable TV Syst.
04. ___ MSO (two or more Cable TV Systems)
05. ___ Cable TV Contractor
06. ___ Cable TV Program Network
07. ___ SMATV or DBS Operator
08. ___ MDS, STV or LPTV Operator
09. ___ Microwave or Telephone Comp.
10. ___ Commercial TV Broadcaster
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14. ___ Law Firm or Govt. Agency
15. ___ Program Producer or Distributor
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17. ___ Educational TV Station, School, or Library
18. ___ Other (please specify)_____

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19. ___ Corporate Management
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21. ___ Programming
Technical/Engineering
22. ___ Vice President
23. ___ Director
24. ___ Manager
25. ___ Engineer
26. ___ Technician
27. ___ Installer
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D. In the next 12 months, what cable equipment do you plan to buy?
30. ___ Amplifiers
31. ___ Antennas
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41. ___ Interactive Software
42. ___ Lightning Protection
43. ___ Vaults/Pedestals
44. ___ MMDS Transmission Equipment
45. ___ Microwave Equipment
46. ___ Receivers and Modulators
47. ___ Safety Equipment
48. ___ Satellite Equipment
49. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
50. ___ Telephone/PCS Equipment
51. ___ Power Suppls. (Batteries, etc.)
52. ___ Video Servers

E. What is your annual cable equipment expenditure?
53. ___ up to $50,000
54. ___ $50,001 to $100,000
55. ___ $100,001 to $250,000
56. ___ over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?
57. ___ Fiber-Optic Amplifiers
58. ___ Fiber-Optic Connectors
59. ___ Fiber-Optic Couplers/Splitters
60. ___ Fiber-Optic Splicers
61. ___ Fiber-Optic Transmitter/Receiver
62. ___ Fiber-Optic Patchcords/ Pigtails
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70. ___ Audio Test Equipment
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74. ___ OTDRs
75. ___ Power Meters
76. ___ Signal Level Meters
77. ___ Spectrum Analyzers
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The following is a listing of some of the videotapes currently available by mail order through the Society of Cable Television Engineers. The prices listed are for SCTE members only. Nonmembers must add 20% when ordering.

• *Signal Leakage and CLI Testing* — A basic presentation of signal leakage and CLI testing including what they are and how to deal with them. This program, which features Tom Polis and Robert V.C. Dickinson, provides necessary information concerning FCC rules and limits, grandfathering, filing and equipment. Ground measurement techniques and flyover procedures also are discussed. This is a useful tool for developing your own plan to deal with FCC requirements. (70 min.) Order #T-1060, $45.

• *Category V Review Course: Data Networking and Architecture* — Al Kuolas discusses digital data and methods of transmission, covering such topics as bits and bytes, parity bits, verification, formats of information, networking, modulation and multiplexing. (1 hr.) Order #T-1061, $35. **(Reference for BCT/E Category V)**

• *Category VI Review Course: Terminal Devices* — William Cohn and Mike Long discuss regulatory agencies and standards, signal levels, noise figures, locating the source of ingress, installation equipment and practices, converters, remote controls, interfacing with consumer equipment and emerging technologies. (1-1/2 hrs.) Order #T-1062, $45. **(Reference for BCT/E Category VI)**

Note: The videotapes listed this month were recorded at Cable-Tec Expo '88 in San Francisco. They are in color and available in the NTSC 1/2-inch VHS format only. They are available in stock and will be delivered approximately three weeks after receipt of order with full payment.

Shipping: Videotapes are shipped UPS. No P.O. boxes, please. SCTE pays surface shipping charges within the continental U.S. only. Orders to Canada or Mexico: Please add $5 (U.S.) for each videotape. Orders to Europe, Africa, Asia or South America: SCTE will invoice the recipient for additional air or surface shipping charges (please specify). "Rush" orders: a $15 surcharge will be collected on all such orders. The surcharge and air shipping cost can be charged to a Visa or MasterCard.

To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Orders without full and proper payment will be returned. Send orders to: SCTE, 669 Exton Commons, Exton, PA 19341 or fax with credit card information to (610) 363-5898.

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CALENDAR

May

7-10: National Show, Dallas Convention Center, Dallas. Contact National Cable Television Association, (202) 775-3669.

9: SCTE Chattahoochee Chapter seminar, leakage measurements and FCC public inspection files, Ramada Inn, Dunwoody, GA. Contact Greg Worthman, (404) 874-8000, ext. 250.

9: SCTE Ohio Valley Chapter testing session, BCT/E and Installer exams to be administered, Cincinnati. Contact Jon Schatz, (614) 221-3131.

