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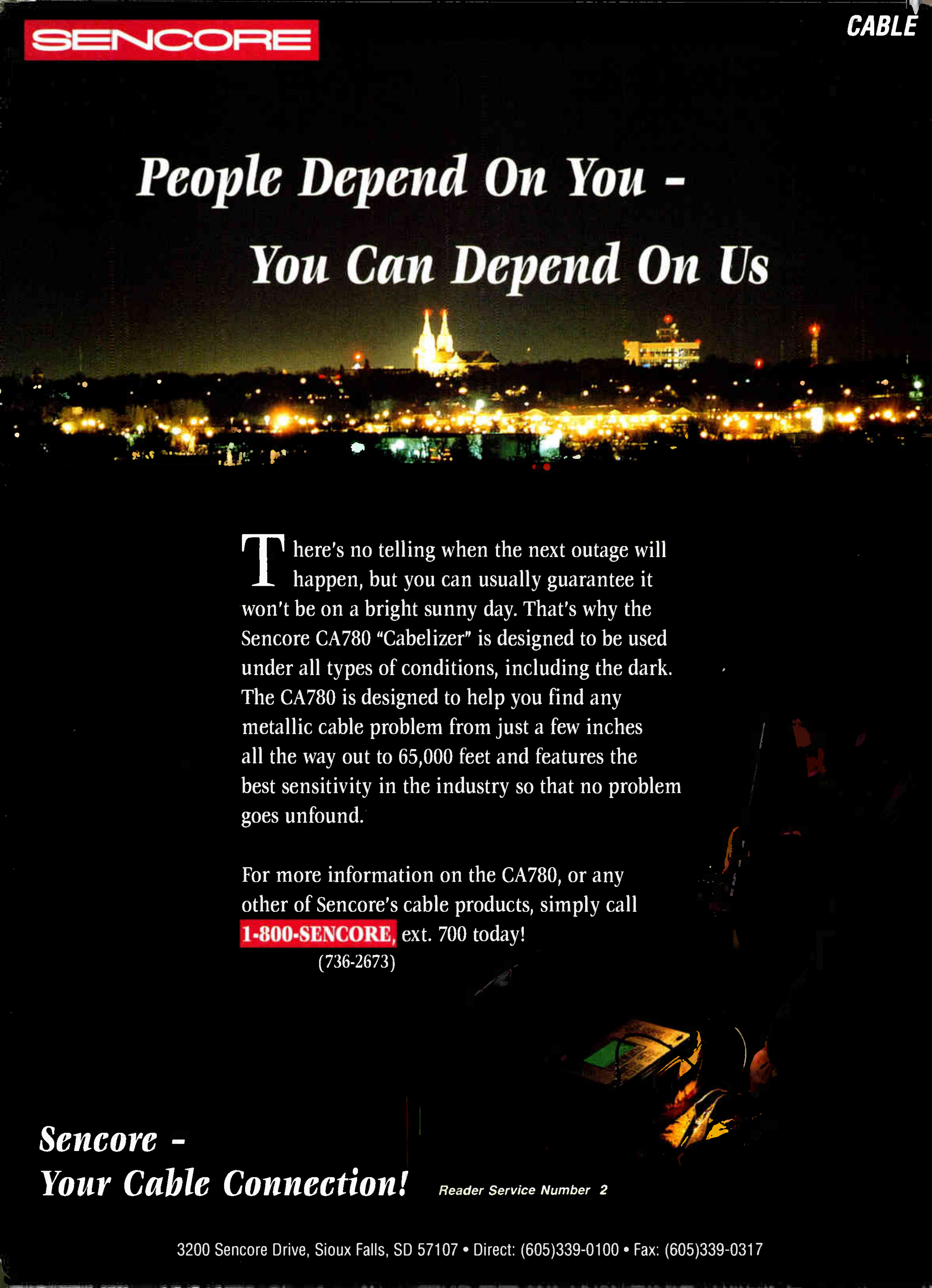
Future-proofing construction

June 1995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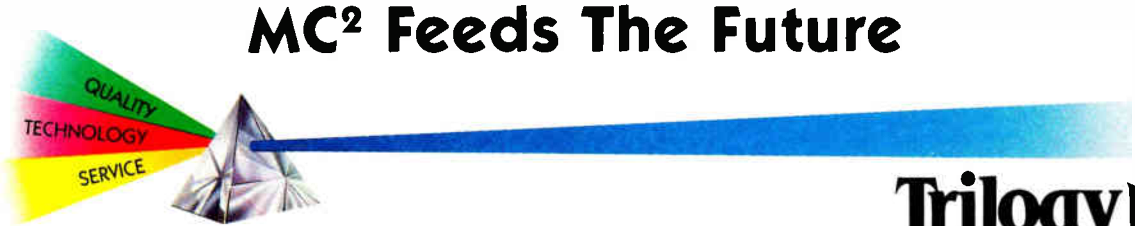

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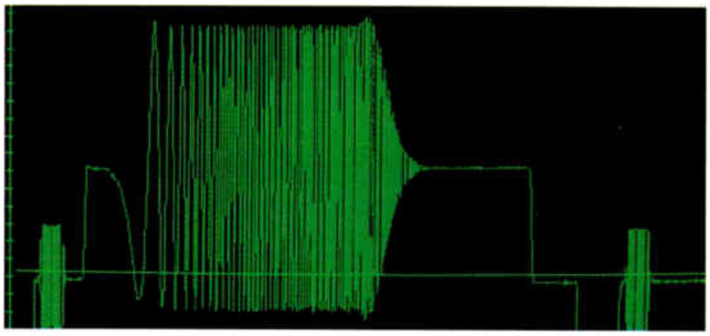

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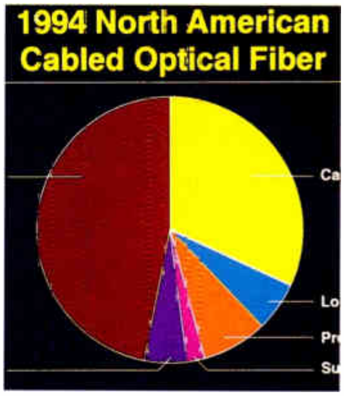

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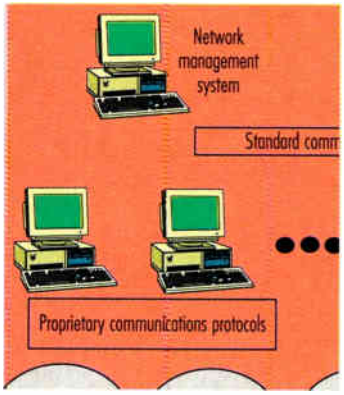

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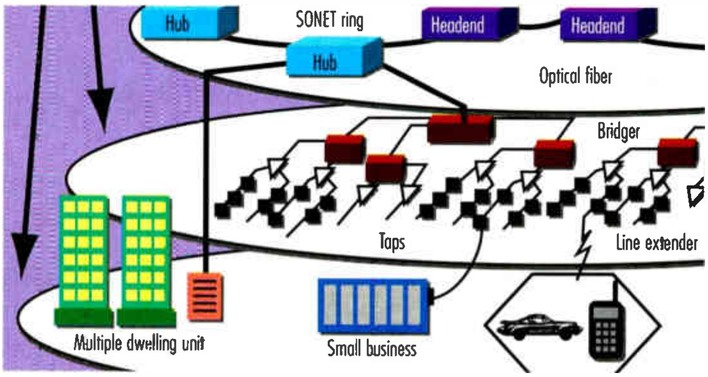

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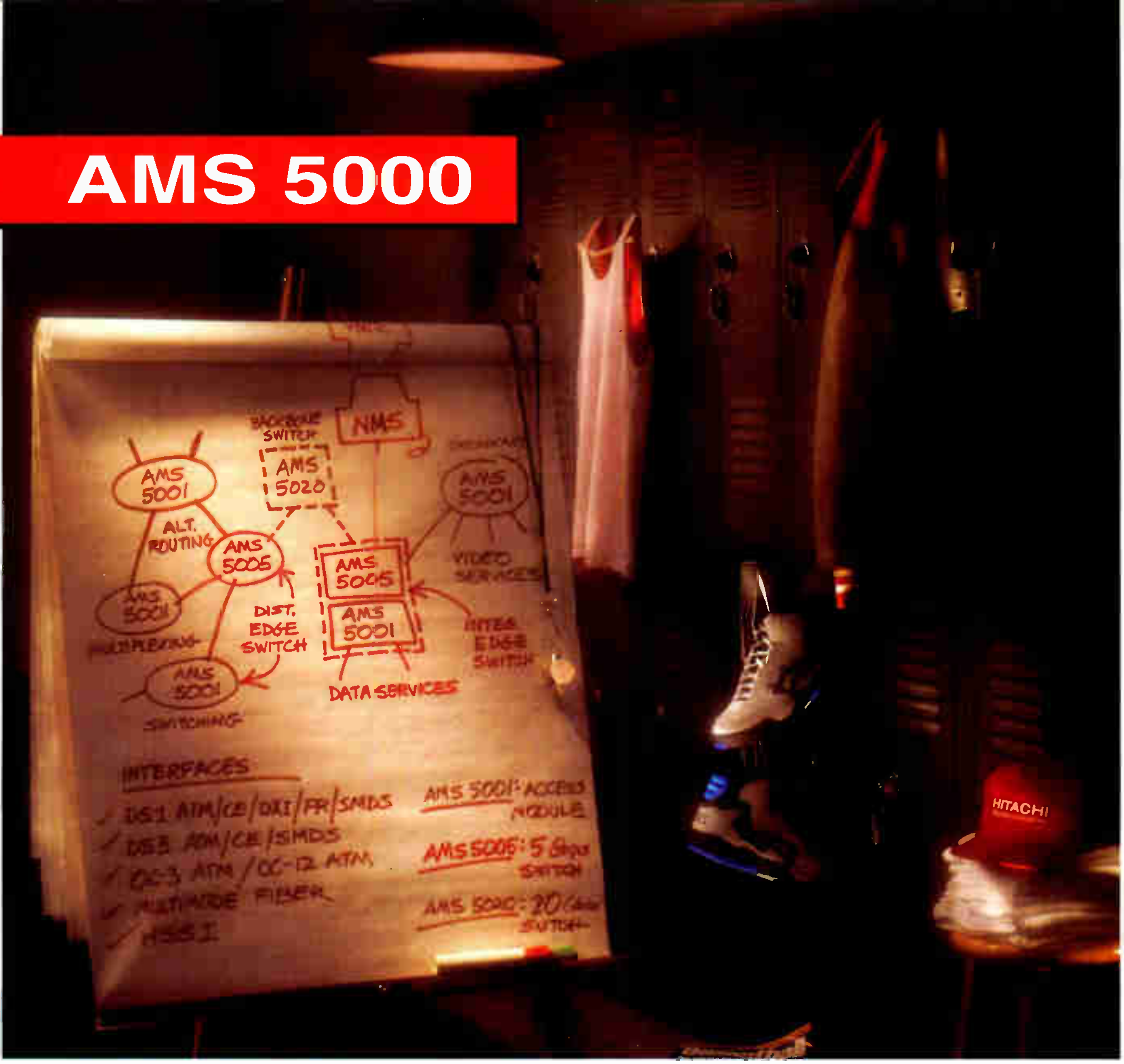

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EDITOR'S LETTER

Quality and reliability

Last month's National Cable Television Association convention in Dallas provided a look at interactive, data communications and telephony-via-cable technology. The future appears to hold a lot of promise for advanced nonentertainment CATV-based services, but at least one panelist cautioned, "We could lose the war." Judging by the results of a survey conducted for *Cable World* magazine (May 8, 1995 issue) by Talmey-Drake Research & Strategy Inc., we have a lot of battles to win in order to claim victory in the war.