9-10: Scientific-Atlanta broadband training course, hybrid fiber/coax system sweep and balance, Atlanta. Contact Bill Brobst, (404) 903-6306.

9-11: C-COR training seminar, cable TV technology, Fremont, CA. Contact (800) 233-2267.

9-11: C-COR training seminar, broadband communications technology, State College, PA. Contact (800) 233-2267.

9-11: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

10: SCTE Mid-South Chapter testing session, BCT/E exams to be administered, Time Warner office, Memphis, TN. Contact Kathy Andrews, (901) 365-1770, ext. 4110.

10: SCTE Ohio Valley Chapter testing session, BCT/E and Installer exams to be administered, Cincinnati. Contact Jon Schatz, (614) 221-3131.

11: SCTE Magnolia Chapter testing session, BCT/E and Installer exams to be administered, Ramada Coliseum, Jackson, MS. Contact Robert Marsh, (601) 932-3172.

11: SCTE New England Chapter testing session, Installer exams to be administered, Worcester, MA. Contact Tom Garcia, (508) 562-1675.

11: SCTE Penn-Ohio Chapter seminar, emerging technologies, annual business meeting and election of officers, Sheraton Inn North, Pittsburgh. Contact Marianne McClain, (412) 531-5710.

11: Society of Cable Television Engineers Tele-Seminar Program, *Convergence (Part I)*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.

12: SCTE Palmetto Chapter seminar, video, headend and system proof-of-performance tests and measurements, Martinique Hotel, Myrtle Beach, SC. Contact John Frierson, (803) 777-5846.

13: SCTE Cascade Range Chapter testing session, BCT/E exams to be administered, Portland, OR. Contact Cindy Welsh, (503) 667-9390.

15: Scientific-Atlanta broadband training course, fundamentals of the hybrid fiber/coax network, Chicago. Contact Bill Brobst, (404) 903-6306.

15: SCTE North Country Chapter testing session, Installer exams to be administered, Paragon Cable office, Minneapolis. Contact Bill Davis, (612) 646-8755.

15: SCTE Oklahoma Chapter seminar, fiber-optic cable construction and troubleshooting, Moore-Norman Vo-Tech Center, Norman, OK. Contact Oak Bandy, (405) 364-5763, ext. 249.

15-18: Antec Fiberworks training course, fiber-optic systems, Denver. Contact (800) 342-3763.

15-19: General Instrument training course, broadband communications network design, Dallas. Contact Lisa Nagel, (215) 830-5678.

16-17: Scientific-Atlanta broadband training course, hybrid fiber/coax field test and measurement, Chicago. Contact Bill Brobst, (404) 903-6306.

16-17: Scientific-Atlanta broadband training course, interactive

Planning Ahead

June 14-17: Society of Cable Television Engineers Cable-Tec Expo, Las Vegas, NV. Contact (610) 363-6888.

Aug. 13-15: Great Lakes Cable Expo, Indianapolis. Contact (317) 845-8100.

Oct. 31-Nov. 2: Private Cable & Wireless Show, Miami Beach, FL. Contact (713) 342-9826.

Dec. 6-8: The Western Show, Anaheim, CA. Contact (510) 428-2225.

broadband delivery system overview, Chicago. Contact Bill Brobst, (404) 903-6306.

16-18: C-COR training seminar, broadband, CATV laboratory, State College, PA. Contact (800) 233-2267.

17: SCTE Badger State Chapter testing session, BCT/E and Installer exams to be administered, Fond du Lac, WI. Contact Brian Revak, (608) 372-2999.

17: SCTE Big Sky Chapter seminar, BCT/E and Installer exams to be administered, Billings/Laurel Mt., MT. Contact Marla DeShaw, (406) 632-4300.

17: SCTE Dakota Territories testing session, BCT/E exams to be administered, Watertown, SD. Contact Tony Gauer, (605) 426-6140.

17: SCTE Dixie Chapter seminar, basic telephony and current system architectures, Holiday Inn, Huntsville, AL. Contact Powell Bedgood, (205) 733-1679.

17: SCTE Ohio Valley Chapter seminar, competing in a changing industry, Cincinnati. Contact Frank Adams, (216) 826-2941.

17: SCTE Oklahoma Chapter seminar, fiber-optic handling and construction practices, Moore/Norman Vo-Tech Center, Norman, OK. Contact Oak Bandy, (405) 364-5763, ext. 249.

17: SCTE Piedmont Chapter seminar, competitive access, Raleigh, NC. Contact Mark Eagel, (919) 220-3889.

17: SCTE San Diego Chapter seminar, San Diego. Contact Kathleen Horst, (310) 715-6518.