Here's the bottom line: Before we worry much about the high tech stuff, we have to make sure the basic stuff is taken care of. First and foremost is giving our subscribers the confidence that we can be a serious player in the future of telecommunications. Right now, cable is perceived by much of the public as a low tech industry. According to the *Cable World* survey, when asked which companies would lead the way in developing the information superhighway, subscribers put cable next to last, behind AT&T (31%), IBM (20%) and the telcos (19%). We got a whopping 7% — barely ahead of Microsoft at 5%.

Bad programming (9%), not enough channels (9%), and high monthly subscription fees (14%) are among the top problems with cable, according to the survey. Also cited were poor reception (11%) and outages (11%). These latter two are something we in the technical community can do something about.

Coincidentally, one of the engineering panel sessions at this month's Cable-Tec Expo in Las Vegas is "Improving System Operations: Laying the Groundwork for Our Future." I'll be on that panel, speaking about two relatively low tech subjects: quality and reliability. I'm convinced that we must get these two right before we move beyond being entertainment providers.

Fiber-based architectures in rebuilds and upgrades, the use of high-quality equipment, preventive maintenance, proactive outage management, training, good installation practices and effective quality control programs collectively will do much to improve overall reliability. These efforts also will improve overall signal quality, but more important, we need to make sure we have a thorough understanding of the engineering process. Quality begins at the stage where we choose the architecture, set the technical specs and design the system. If we don't provide for it here, no amount of effort after the fact will bring subscribers the quality they demand and deserve.

Once we have reliability and quality under control, only then will we be prepared to move forward with advanced services. Of course, management will simultaneously have to work on the programming and cost concerns as well as do something about our low tech image. It's going to take a little public education and PR to turn that last one around.

CT's new look

As you flip through this month's issue of *Communications Technology*, you'll notice some changes. Although we look a bit different, our first and foremost commitment is still the same: Bringing you the technological information you need to continue to carry our industry into the future. We hope you find the new look attractive and easy to read.

Ronald J. Hranac
Senior Technical Editor

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CableLabs testing digital conformance

Cable Television Laboratories Inc. began digital video system conformance testing at its facilities in Louisville, CO. The tests will help verify the compatibility and interoperability of different vendors' compressed digital bit streams and decoders. The advanced phases of this conformance testing were approved by the CableLabs board of directors last December.

The bulk of work since then has been in creating the computer software and hardware configurations that will be employed in this testing. Currently, half of some 104 system transport stream elements and 75% of some 71 video stream elements are verified in the tested bit streams. The video parameters are checked to comply with the main profile at main level definition.

Tests are being performed on MPEG-2 transport streams at the system layer level using a common, agreed upon interface in order to test the video, audio, data, synchronization and multiplexing (not just elementary bit streams such as compressed video alone).

Comcast picks AT&T for broadband trial

Comcast Corp. will use AT&T Network Systems' HFC-2000 broadband access system for an integrated video and telephony services trial scheduled to begin early next year. This represents the first application of AT&T's hybrid fiber/coax (HFC) access platform with a major cable company.

Initial deployment will provide basic telephony services to approximately 1,000 Comcast customers. Also, the system will enable Comcast to offer a variety of other services to its customers including ISDN data services, dedicated data services and small business applications.

In other news, AT&T Corp. and Samsung Electronics signed agreements to support the integration of the Microsoft Interactive Television (MITV) platform in tests and commercial deployments around the world. AT&T and Samsung also have joined Insight, Microsoft's collaborative program, to prepare the broadband industry for early testing and deployment of MITV.

AT&T and Samsung join Alcatel SEL AG, Andersen Consulting Co., Lockheed Missiles & Space Co., NTT Data Communications Systems Corp. and Olivetti SDA in providing integrating support for the MITV broad-

Industry veteran Jimmy Schulz dies

Superior Electronics Group is saddened to announce the death of Jimmy Schulz, who died of a heart attack in Dallas on May 7. Schulz was the director of technical services for the company, a 20-year cable TV veteran, and is perhaps best known as chief engineer at Paragon in Minneapolis.

Jimmy was 42 and is survived by his wife, Vicki, and his two children Jeremy, 6, and Jason, 13. A memorial service was held May 12 in Sarasota, FL.

A memorial trust fund has been set up for the family. Donations can be sent to: Jimmy Schulz Memorial Trust Fund, South Trust Bank, 1800 2nd St., Sarasota, FL 34236, Acct. #01141662.

band network architecture, combining the operating system with a variety of servers, switches, set-top boxes and network operation and management software to provide a complete end-to-end system that can be deployed by network operators.

PowerTV forms interactive TV consortium

PowerTV formed an open consortium to provide information and guidance regarding the interactive TV market. The Partners in Open Wideband Entertainment Resources (POWER) alliance is made up of eight initial ITV-related hardware, software and operating systems companies. The alliance is dedicated to fostering open standards for the industry.

It will work with worldwide standards organizations such as ANSI/ISO and DAVIC (Digital Audio-Visual Council) to support open-architecture initiatives related to interactive TV. Initial members include Argonaut Technologies, C-Cube Microsystems, PowerTV, Scala, Scientific-Atlanta, Software Development Systems, Sybase and 3DLabs.

H-P signs digital deals

Bell South will be the first Hewlett-Packard MediaStream server customer to install the new H-P real-time MPEG encoding system in an upcoming field trial. Bell South is building a broadband network that will pass 12,000 residences in greater Atlanta.

In other news, TCI increased its intent to order H-P's Kayak system digital media receivers from 500,000 to 750,000. Total orders for the Kayak system topped 1 million units with a 100,000-unit intent to order from Cox Communications.

GI, ACTV pen compatibility deal

General Instrument and ACTV announced an agreement whereby ACTV's individualized programming technology will be compatible with GI's DigiCipher digital compression system. ACTV's software enables personalized interactivity for video, audio and data.

ACTV recently completed its InTV master control facility for its on-schedule commercial interactive network rollout. The facility is in Agoura Hills, CA.

• • •

Notes

Society of Cable Television Engineers President Bill Riker was presented this year's **National Cable Television Association's** Vanguard Award in the science and technology category at the National Show in Dallas.

Microsoft Corp. and **NBC** formed an alliance to develop and market branded multimedia products. The alliance covers a broad range of areas, including online service, CD-ROM, interactive TV and other digital products, as well as the integration of those efforts into traditional broadcast and cable TV.

The Video and Electronics Standards Association's open set-top standard received the support of the **National Cable Television Association, National Association of Broadcasters** and the **Interactive Television Association**, who will work together to complete the development of the standard that promises to bring video-on-demand, interactive TV and interactive games to the consumer market.

TCI Technology Ventures and venture capital firm **Kleiner, Perkins, Caufield & Byers** formed a company, to be called **@Home**, to provide Internet access through cable TV wires.

General Instrument established a long-term relationship with **Wink Communications**, licensing Wink's technology for use in all GI set-tops. Wink's technology allows various data-driven interactive services to be delivered as stand-alone applications including "virtual channels" that provide interactive weather reports, traffic updates and local community information.

Virginia Power will join **Cox** in a trial of **Nortel's** integrated digital transport technology in Virginia. Virginia Power will test the delivery of interactive energy management services over the hybrid fiber/coax network to a limited number of Cox and Virginia Power employees' homes.

Society selects UPC bar code

The Engineering Committee of the SCTE announced the issuance of an Interim Material Management Practice that calls for the use of the universal product code (UPC) as the bar code standard for the cable telecommunications industry.

This interim practice will be replaced with a wider-ranging Material Management Practice when that practice has been defined.

"This is the first step in the adoption of an overall electronic data interchange (EDI) practice," stated SCTE Material Management Subcommittee Chairman Tom Gimbel.

The EDI practice will allow trading partners in the cable industry to maximize the use of computer systems in controlling material inventory. The interim practice is being issued at this time in order to get the material suppliers started marking the material with the familiar bar code used in retail and industrial distribution channels throughout the world.

Gimbel comments, "The cable industry is moving toward the use of electronic systems to place purchase orders, receive invoices and settle accounts. The EDI system will reduce the cost of all material administration functions and facilitate 'just-in-time' management techniques."

The subcommittee's next step will be to issue a product and package bar code marking practice. This practice will outline what additional information will be marked on products and packages in bar code form.

The SCTE Material Management Subcommittee is composed of cable operators, equipment manufacturers and distributors. Membership is open to all participants in the cable industry. For further information on the Material Management Subcommittee, please contact Secretary Richard Pulley at (215) 665-1700.

Donations sought for new fiber seminar

SCTE is requesting the donation of equipment and materials to be utilized in its new basic fiber-optics training seminar.

Items needed include optical fiber, cladding removal and cleaving tools, an emergency restoration kit, power meters, optical time domain reflectometer (OTDR), cleaning pads and an alcohol/fiber cleaner, jumpers with connectors (ST, TC and SC), safety goggles and a mechanical splicer with reusable splices.

The Society also is seeking the support of a fusion splice manufacturer/vendor to attend the seminar on the afternoon of its second day.

This fusion splice representative will discuss the need for good fusion splicing in fiber systems, provide a fusion splicer, demonstrate how to make a fusion splice and allow each attendee to make one fusion splice that

meets normal minimum standards.

For additional information, please contact SCTE Director of Training Ralph Haimowitz at (704) 264-8310.

MSOs support Installer Certification

The Society is pleased to announce that 354 installers from over 70 companies successfully completed Installer Certification training and testing during 1994. The SCTE certification program helps ensure that employees are professional, knowledgeable and competent. In turn, their companies boast a more efficient work force and gain an enhanced image through increased customer satisfaction and confidence.

SCTE would like to recognize the companies that supported SCTE's certification program in 1994. What follows is a list of the companies that participated and the number of employees certified: Crown Cable (51); Comcast Cablevision (32); Viacom Cablevision (26); Continental (11); TCI Cablevision (11); Baker Installations (10); Paragon Cable (10); Colony Cablevision (9); Star Cablevision (9); River Raisin Cablevision (9); Columbia Cable (8); C-Tec Cable (8); Inland Valley Cablevision (8); Marcus Cable (7).

Survey indicates Society support

The need for and interest in certification for technical personnel were confirmed in a survey conducted at the 1995 Texas Cable Show.

Sixty industry professionals, 50% of whom work at the corporate or system general management level, participated in an SCTE training survey focusing on the amount and types of training provided for their technical employees and their opinions on the value of certification.

Here are some results:

• 80% of the respondents felt that technical certification was important to them, showing their strong support for SCTE's certification programs. They indicated that there are a variety of reasons for this support. Among the benefits cited were that certification "measures employees' qualifications," "improves job performance" and "improves customer satisfaction."

• Results show a variety of training environments and resources are being utilized. 37% said they train new employees through industry seminars (such as those conducted by SCTE's 73 chapters and meeting groups), and 40% train new employees through programs conducted at the system level. 61% percent of the respondents indicated that they provide ongoing training to employees through regional or national seminars, such as SCTE's "Technology for Technicians" regional seminars and Cable-Tec Expo, the industry's premier hardware trade show.

NJ Chapter to hold annual vendor fair

The Society's New Jersey Chapter will hold its third annual vendor fair June 29 at the TKR Training Center in Piscataway, NJ. Participating vendors include everything from bucket truck manufacturers to advanced technology companies (telephony-over-cable, interactive services and data-over-cable.)

For further information, contact Dan O'Sullivan at (908) 356-1110.

channel Surfing

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By Lawrence W. Lockwood, President, TeleResources, East Coast Correspondent

Ghost canceling

TV ghosts are multiple images caused by multipath echoes. Sometimes the situation shown in Figure 1 occurs. The receiving antenna may have a short direct path between it and the transmitter antenna. The same signal can reach the receiver antenna over a different longer echo path due to reflection off nearby buildings and other objects. Then the receiver will show two images, a strong main image and a weaker "ghost" of the echo shifted right on the screen. This is called a post-delay ghost or post-ghost. It also is possible for a ghost to occur before the main image resulting in a pre-ghost. In CATV the cable propagation is about two-thirds that of over-the-air transmission, so a signal from a broadcast transmitter will likely reach the subscriber before the same signal carried on cable. If the TV tuner has inadequate shielding, the broadcast signal will leak into the tuner and mix with that cable signal arriving a few microseconds latter (often referred to as DPU — direct pickup). The result is a pre-ghost for large delays and a smearing of detail for small delays.[1]

From a 1944 paper in the proceedings of the IRE (Institute of Radio Engineers — the predecessor of the IEEE), "It has become apparent that

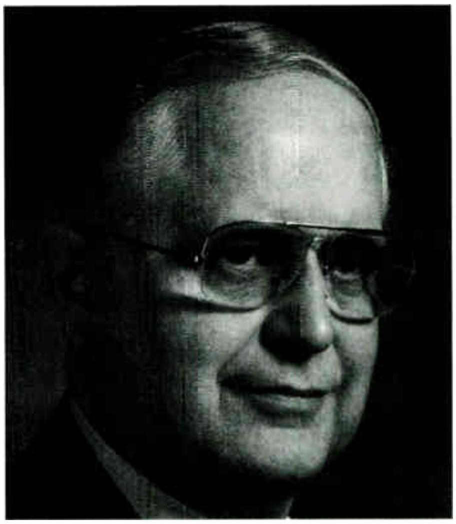


Figure 1: Ghosting conditions

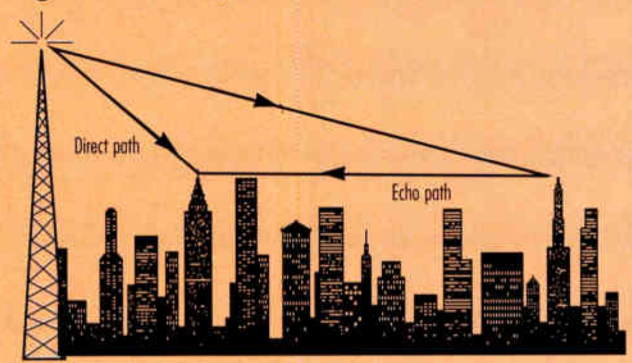


Figure 2: Simple RC low-pass filter

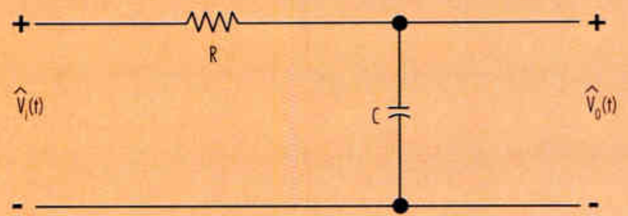


Figure 3: Block diagram of a digital filter

Figure 4: Simplified block diagram of a ghost cancellation system

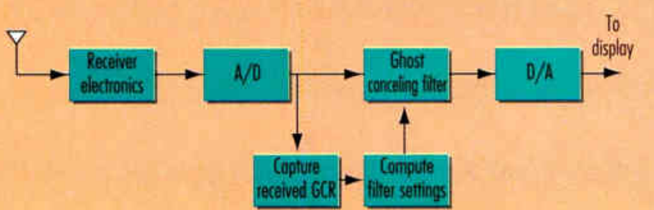
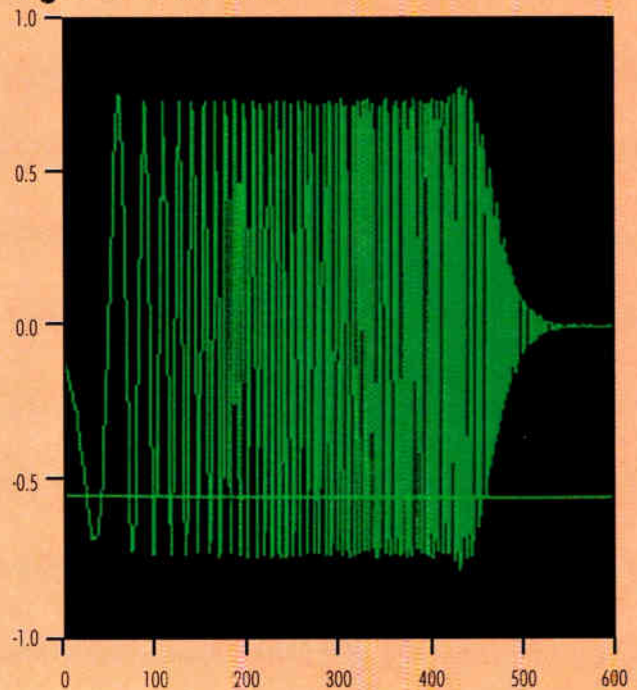


Figure 5: GCR waveform

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secondary images are the number one problem of the telecaster." Finally, after 50 years, the solution to this "number one problem" is at hand. This solution was really not possible before the recent advent of high-speed, low-cost digital electronics and the progress of developments in DSP (digital signal processing). As we progress into the transmission of digital signals, ghosting poses even more serious concerns. Instead of just an annoying secondary image, the ghost digital echo may interfere with the main digital signal strongly enough to prevent any reconstruction of the analog signal, i.e., effectively *no* signal reception.

Digital filters

Ghost cancellation would be impossible without the use of digital filters. Analog filters are implemented with the use of hardware combinations of capacitors, resistors and inductances — and transistors in the case of active analog filters. Figure 2 (page 16) shows a simple analog RC low-pass filter, i.e., passes lower frequencies and does not pass higher frequencies. The equation describing the action of this filter (where $\hat{v}_i(t) = 0$ for $t<0$) is

$$\hat{v}_o(t) = \int_0^t \frac{1}{RC} e^{-(1/RC)(t-\tau)} \hat{v}_i(\tau) d\tau$$

A block diagram of a digital filter is shown in Figure 3 (page 16).

Because the input to the analog RC filter is analog the first step for the equivalent digital filter is to have an analog-to-digital (A/D) converter at the input end to convert the analog input voltage $\hat{v}_i(t)$ into a digital signal $v_i(n)$. In a reverse manner a D/A converter is placed at the output end of the digital filter to convert the output digital signal $v_o(n)$ into an analog output signal $\hat{v}_o(t)$.

If software is created to satisfy the requirement of the filter equation, then the digital filter in the block diagram in Figure 3 (page 16) would be a computer — if implemented in hardware the filter would be a chip. The analog action of this filter (attenuating the high frequencies and passing the low frequencies) is done in the digital domain just by manipulating digital bits and thus achieves the same results that would be obtained by the use of hardware parts in the analog domain. Of course much more sophisticated digital filters can be implemented in the same manner.

How are ghosts canceled?

Ghosts are canceled in the receiver with a two-step process:

1) Characterize the ghosting channel →

Figure 6: GCR signal in Line 19 of the VBI

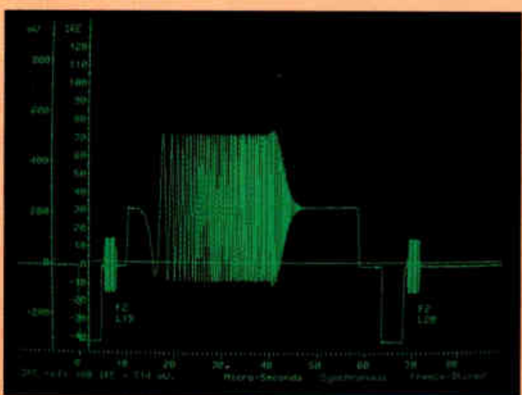


Figure 7: Block diagram of Philips ghost canceler, Vector

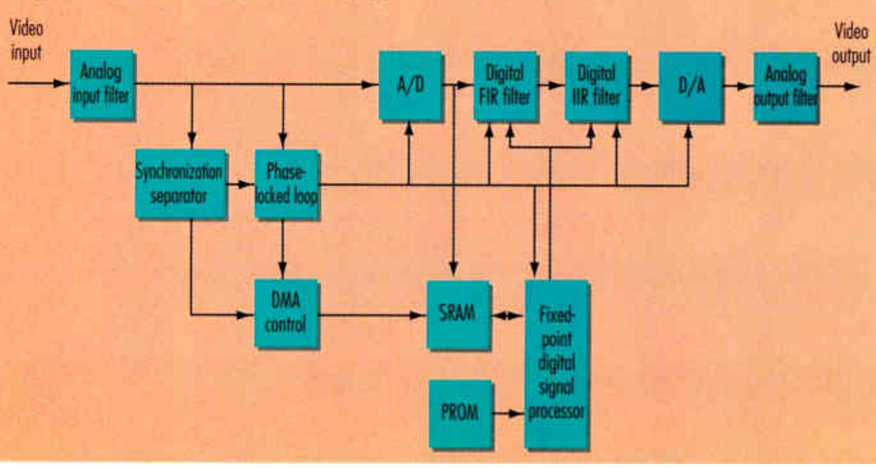
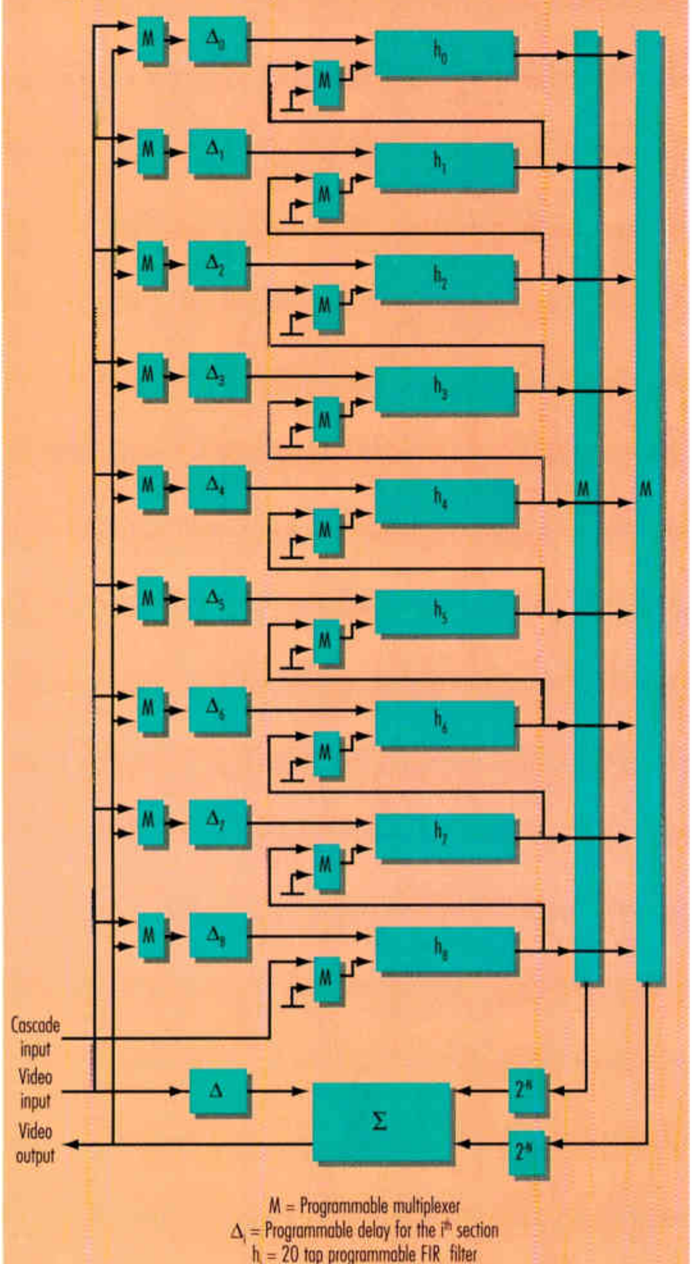


Figure 8: Block diagram of digital filter



2) Cancel the ghosts using adaptive digital filters

To facilitate the channel characterization step the broadcasting station transmits a "ghost cancellation reference" (GCR) signal. The received analog composite baseband video signal is converted to digital form by an A/D converter. See Figure 4 (page 16). The receiver compares the received, ghosted version of the GCR signal with a clear, stored replica of the same signal. The results of such comparisons are computed by a digital signal processor chip. The chip uses special ghost cancellation algorithms to calculate the coefficients to be fed to the digital ghost canceling filter that cancels the ghosts. This two-step process occurs continuously. The coefficients of the digital filter are being constantly updated to follow transient conditions as measured from the received GCR. The digital signal from the filter is then converted back to an analog de-ghosted signal.