18: SCTE Big Sky Chapter seminar, BCT/E and Installer exams to be administered, Elks Lodge, Helena, MT. Contact Marla DeShaw, (406) 632-4300.

18: SCTE Dakota Territories testing session, BCT/E exams to be administered, Fargo, ND. Contact Tony Gauer, (605) 426-6140.

18: SCTE Michiana Chapter testing session, BCT/E exams to be administered, LaPorte, IN. Contact Russ Stickney, (219) 259-8015.

18: SCTE Ohio Valley Chapter seminar, competing in a changing industry, Cleveland. Contact Frank Adams, (216) 826-2941.

18-19: Scientific-Atlanta broadband training course, analog headend and earth station system, Chicago. Contact Bill Brobst, (404) 903-6306.

19: SCTE Central Indiana Chapter seminar, BCT/E Category VII tutorial, Speedway Motel, Indianapolis, IN. Contact Gordie McMillen, (317) 353-2225.

20: SCTE Chaparral Chapter seminar, telephony transmission on coaxial cable, Sandia Preparatory School, Albuquerque, NM. Contact Bob Wiseman, (505) 761-6243.

21: SCTE Old Dominion Chapter seminar, BCT/E Category V tutorial, data networking, BCT/E and Installer exams to be administered, Holiday Inn, Richmond, VA. Contact Margaret Fitzgerald, (703) 248-3400.

22: SCTE Old Dominion Chapter seminar, digital compression and DBS, BCT/E and Installer exams to be administered, Holiday Inn, Richmond, VA. Contact Margaret Fitzgerald, (703) 248-3400.

22-24: Scientific-Atlanta broadband training course, hybrid fiber/coax operation and maintenance, St. Louis. Contact Bill Brobst, (404) 903-6306.

22-25: Antec Fiberworks training course, digital networks, Philadelphia. Contact (800) 342-3763.

22-25: Siecor training course, fiber-optic installation and splicing, maintenance and restoration, Keller, TX. Contact (800) 743-2671.

23: SCTE Desert Chapter seminar, BCT/E Category IV, distribution systems, El Rancho, Beaumont, CA. Contact Bruce Wedeking, (909) 677-2147.

23-25: C-COR training seminar, digital video and fiber-optic networking, State College, PA. Contact (800) 233-2267.

24: SCTE Gateway Chapter testing session, BCT/E exams to be administered, St. Louis. Contact Don Widaman, (314) 272-3900.

24: SCTE Heart of America Chapter testing session, BCT/E exams to be administered, Blue Springs, MO. Contact David Clark, (913) 599-5900.

24: SCTE Snake River Chapter seminar, proof-of-performance video measurements, BCT/E and Installer exams to be administered, Weston Plaza, Twin Falls, ID. Contact Neil Ransbottom, (208) 232-1894.

25: SCTE New England Chapter testing session, Best Western, Marlboro, MA. Contact Tom Garcia, (508) 562-1675.

25: SCTE Shasta/Rogue Chapter seminar, BCT/E and Installer exams to be administered, Miners Inn, Yreka, CA. Contact Mark McIntosh, (503) 476-6362.

25: SCTE New England Chapter testing session, BCT/E and Installer exams to be administered, Best Western, Marlboro, MA. Contact Tom Garcia, (508) 562-1675.

26: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

30-31: Antec Fiberworks training course, broadband cable TV technology, Denver. Contact (800) 342-3763.

A new name, a new future

By William W. Riker
President, Society of Cable Television Engineers

Since its formation in 1969, the Society of Cable Television Engineers has been at the forefront of the technical development of the broadband communications industry. The organization has evolved and grown to become the industry's foremost provider of training, certification and standards.

Today, with the communications industry literally exploding with a variety of technologies and new cable-based forms of media delivery, SCTE has taken a major step to stay current with this rapid evolution by changing its name.

I am pleased to let you know that, as a result of a referendum vote by the SCTE's more than 13,000 national members, we will be altering our name to become the Society of Cable Telecommunications Engineers.

The new name was initially proposed by the Society's Planning Committee at the 1994 Texas Show last February. We followed this proposal with 10 months of research, which included publishing a survey in the Society's monthly newsletter, *Interval*, that polled members on their initial support of this transition.

This initial polling drew a largely favorable response, prompting the inclusion of the referendum vote on this year's election ballot, along with voting for seven open positions on our national board of directors. The membership overwhelmingly supported the new name — 93% of all voting members favored the change, which will officially occur in June, when it is confirmed by the board of directors at its meeting held prior to Cable-Tec Expo '95.

This year's Expo will mark a turning point, after which we will thereafter be known as the Society of Cable Telecommunications Engineers Inc.