In the Philips ghost canceling system the GCR signal is the key link between the broadcaster and the receiver. It carries all the information that the receiver needs to be able to successfully cancel ghosts. It looks like a swept-frequency chirp pulse, as shown in Figure 5 (page 16). In fact it is not such a pulse. Instead it was carefully synthesized to have a flat frequency spectrum over the entire 4.2 MHz band of interest to NTSC applications. (The spectrum of a linear FM chirp pulse is not flat.)

In recognition of the fact that commercial ghost cancellation would not be possible without a standard GCR signal the Advanced Television Systems Committee (ATSC) began to search for the most suitable GCR in 1989. The starting point was the GCR that was adopted as the national standard in Japan in that year after many years of research by the BTA (Broadcast Technology Association of Japan). The BTA GCR was a (sinX)/X signal rather than the flat frequency spectrum of the Philips GCR. In the 1989-1992 time interval, the ATSC Specialist Group on ghost cancellation compared the original BTA signal to four

Figure 9: Vector ghost canceler in operations

Figure 10: ImageLock GC2010 consumer ghost canceler

other candidates — submitted by AT&T/Zenith, Sarnoff/Thomson, Samsung and Philips. Tests were conducted in late 1991 and early 1992. Based on the results of these tests, the ATSC voted unanimously in August 1992 to recommend the Philips GCR as the U.S. standard signal. On Oct. 27, 1992, the FCC gave its approval for placing the GCR signal into Line 19 of the vertical blanking interval (VBI), making the Philips GCR and its VBI location the official U.S. voluntary standard. The GCR as inserted into Line 19 of the VBI is shown in the photo in Figure 6 (page 19).

Philips ghost canceler

Since 1992 Philips has offered a professional model ghost canceler called Vector for use in CATV headends. A block diagram of Vector is shown in Figure 7 (page 19). It can be seen as a somewhat more detailed version of the simplified block diagram of the ghost canceler in Figure 4 (page 16).

In the Vector the ghost canceling filter function is implemented with two digital filters, an FIR (finite impulse response) filter and an IIR (infinite impulse response) filter contained in two custom chips.[2] The FIR filter is used to cancel pre-ghosts, main signal distortion and post-ghosts. The IIR filter is used to cancel post-ghosts. Each chip has nine sections of 20 tap transversal filters with programmable delays. See Figure 8 (page 21). More details about the operation of these filters can be found in Reference 2. The digital signal processor (DSP) chip needed to perform the necessary calculations and control the ghost cancellation process is an off-the-shelf Texas Instrument TMS320C25 chip.

Specifications call for canceling ghosts in the range of -3 μs to +45 μs. The Vector is designed to cancel up to 13 groups or clusters of ghosts, where each group can contain several closely spaced echoes. David Koo, GCR project leader at Philips Laboratories and inventor of the Philips GCR system, stated that at times these specifications are exceeded. In CATV headends the units are normally used while being tuned to a single channel for long periods of time. On the other hand consumers often do rapid "channel hopping" or "surfing." To accommodate this additional digital memory is allocated in the consumer version to store initial approximations to the filter coefficients for each channel.

Field tests by the ATSC showed that ghosted images were improved about 95% of the time as a result of ghost cancellation. The magnitude of the improvements were such that most ghosted images had no perceptible ghosts after cancellation.

Performance of the Vector is shown in the photo in Figure 9, which shows two monitors — the left with a ghosted picture, the Vector digital ghost canceler in the middle and the right monitor showing the de-ghosted picture.

The Vector currently sells for about $4,000. Philips is now ready to release a single chip that handles all the tasks performed by the $4,000 unit. The chip will go into a consumer ghost cancellation box made by the Magnavox division of Philips at a cost of approximately $150. A photo of that box, called ImageLock, is shown in Figure 10. The chip ultimately will be designed directly into the TV set or VCR.

Conclusions

At the '95 National Association of Broadcasters convention, Alford Rodgers, vice president of Philips consumer electronics company, said "Approximately 50% of terrestrial broadcasters in the U.S. currently are broadcasting the GCR, and in the next 12 months we should be well on the way to 100%." The governments of Holland and Germany are considering the Philips GCR as the "defined signal"; Canada is in the process of adopting it; and it is already in use in England and Mexico. As Rodgers said, "Our overseas tests have gone well, and by all indications, Philips' GCR signal will soon become the standard for the world."

As noted previously, ghosting can be a much more serious problem in digital transmission than in analog transmission. The two most widely proposed modulation methods for digital transmission of television are quadrature amplitude modulation (QAM) and vestigial sideband (VSB). Multipath in digital transmission using these modulation methods is usually dealt with in the digital demodulators with a device known as an adaptive equalizer. The GCR inventor David Koo said that the GCR system can be made to work with both QAM and VSB transmissions and in his opinion will perform better than adaptive equalizers.

Well, time will tell but the comfort level is definitely improved as we venture into the new and different world of digital transmission with more tools in our toolbox. **CT**

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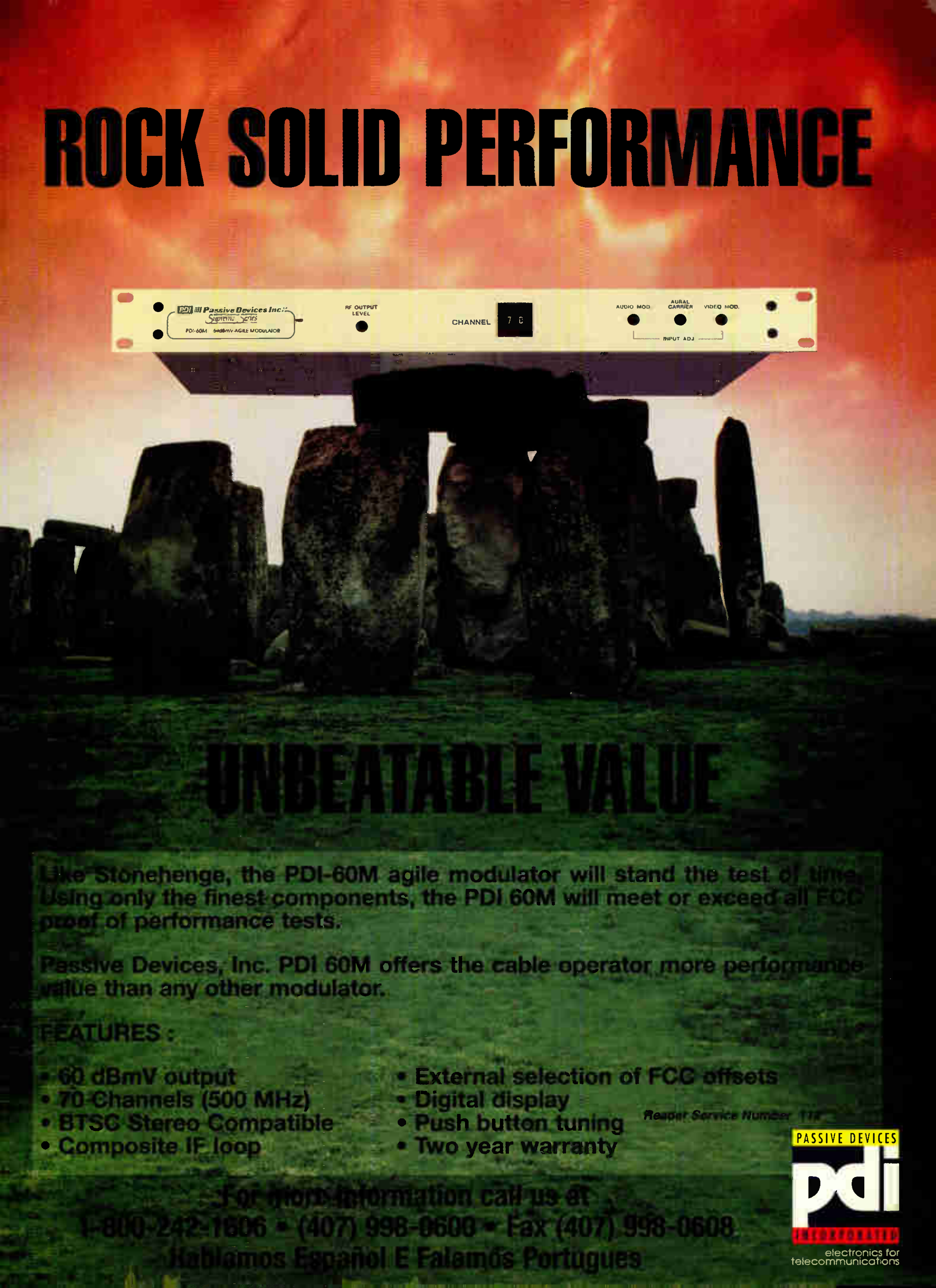

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By Bob Luff, Chief Technical Officer, Broadband Group, Scientific-Atlanta

Powering: 90 volts?

Should the cable industry be preparing for 90 volt system powering? Pressures appear to be mounting for increased plant voltage for several competitive and technical reasons. But there are safety issues to weigh carefully.

Why 90 volts?

Today's more competitive telecommunications environment is creating increased interest by both cable operators and telephone companies in providing telephony services over existing or newly constructed broadband networks. And because telephones are sometimes needed in safety-of-life situations (medical emergencies, burglary, fire) both industries favor powering the customer's on-premises equipment, the customer interface unit (CIU) and phones, from the broadband plant rather than from the home. This allows the broadband network's standby power supplies to power the telephone equipment even when there is a local power outage.

However, the impact of thousands of these small additional loads distributed throughout the plant results in higher average current levels all over the system as well as even higher peak levels. Peaks?

Today's CIUs may require a few watts in the standby mode and 3-4 watts when active during the period of a telephone call. The concept of variable plant powering requirements is new to cable operators accustomed to nearly constant trunk and line extender amplifier loads. But since CIU power requirements increase from standby during active-call status, the worst-case plant load must assume situations when half or nearly all customers desire to go off-hook to make a call during the same period (Mother's Day or a communitywide emergency).

However, added total telephony powering requirements on systems with older long cascade architectures can result in current requirements exceeding the overall plant design as well as exceeding certain individual components, such as the current rating of taps, directional couplers, or amplifier power-passing circuits. Meltdown!

So how does increasing system voltage help? A system redesign would be very expensive, especially in underground areas where it is almost impossible to relocate network components without significant reconstruction costs. But Ohm's law tells us, for example, that current levels would be reduced from 30 amperes to just 20 amperes by a system powering increase from 60 volts to 90 volts. Accordingly, a system can easily reduce its maximum current requirements by simply increasing its adoption of a higher plant operating voltage.

It also is believed that network powering of telephony reduces expensive service calls caused by various customer powering problems such as inadvertently unplugging the power transformer or having its power interrupted from a switch or blown circuit breaker. Further, the installation process could be much more complicated if it is necessary to route power from somewhere in the house to the outside-mounted CIU.

Various studies suggest that the negative impact of power line spikes from transients and lightning would be reduced in systems operating at higher voltages. And, at higher operating currents, the $I^2 \times R$ cable power losses increase by the square of the current. In many systems the power bill can be as high as the gasoline bill for the service trucks. So, improving a system's overall powering efficiency represents a savings of important annual dollars in a competitive industry. And over the life of these systems, the savings are even more significant.

Why not batteries?

If the primary concern is local power interruption, why not use home-mounted backup batteries for the CIU? Well, the argument against relying on home-mounted batteries, is that you can't rely on them! Like all rechargeable batteries, they would go bad over time and the customer would not know it. Even with some kind of reminder to replace the batteries, many consumers would not, leaving them vulnerable to power-related outages. Also, it would be difficult for network operators to maintain consumer batteries located inside customers' homes without a service call, and mounting the battery outside in the CIU would expose the battery to freezing temperatures in many locations. Network operators would have the responsibility of properly disposing of millions of worn-out rechargeable batteries laden with heavy metals. →

"There is no reason for accidents to increase with 90 volt system powering."

Despite these issues, many believe that over time emergency powering by batteries may shift back to consumers. Proponents point to the fact that consumers are already comfortable with "safety-of-life" battery responsibility in smoke detectors, portable and wireless phones. Also, the home security industry relies on home-based rechargeable batteries that are maintained as part of the service contract.

How would systems repower?

At one time the cable industry practice was to use 30 volt power supplies. But as service areas and cascades grew along with higher bandwidth, and more sophisticated amplifier technologies evolved requiring more power, so did system over-current requirements. The change to today's universal 60 volt powering practice occurred painlessly over time by manufacturers building dual voltage power packs fitted with field-selectable jumpers that line technicians could change as they upgraded their systems leg-by-leg to 60 volts, usually in association with a general plant upgrade to higher bandwidths. An upgrade to 90 volts would be implemented in the same fashion today. In fact, many amplifier manufacturers are already selling equipment that is ready for 90 volts today.

Safety first

But there is a potential safety and regulatory issue that must be considered. Safety organization codes such as National Electrical Code (NEC) and National Electrical Safety Code (NESC) specify maximum voltages allowable on cables that are located in the communications area on poles and around dwellings where the general public could come in contact with them.

These rules have generally restricted cable operators from using higher than 60 volt powering. Several initiatives are underway to have these rules amended to allow higher voltage, such as 90 volts. Of primary concern is the safety of employees and the public. While 60 volts has potential to kill, many experts believe 90 volts has that risk even more so. The danger is not limited to electrocution. Serious accidents can occur when employees or the public working on ladders or the roof inadvertently come in contact with exposed voltages (squirrel or abrasion damage) and suffer a startling shock that cases loss of balance and a fall. Even unsuspecting employees of another utility accustomed to cable's lower voltage threat could be caught off guard. This is of course a concern to safety organizations.

There is no reason for accidents to increase with 90 volt system powering if operators properly train and inform all those involved and insist that all safety precautions be followed at all times. Cable has been challenged in maintaining training levels over the years because of higher employee turnover than other utility-type companies routinely in contact with high voltages.

Conclusion

Competition and technology advances may stimulate some broadband systems to consider increasing plant powering to 90 volts. Safety organizations are reviewing the issues and it is likely provisions will be made for conditional approvals. Many vendors already have 90 volt equipment available. But to take advantages of the benefits higher system operating voltages may provide, systems must recognize the importance of safety issues. **CT**

Recipient of Communications Technology's 1995 Service in Technology Award

Time Warner's FSN team

The FSN Team: 1995 Service in Technology Award

This year "Communications Technology" is proud to present the Service in Technology Award to the team at Time Warner Cable responsible for making the Orlando, FL, Full Service Network (FSN) a reality. What follows is a short overview of the technology and the people behind the FSN.

By Andy Morris

The launch of Time Warner Cable's FSN in Orlando, FL, was not only a triumphant convergence of technologies but also an interesting convergence of corporate cultures. The cable engineers from Time Warner and Scientific-Atlanta learned how to decipher the jargon and work in concert with engineers from Silicon Graphics Inc. and AT&T in order to develop and implement the technology that made the FSN possible.

The players

Mike Hayashi, vice president, advanced technology, Time Warner Cable, explained that Time Warner Cable engineers easily mastered this art of corporate convergence since Time Warner itself is composed of so many diverse companies.

"Time Warner has Time Warner Cable, Time Inc. magazines, Warner Brothers Studios and Warner Music. We are already communicating with and working with many strange and diverse cultures within our own company," said Hayashi.

"In Orlando, our partners included

The Home Communications Terminal by S-A, SGI and Toshiba.

Michael Adams is a senior project engineer with Time Warner Cable responsible for ATM networking in the FSN. Previously he was a manager of ATM switch software development for Bell Northern Research in Canada.

Adams graduated from the University of Bristol, England, with a BSc in electrical and electronic engineering in 1976. He worked with Kent Process Control as a hardware and software designer for two years before moving to Digital Equipment in Reading, England. Here Michael worked on diagnostic and communications software including narrowband ISDN. Michael moved to Ottawa, Canada, in 1988 to join Bell North Research and worked on fiber-to-the-home, SMDS, frame relay and ATM projects. He joined Time Warner Cable in 1993 to work on the FSN as a network architect and project manager.

Ralph Brown is currently a senior software engineer at Time Warner Cable Engineering and Technology in Englewood, CO. In this position, he is responsible for the design of interactive TV software architectures for the FSN. Prior to joining Time Warner Cable, he was a software engineering manager at Solbourne Computer Inc.

Ralph earned a master's degree in electrical engineering from Massachusetts Institute of Technology. His thesis work at MIT was in speech recognition. He received his bachelor's degree in electrical engineering, Summa Cum Laude, from North Carolina State University.

After completing his degree at MIT, Brown designed packet switching hardware at Bell Laboratories in Denver. Subsequently, he worked for Precision Visuals designing and developing device independent graphics software. He then moved to Sophia Antipolis, France, to work for LogiTec SA, developing software for computer animation and video production. He joined Time Warner Cable in 1994 to work on the FSN as a software architect and technical project manager.

John Callahan is software program manager with Time Warner Cable responsible for software technologies development in support of Time Warner Cable's vision of broadband, interactive, multimedia communications and entertainment services on its FSN architecture.

Callahan has held several previous positions in systems software development, systems engineering and telecommunications network engineering with AT&T Bell Laboratories and US West Advanced Technologies prior to joining Time Warner Cable (on loan from US West).

John holds a B.A. in computer science from Ohio Wesleyan University and a M.S. in computer science from the University of Illinois at Urbana-Champaign. He has focused his engineering efforts on narrowband messaging and broadband information services architectures. John joined Time Warner Cable in 1993 to work on the FSN as a software systems engineer and program manager for systems software development.

US West, Hitachi, Toshiba, Objective System Integrators and Anderson Consulting as well as SGI, S-A and AT&T. Orlando was probably the very first project that brought not only Time Warner but all the other companies into the one goal of deploying an interactive network."

Initial development for the Orlando FSN took place at Time Warner Cable headquarters in Denver. Hayashi said, "We were the integrators, the program managers, for the Orlando project. We had to make sure our partners were focused on working toward the right common goal.

"It is important to understand how we chose our partners. I believe we chose the best in each of their respective fields and this means that the work they performed in the past has been done correctly.

"If you look at SGI, it is very strong in the graphics environment, in high-end computing. It is the best in that field and the company grew in that environment. As for AT&T, its GCNS-2000 ATM switch is the largest in the world and it is number one in the marketplace. S-A, of course, has always been a leading supplier to the cable industry."

Hayashi added, "We all had our beliefs in how things should be done and there are many ways of doing any one thing. When you are working with companies of that quality, there are, naturally, a lot of creative differences on how things should get done. And that's where you can call it conflict, but on the other hand that

Lynn Edwards graduated from Furman University in Greenville, SC, with a B.S. in computer science/math in 1990. She graduated from the University of Colorado at Boulder with a master's in computer engineering/telecommunications in 1993.

Edwards joined Time Warner Cable in 1994 to work on the FSN as an associate engineer.

Michael Hayashi is currently vice president, advanced engineering for Time Warner Cable Engineering & Technology in Englewood, CO. He oversees the company's FSN development, subscriber technologies and network engineering.

He was appointed vice president, international development, for Time Warner Cable in 1992, where he was involved with the next generation of terminals and provided vital international liaison with the company's Japanese partners.

Prior to joining Time Warner, Hayashi was vice president and general manager of video systems for Scientific-Atlanta and was responsible for product line management of all addressable equipment, including set-top terminals, interdiction technology, international activity and commercial MMDS hardware. His technological accomplishments include the development and introduction of the first set-top with on-screen display and other easy-to-use interactive features.

The FSN's remote also is the video game controller.

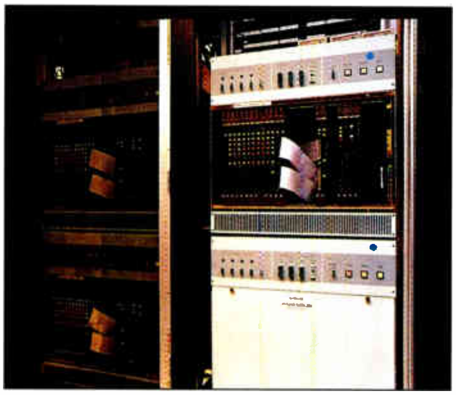
is how integration takes place.

"SGI, S-A, AT&T made the true engineering efforts that went into the FSN. They were the technology developers that helped us put this together. We were the agents that made sure things took place in a timely fashion. We made sure the communication was there. We performed technology conflict resolution. We functioned as the integrators of this engineering R&D program."

Culture clashes?

Hayashi discussed the cultural differences between the different partners.

He said, "Of course, there was the acronym thing and we had to go through our own understanding of



Hitachi built the multiplexer/demultiplexer used in the network.

AT&T's ATM switch can send 20 gigabytes per second.

what the languages were. Today, we all have a vocabulary that is really quite extensive!

"There were obvious cultural differences between the East Coast-based AT&T and S-A with their suits and ties and the free, creative West Coast Silicon Valley environment of SGI. Time Warner Cable, based in Denver, was in between both culturally and geographically. When we initially assembled for a big meeting in Denver you could immediately tell who was from where."

Hayashi stated, tongue-in-cheek, that a close second to the achievement of building the FSN was that these multiple company multicultural meetings "did help us convince our management that casual dressing is good."

The relevancy of technology

On a more serious note, Hayashi explained, "There was a tremendous amount of focus on technology itself, but the dynamics of integrating these working environments was the most difficult challenge. Integration means that when all the entities are brought together they work as a coherent unit. That's true for equipment, that's true for software and that's true for people. I think we are all going to go through the integration process in the next couple of years."

"We learned that a lot of the theories we believed as engineers were wrong. We learned that we are not consumers — that consumers are consumers. We learned the value of extensive user-interface testing and consumer behavior testing. We learned something about what consumers do and don't want to see on their TV sets and we learned some-

James Ludington is vice president, technology, for the FSN in Orlando. Prior to this, he was the project director for Quantum, the world's first 150-channel cable service launched in Queens, NY, by Time Warner in 1992.

Ludington joined Time Warner in September 1982 after graduating from Colorado State University with a B.S. in industrial construction management. As project manager from 1983-1988, he directed projects in Austin, TX; Burlington, NC; Colorado Springs, CO; and Queens, NY.

Jay Vaughan currently is director of engineering for Time Warner Cable in Denver. His current mission is to advance TWC's interests in the emerging standards forums and in technical advisory/regulatory arenas, such as the EIA NCTA Joint Engineering Committee subgroups. Jay also has responsibility for TWC's National Training Center and launch support of new services such as the Sega Channel.

He began his career in cable 18 years ago as the single technician in a small system outside of Austin, TX. After spending a couple of years working for Jerrold/GI, he spent four years with Rogers Cablesystems in California and Texas prior to joining American Television & Communications in Denver in 1987. Vaughan spent two years in France for ATC on a consulting project and worked on advancing Time Warner's fiber architecture after returning from this oversees assignment. He also worked on set-top deployment and other projects prior to his current assignment.