With this transition, SCTE advances into the widely developing arena of multiple media and interactive cable services. Our name change continues a trend set by a number of industry organizations that have undergone similar transitions, including the Cable Telecommunications Association (formerly the Community Antenna Television Association), Women in Cable and Telecommunications and the Pennsylvania Cable Telecommunications Association.

This alteration of the Society's name is intended to address changes in both the industry and the disciplines comprising SCTE's membership. It more accurately represents our members and our field, which is currently evolving from "cable TV" into the more broadly defined area of "cable telecommunications."

The new name more accurately represents the technical personnel of an industry that is currently undergoing a transformation from providers of TV entertainment to a modern telecommunications network. This transition better enables the Society to be responsive to the training needs and rapid changes taking place in all forms of cable-delivered media including television, telephone, data, alternate access, LAN, WAN, computer, interactive and multimedia services.

With our ability to help cable TV personnel stay current with the new developments in cable technology, I feel SCTE's services will have a greater impact on the industry's future than ever before. The telcos' entry into the cable field, which appears just over the horizon, could mean an explosion of fierce competition, mergers, buyouts and many cable professionals crossing over into telephony or finding themselves working with telco equipment.

New seminar

One way that we will help our industry deal with such situations is through our new seminar, "Introduction to Telephony." It is a three-day seminar designed for cable TV personnel that will provide information on the basics of telephone system operations, telephone networks and customer equipment along with various interconnect and service options.

The seminar also will be beneficial for nontechnical personnel who will receive a comprehensive understanding of the general workings of telephony. It will be presented by SCTE Director of Training Ralph Haimowitz, who is widely recognized throughout the telecommunications world as one of its foremost instructors.

We believe that the telephone companies are training their employees in cable TV. The question that faces cable television companies is, "Are you training your staff in telco technology?" We believe that the answer in many cases may be "no." That is why we developed a new seminar — to fill this void.

Offered as part of SCTE's Technical Training Seminar Program, which includes its "Technology for Technicians I and II" and "OSHA/Safety" seminars (both taught by Haimowitz at a variety of locations across the country), this course deals primarily with basic telephone systems and services. See "SCTE News" on page 19 for more details on the seminar's outline.

As the industry moves with the current of cable evolution, the Society will continue to work to serve the needs of its members. The name change reflects the changes that are occurring worldwide as cable-based companies exercise their flexibility and redefine themselves. So too, the Society will provide information and education on the different issues and methods as they develop. Changing technology will lead to the challenges of increased consumer demands and expectations. SCTE will be there to help you face these challenges. **CT**

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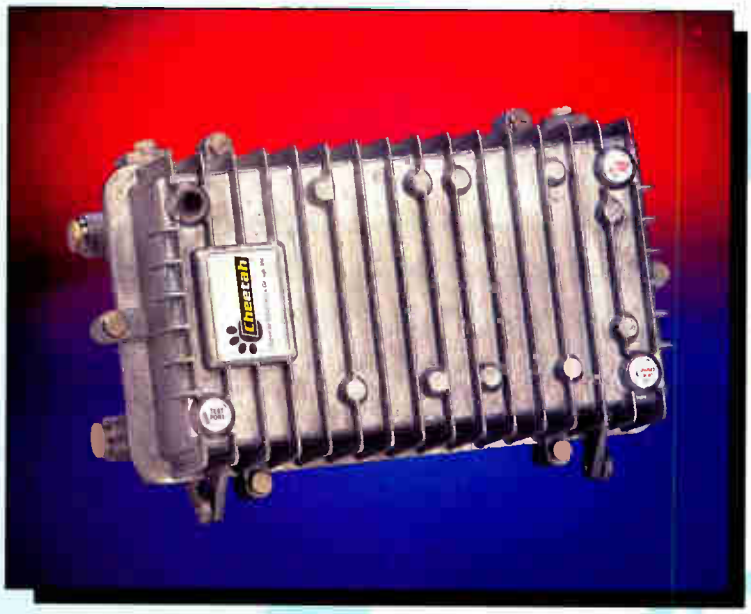

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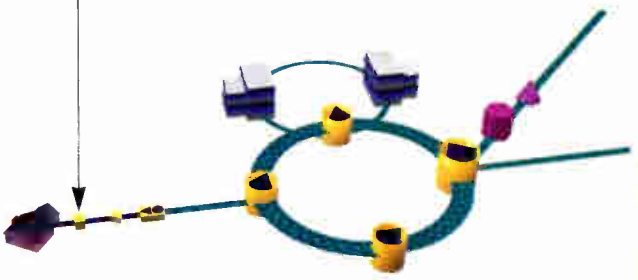

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