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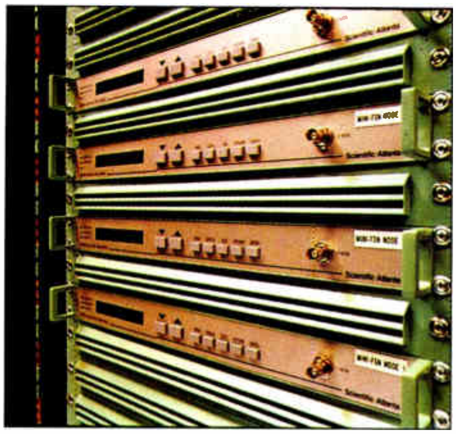

S-A's QPSK modulators receive data streams from the MUX.

Servers by Silicon Graphics store nearly 2 terabytes of information.

thing about which interactive services appeal to consumers. The things we all learned in this area were very, very valuable."

Hayashi said that the Orlando project gave him and other Time Warner Cable engineers a better understanding of the relevancy of software integration.

"When you are writing a couple of million lines of code, you just don't go into a room and hack it. You need to have a certain amount of structure and then you have to ask yourself, 'What are the relevant structures?' I think as an industry we are beginning to understand how important this kind of software development is to our business."

"The design and implementation of the Orlando FSN was a tremendous learning experience for all the partners," continued Hayashi.

"In terms of switch interfaces, I don't think we had a situation where we were building a tunnel from both ends and we got to the middle and we were off by a meter. That didn't quite happen because we were able to tightly integrate the communications aspects associated with the project.

"The funny thing is that despite all the communication and coordination and despite how well we all worked together — until the day about one year ago when we actually saw the end-to-end environment and actually touched the converter and ran an application — we all had a very different understanding of what the FSN would look like."

The actual launch of the FSN in Orlando was very gratifying for Hayashi and the full team of engineers involved in the Orlando project.

"When (Time Warner CEO) Gerry Levin turned on the system and you saw the Carousel (SGI's interactive navigational user-interface) come up — it was a very moving thing when the audience actually clapped and cheers went up. I've never been to a technology exhibition where the audience cheered. It was very stunning for all of us."

Hayashi indicated that the real work has just begun in Orlando. "The Time Warner Cable people in Orlando now have the task of developing applications that are extremely exciting and stimulating to the consumer. I think we have a tremendous opportunity to do that in Orlando," he said.

Hayashi added, "The next step is to go into a very extensive application development and consumer behavioral study in Orlando. That is really important for us because if we have a very good understanding of how consumers interact with the system we will be able to design a much more efficient network. That is what we will be working on for the next year or so."

Behind all the interactive hype, Hayashi believes truly significant technology and product developments have occurred. "Core technology developments that are already taking place in our business include 64-QAM modulation, digital video compression and the video server. Efforts in all these areas are well underway. After work in those areas is complete, we will be ready to fully deploy those technologies. At that point of time we should be ready to roll out a very good and very extensive suite of interactive applications," he said. ■

Susan Whitehead is a senior program director in US West's Multimedia Group who spent 15 months at Time Warner Cable assisting in the deployment of the FSN. She has 24 years experience in information systems management, customer needs analysis, and program/project management. She was program director — FSN, responsible for program managing the technical deployment. In addition to managing the interface to the eight major teaming partners providing products/services to TWC, she was key to driving integration testing, quality and processes.

Whitehead is a project management professional with the National Project Management Institute, a founding and active member of the US West Board for Program Management, and a founding member of US West's Strategic Electronic Data Interchange Board.

Louis Williamson is senior project engineer in the Time Warner Cable Engineering & Technology. He graduated from Virginia Polytechnic Institute and State University in 1980 with a BSEE. He worked for Martin Marietta Aerospace from 1980 to 1983 in the RF systems group were he was involved with various projects in the electronic warfare area.

Williamson joined the research and development group of American Television & Communications (now Time Warner Cable) in 1983. He has worked on numerous development projects in his 12 years at Time Warner Cable, most notably his work in the field of fiber optics and recently on the FSN.

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Andersen Consulting is delighted to add its congratulations to the accolades the Time Warner Cable Full Service Network™ Team has already received, as the recipients of the 1995 Service in Technology Award from *Communications Technology* magazine.

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Reader Service Number 89

By Larry R. Linhart, President, Nacom

Installation services: Increase quality, decrease cost

Many cable companies are looking for ways to comply with the National Cable Television Association's Customer Service Guarantee Program without incurring extra costs. Many believe they can get more control over quality and save money by using more of their own in-house staff (rather than contractors) for installation services. But will this really solve the problem?

When you take a hard look at the installation operation, you'll find that most of our problems start before the technician arrives at the customer's home. Before we can improve the quality of the job, we must improve our system of identifying the customer's needs. In other words, we need to improve the quality of the work order. Then, if we can streamline the installation processes, we'll improve the quality of the job and save money. Operations can become the strategic way for the cable industry to stay competitive.

Improve information flow

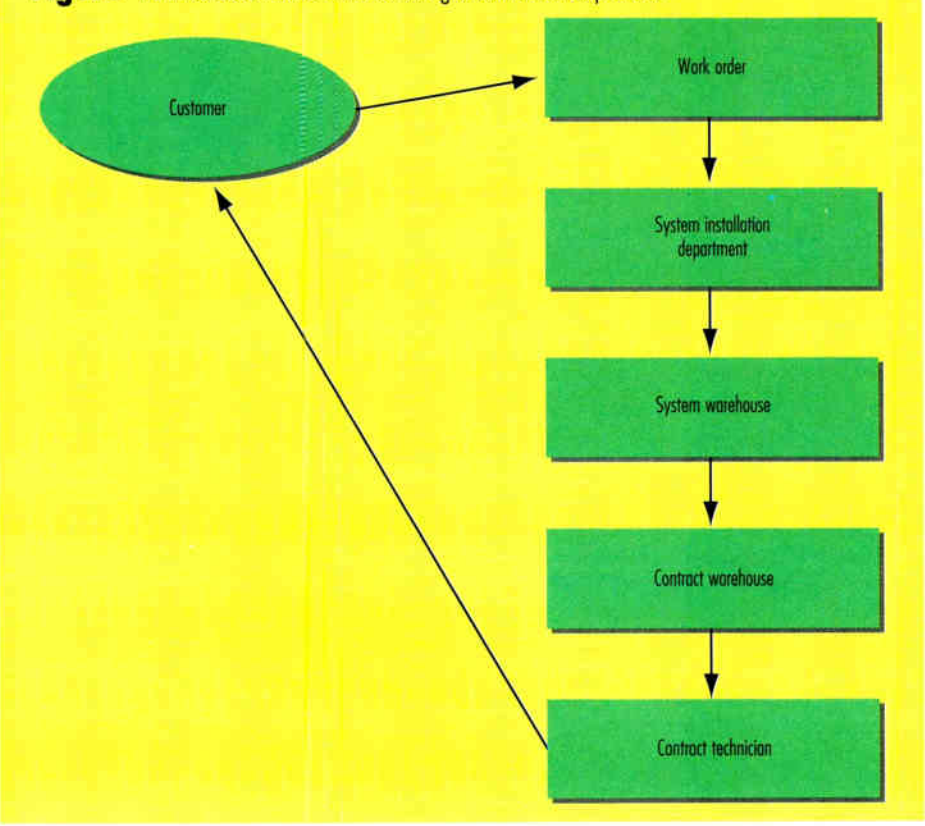
How much can you expect to save by streamlining operations? An article in the Nov. 28, 1994, issue of *Fortune* says, "So clogged is the gross national pipeline with unnecessary steps and redundant stockpiles that the grocery industry alone believes it can wash $30 billion, or nearly 10% of its annual operating costs, out of the system." Cable companies, as well as grocery stores, can benefit from this basic theory: Get rid of the duplication and inefficiency and you'll have more opportunity to get cost out of the supply chain and give quality to the customer.

This is not easy. Finding ways to improve the information flow and streamline processes is a tough challenge. W. Edwards Deming, the man who developed a theory for quality improvement provides insight that cable companies can use. He explains that we must break down barriers, especially communication barriers, with our customers. We must find the most direct path to the customer, and get rid of all processes that stand in the way.

"This is precisely what the cable industry needs right now," says John Santangelo, regional director of technical operations, Charter Communications, St. Louis. "We're facing increased competition and a mandate to improve customer service. We must find ways to reduce our costs and give our customers more of what they want."

The grocery store industry is facing problems not all that different from the cable TV industry's. Wal-Mart-type chains, with very efficient distribution systems, are giving grocery stores unwanted competition. And similar to the NCTA's Customer Service Guarantee Program, the grocery industry is fighting back with its own initiative, "Efficient Consumer Response." Keith Wagar, vice president of procurement and in-bound logistics at Spartan Stores, Grand Rapids, MI, said in the previously mentioned *Fortune* article, "We've got to eliminate all the activities that don't add value to the consumer. Our only chance is to look at the transaction from manufacturer to consumer as a single process. It's a strategy for survival, a strategy for growth."

Figure 1: Processes that can make using a contractor expensive



The source of the problem

Similarly, if we analyze the cable installation transaction from the creation of the work order to final installation, we can begin to see a solution. The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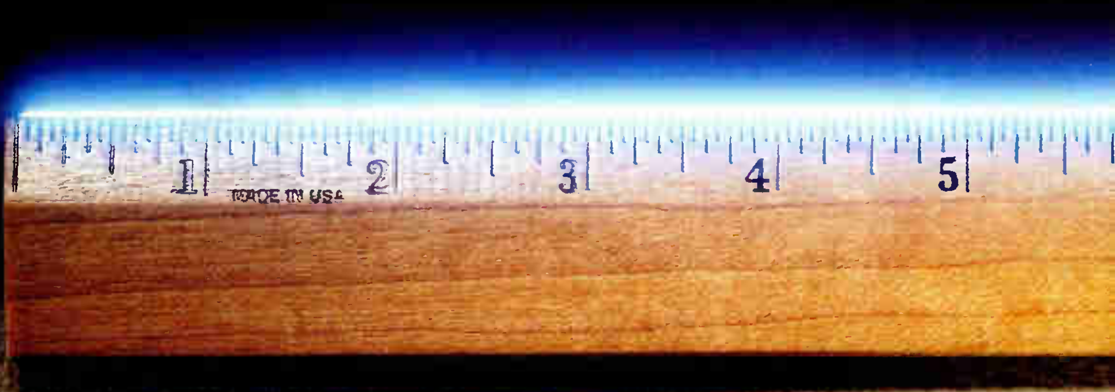

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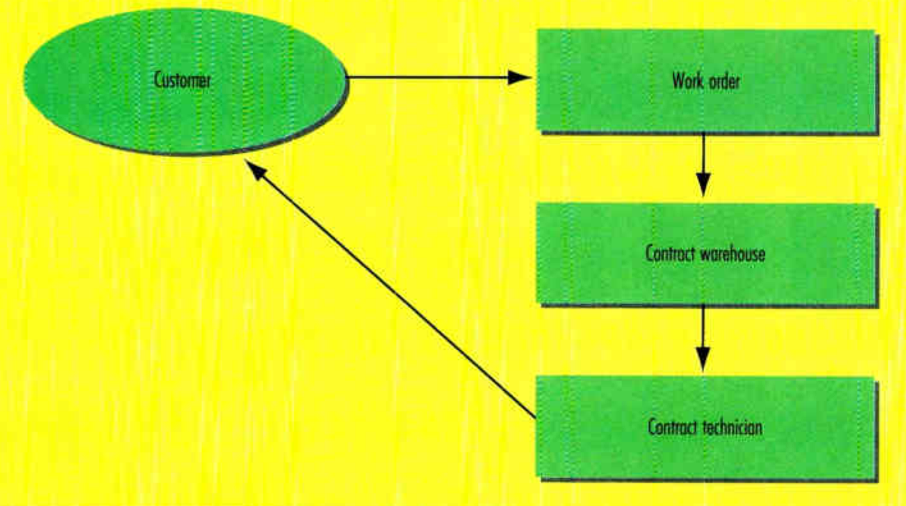
Figure 2: Save money by eliminating processes



person responsible for creating the original work order is the customer service representative (CSR) or salesperson. In most companies, this person has a very limited knowledge about the installation function. Their core responsibility is to sell programming packages and enter the customer into the billing system. Many do not have the training, nor the time, to ask the kind of questions that will precisely identify the work the customer needs.

For example, a CSR may pre-qualify a customer by asking, "Do you have cable service in the room you want it?" If the customer says yes, the CSR may assign four points to the job. (Each point equals 10 minutes.) When the technician arrives, however, he or she finds that cable is in the right room, but on the wrong wall. So what was ordered as a reconnect has become a reconnect and relocate. That's added work not reflected in the work order and not reflected in that technician's schedule. This creates a backlog, and the on-time guarantee promise is a problem for all other customers the rest of the day.

One solution might be to give the CSRs additional installation training. We need to remember, however, that the installation function is only a small part of CSRs' jobs — their main responsibility is to sign up the customer, explain the billing process and sell additional programming services. We could wind up spending a lot of money that will probably do little to improve the overall quality. The CSR's job is too important to be compounded with crucial installation service responsibilities.

Solving the problem

Another way to solve the problem is to create a new position — an installation specialist — who has the sole responsibility to ensure the work order is accurate. This will be a full-time, professional position that requires specialized training.

This is how the new system would work. Once the CSR has entered the customer on the system, the installation specialist will get a message on his or her computer terminal. The specialist will then contact the customer and ask the customer the right questions to create an accurate work order that will enable the customer to get on-time service. Following Deming's advice, we're breaking down communication barriers with customers. This strategy may not eliminate all mistakes, but it will dramatically improve the quality of the installation service.

This means we can improve service and minimize the conflicts between the customer and the cable company.

Eliminate duplicate processes

What about reducing costs? Deming explains that one of the best ways to minimize total costs is to award business to outside contractors and build long-term relationships of loyalty and trust.

Now, the reason using an outside contractor can save you money is that the contractor creates opportunities for you to eliminate internal processes. But many cable companies overlook these opportunities. Let's look at one process — the process of receiving information from your customer for installation. Most cable companies prepare the work-order in-house, route the job to one of its staff, who pulls the equipment from the warehouse, and then transfers the job and the equipment to the contractor warehouse. (See Figure 1 on page 28.)

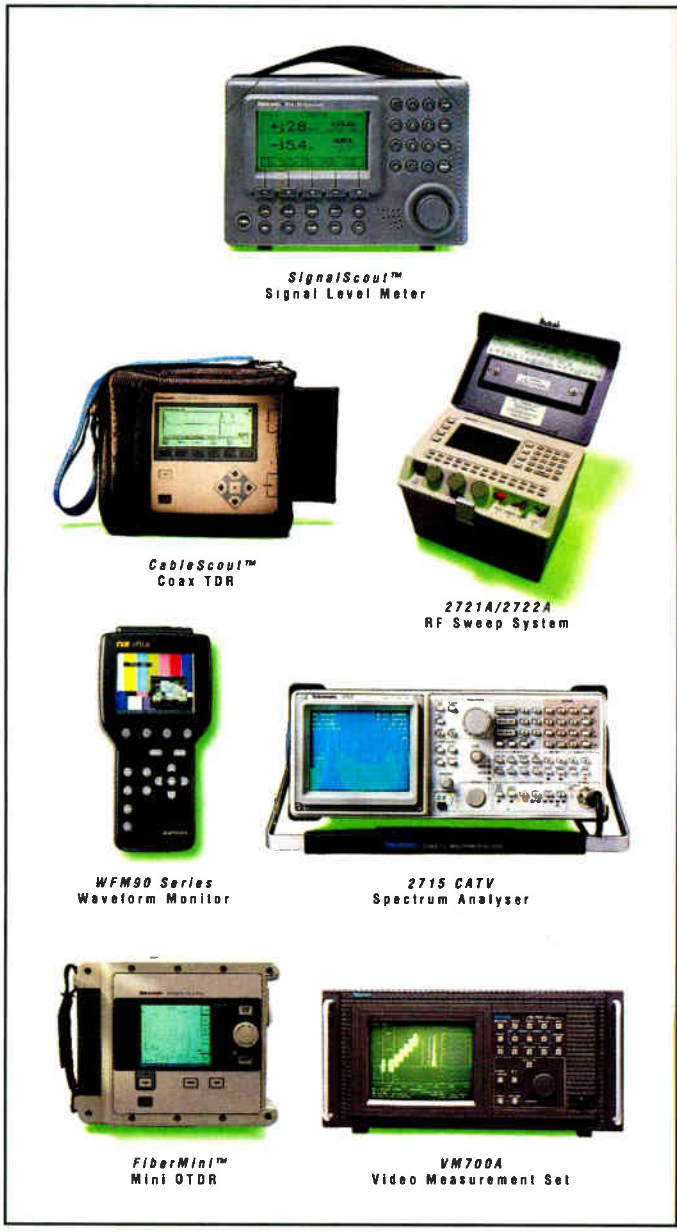
To truly maximize the cost benefits of using a contractor, cut out every process in your company that the contractor can do for you. Let the contractor contact the customer, prepare the work order, route the job and pull the equipment from its warehouse. (See Figure 2.) By collaborating with your contractor, together you can create the right kind of work order for the contractor to use so you are still in control over the process. In this scenario, the equipment never touches your company's hands and you save warehouse costs, including payroll, insurance and other overhead needed to maintain this equipment.

"To get the most for your contractor dollars, you need to make the contractor a part of your overall team," says Robert Moel, vice president of technical operations, Warner Cable, Houston.

Maybe giving a contractor full responsibility for the entire installation could be a way to relieve the burden of quality assurance. Let an outside contractor pay for the costs involved in training the installation specialist. By utilizing the electronic links from the cable system to immediately put the contractor's installation specialist in touch with the customer streamlines the process, providing a cost savings that more than justifies the new position.

This strategy will let you focus on your competencies — delivering quality, cable programming while enabling you to save money. Also, if the outside contractor is completely responsible for the work order, routing the job and the installation, the contractor will be the one who pays for late installations. Another assurance that the contractor will develop efficiencies, giving you an incredible customer service advantage and cost savings. These cost savings can be used for additional investments in customer service.

Using an outside contractor for all of your installation services may not be the best solution for you. Each cable company will need to find a healthy balance between using its own staff and an outside service. But, eliminating all duplicate processes for the work you do give to a contractor will save you money. →



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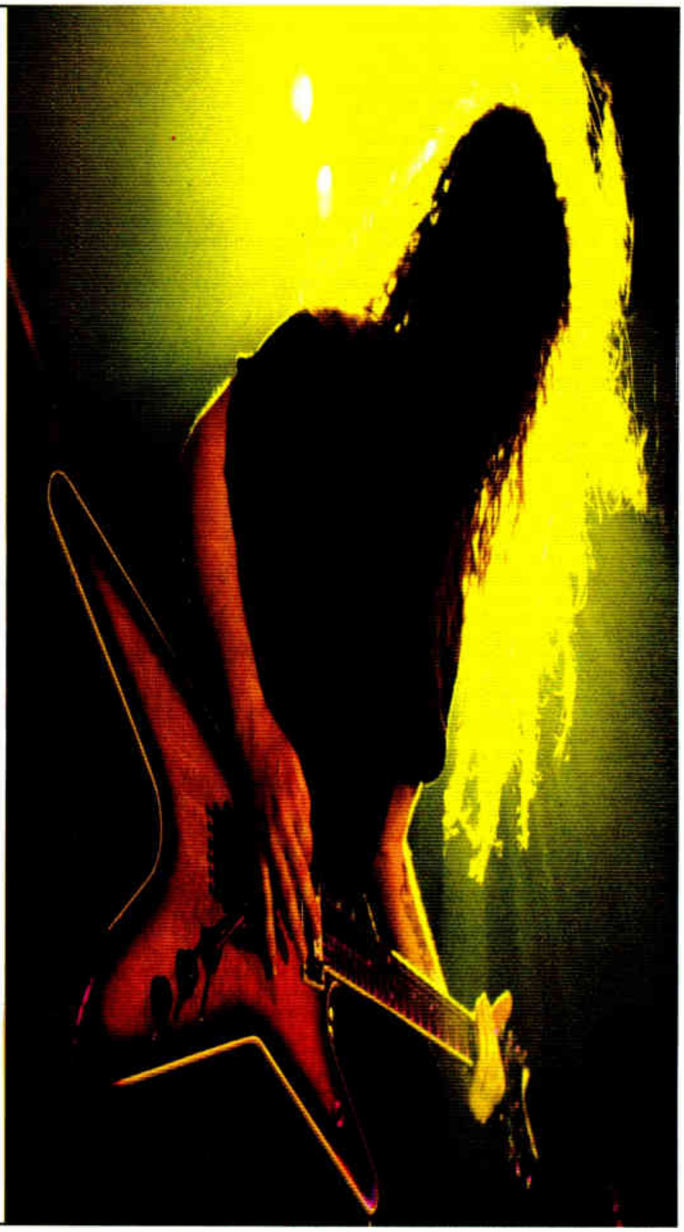

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Reader Service Number 185

Five benefits to streamlining processes

1) *Use activity-based costing to budget exact costs.* Cable companies can stop guessing at service charge costs. Contractors use unit-pricing — fixed costs that tell you precisely what each service call will cost you in advance. There are no quantities on the contract — you pay only for the installation services you use.

2) *Improve the quality of your service calls.* Most reputable contractors use full-time technicians, not temporaries, who undergo continuous training, improvement and quality education programs that keep them in step with new technology.

3) *No more delays for free-install marketing specials.* If you use a regional or national contractor, it can pull its own full-time technicians from other regions to help you handle increased installation demand and service problems — without delays and overtime charges.

4) *Save payroll, workers compensation and insurance costs.* The support staff needed to support unnecessary processes can be eliminated.

5) *Reduce capital expenses.* You'll be able to avoid investments in vehicles, equipment, tools, warehouse facilities and costs related to lost and damaged equipment.

The Saturn car company already has a Deming-based system in place. An outside contractor, Ryder, delivers components from the supplier directly to the customer. Saturn eliminated communication barriers by linking Ryder to a central computer that directs Ryder to make component deliveries straight to the factory and to dealerships. This streamlined operation eliminates the need for Saturn to maintain a warehouse of components and keeps Saturn employees out of an unnecessary loop.

"We need to integrate the contractor work force with our in-house work force to fully serve our customers," says Warner's Moel.

Making quality decisions

But how can you be assured quality will improve? Deming tells companies to stop awarding business on the basis of price alone and rather build long-term relationships of loyalty and trust with suppliers. Before you select a contractor, try to understand how this company measures quality. What systems does the contractor already have in place to build quality into the total job? Some contractors have ongoing quality programs that include a series of questions addressed to the subscribers that give them instant, direct feedback. They use this information to help them continuously improve and enhance their service for you and your subscribers.

When you begin looking for an outside contractor, before you even talk about price, find out if the contractor is willing and able to invest in the training your company will need to improve overall quality. Measure the improvement capabilities in your customer services along with the cost savings benefits to your company. Then, and only then, should you begin having discussions about price.

Conclusion

The idea of creating a new position, investing in training, closing warehouses and giving contractors direct access to customers requires re-engineering your systems. This idea presents opportunities for the cable industry — opportunities that improve quality and save you money. "We won't be able to stay competitive unless we can find ways to drastically improve the way we allow our customers to get our services," says Charter Communications' Santangelo. Streamlining processes will bring a timely transformation to the cable industry.

The bottom line is that to meet the NCTA's Customer Service Guarantee Program we must improve the quality of the work order, and eliminate duplicate costs. The money you save can be turned into customer service programs aimed at keeping your customers. After reviewing this strategy, Santangelo says, "This is an idea we should consider." **CT**

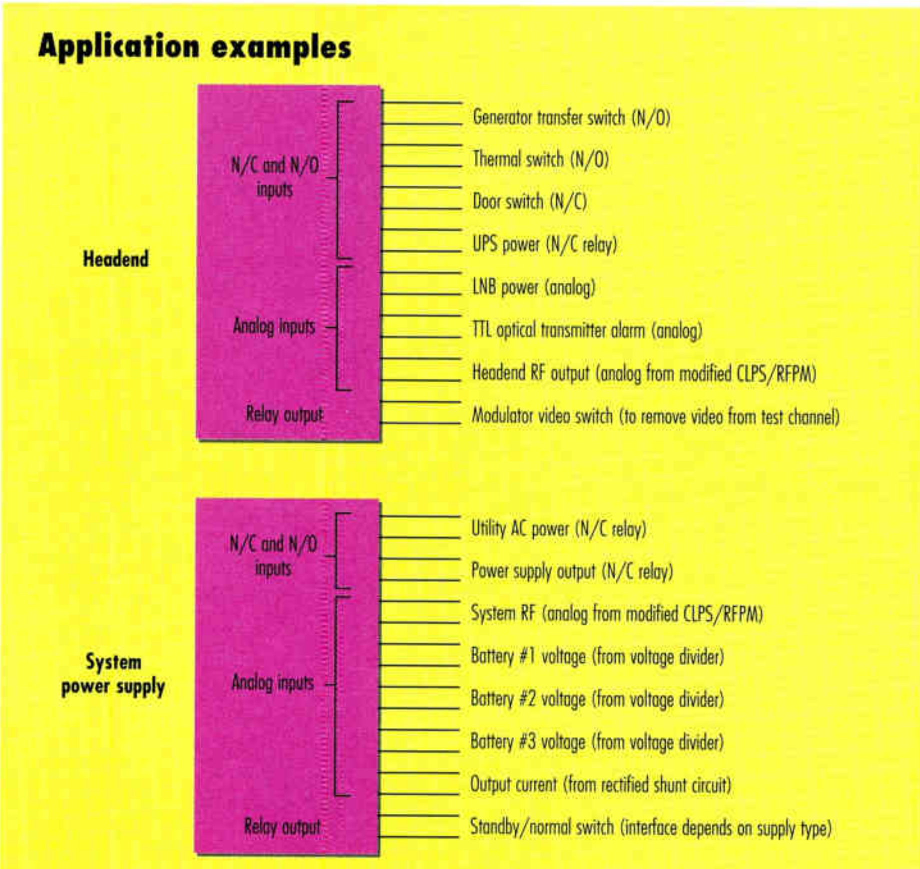
By Bill Hutchins, System Engineer, Cox Cable

Benefits of an inexpensive multipurpose remote monitoring system

The ability to be aware of problems when and where they occur without having to rely on angry customers for this information seems like a better way of doing business in our industry. Most system problems are located by information supplied by the affected customers and can result in excessive downtime related to locating the exact source of the problem. Many potential problems also can be prevented if certain information relating to system operation is sensed and relayed to the appropriate person. I will discuss a system that is capable of doing both these operations at a nominal cost while providing extreme flexibility and features.

Reasoning behind monitoring

The need for remote monitoring capabilities came about in our system after we relocated our over-the-air receiving site to a location quite distant from our main headend. I wanted the ability to monitor parameters like AC power, RF presence to the optical transmitter used for transportation of signals back to our headend, site door security, cabinet temperature and backup power operation. I also wanted to be informed of problems by several methods, no matter where I was at the time.



The system

Pacific Research's PET-820 proved to be an ideal unit that would accomplish these ends (along with the help of a few simple sensors). See the accompanying figure for application examples. It is a complete stand-alone system that provides both remote monitoring and control via a standard phone line, radio link or serial I/O port.

The standard unit provides eight dry contact (switch) inputs, one programmable relay contact and one digital output. Each of the inputs can be connected to any type of switch or sensor that contains a switch contact. This can include a temperature limit switch, optical transmitter/receiver alarm switch, door ajar switch or AC operated relay.

While the equipment is unattended and one of the sensors detects an error condition, the PET-820 initiates a telephone call to one or more numbers and sends a preprogrammed voice message describing the source of the error such as "Location 2 AC power is out." (I programmed my units to first call a special number in my office. If I don't answer there, then they will call my pager and send a special number code advising me of the problem. They will then call my cell phone and my home, in that order.)

After being advised of the type of problem, I can decide whether to respond and correct it or disable the alarm and continue to monitor. An example of this is if I was advised that an AC power interruption occurred at the site, which has about eight hours of uninterruptible power supply (UPS) backup power. I would call back the unit in 15 minutes and see if the power had been restored. If not, I would call the power company and advise it of the problem. Periodically, I would check back to see if the power

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Reader Service Number 66

Modifications to CLPS/RFPM

The Cable Innovations Model CLPS/RFPM is available in two versions. One is a surge protection unit (CLPS-35) and the other is a combination power inserter/surge protection unit (CLPS-35PI). Selection of either unit will depend on the application and location within the system.

There are several modifications that can be made to the unit. One will provide a DC voltage to the remote monitor to indicate presence of RF. Another will provide a DC voltage to indicate presence of AC system power. A third will allow the CLPS/RFPM to be powered by a source other than the 60 volts AC provided by the cable system. (This will simplify use in headends and locations where system power is not available.)

The first modification involves soldering a wire to the hot side of the RF indicator LED. This will provide about 1.7 volts DC to indicate RF presence. The common ground connection for all modifications can be made at the indicated position on the small circuit board that also is connected to the ground side of the RF indicator LED.

The second modification involves soldering a wire to the hot side of the AC indicator LED, which will provide about 1.7 volts DC to indicate presence of AC power. This is located behind a disk capacitor on the main circuit board next to where the AC indicator LED is soldered to the board. There are two LED leads soldered to the board at this location. The proper connection is the one nearest the resistor.

The third modification involves soldering a wire to the side of the resistor connected to the trace on the main circuit board that is connected to the positive side of the electrolytic capacitor located next to the large RF choke. This will allow the RFPM to be powered by an external 9 VDC source (if required for the application).

A connector to allow interface to the remote monitor can be installed on the flat portion of the RFPM housing next to the strand clamp. Be sure that the connector is weatherproof and that it provides adequate internal clearance from the circuit board and RF choke when the plate is reassembled to the housing.

The CLPS/RFPM is available from Cable Innovations Inc., 288 King Arthur Dr., Lawrenceville, GA 30245; phone, (800) 952-5146.

had been restored. If after several more hours the power was still off, I would have someone respond with a generator to supply power to the site until the utility power returned. Several benefits of this scenario are as follows:

1) I was aware of the location of the problem (Location 2).

2) I was aware of the cause of the problem (AC power failure).

3) I was aware of the time it occurred (rather than finding out when the batteries in the UPS went flat and the customers started calling in by the hundreds).

4) I was able to determine if it was a problem of short duration (by calling the unit back and checking the status of the error).

5) I was able to contact the utility company if it had been required in the event of an extended power outage.

Options

All of this could have taken place from the office or my home via the telephone and not required a response to the site for any reason. The unit that I installed in the headend monitors the air conditioning system, room temperature (by using an inexpensive thermostat), AC generator power transfer switch (which has several unused status contacts), UPS operation (by using a relay on its output), six optical transmitters (by using the status logic outputs), and driver amplifier RF output (by using a modified sensor described later).

I am advised of any problems that arise via a telephone-relayed voice message that describes the location and type of problem or via my pager that displays a number code that relates to the problem type and location. The voice messages are programmed from a large list of preprogrammed

words and numbers contained in the unit's ROM. Custom ROMs can be ordered to supply additional words, if desired. Up to 10 telephone numbers can be programmed into the unit. Several options are available to customize operation and add versatility.

The addition of the analog and data logging option to the PET-820 can be used to monitor up to eight analog voltages. Once limits are set for each of the analog inputs, the PET-820 can respond to them as an alarm in the same way it responds to the switch inputs. I use these inputs to monitor status logic outputs as found on some type of optical transmitters. I also have devised a method of modifying an inexpensive RF/AC power monitor (Model CLPS/RFPM from Cable Innovations Inc.) that will allow monitoring of AC power or RF presence from any location in the system that is accessible by a phone line. See the accompanying sidebar. This is an ideal method of monitoring node locations and major trunk end-of-lines.

The addition of a simple voltage divider circuit will allow the unit to monitor battery voltages in standby power supplies and the relay output can be used to force the power supply into standby to read the voltages while the batteries are under load. This can help cut down drastically on standby power supply-related outages and power supply maintenance time. The addition of a relay on both the AC input and the AC output will advise if power is interrupted to or from the power supply. The power supply will call you if a problem arises, or you can call the location to check its parameters at any time.

The standard PET-820 allows the monitoring of eight dry contact inputs and the control of one relay output (5 ampere) and one digital output. In this mode, only two of the 16 messages can be modified.

The addition of the RAM and real-time clock option will permit all 16 message buffers to be modified and also allows for date- and time-stamping of the most recent alarm condition, which can be interrogated at any time. The addition of a 12 volt battery enables operation in the event of a power failure for about 8 hours (or more if a larger external battery is used).

The analog input and data logging option adds inputs for monitoring up to eight analog voltages. These inputs can be programmed for single-ended (0 to +5 volts) or differential-ended (-5 to +5 volts) use and provide a 1 millivolt resolution. These inputs can be scaled to represent what the connected sensor is really seeing. An example of this is if a voltage divider is connected to a battery to provide 5 volts to the analog input with a battery terminal voltage of 13.8 volts, then the unit will return a reading of 13.8 volts DC.

If the battery terminal voltage drops to 12 volts, the voltage applied to the analog input will be about 4.37 volts and the unit will return a reading of 12 volts. Voltages supplied by a temperature sensor or other low voltage device with an output in the range of 0.1 to 0.5 volts can be read by using a low-range programming mode. This allows a 100 microvolt resolution. If the temperature sensor output was 0.3 volts at a temperature of 75°F, the unit could report back with a phrase like "The temperature is 75°."

Again, limits can be set for maximum and minimum voltages, causing the unit to initiate an alarm if one or both limits are exceeded. The unit also keeps track of the date and time in which each reading took place as well as high, low, average readings and when they occurred for each input. An optional expanded input/output board has 16 independent lines. Each line can be configured as an input or an output. Each output can be controlled remotely and each of the inputs can be configured to operate in the same manner as the standard eight loop circuits.

Easy programming

Programming of the unit is quite simple and can be accomplished via a telephone connection, radio link or serial link (direct or modem). Any of the parameters, including stored telephone numbers, can be changed remotely. An optional keypad and display unit allows local operation and control of the unit.

The versatility of this unit is limited only by the imagination of the user and the availability of appropriate sensors for special applications. One unit can pay for itself easily by preventing a large outage, cutting down on troubleshooting time during outages or preventing a headend from overheating because of failure of the air conditioner.

The PET-820 is available from Western CATV. For more information, contact (800) 551-2288 or (310) 539-8030. **CT**

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DX ANTENNA

Reader Service Number 86

By Kevin Quinlan, Product Line Manager, Network Management Systems, Antec Corp.

An integrated broadband network management solution

As broadband operators position their networks to deliver advanced interactive services — including telephony, data communications and video-on-demand (VOD) — the need for a more cohesive and function-rich network management solution becomes paramount.

Paradigm shifts

Currently, network management solutions rely largely on proprietary, hardware-based implementations. To meet Federal Communications Commission testing requirements, for example, some broadband operators use end-of-line monitors to collect information on test points and communicate that information through telephone modems. Status monitoring systems utilize transponders to communicate status changes over the return path to a central point. Simple, stand-alone software supports these limited management applications using closed, nonstandard communication protocols.

Today, these proprietary hardware solutions are migrating toward integrated, full-featured software solutions using standardized communication protocols, operating systems and data base management capabilities. Isolated proprietary status monitoring systems are no longer as attractive as building an integrated network management system that will ultimately provide a global view of the end-to-end broadband network. Integrated network management will give broadband operators a competitive advantage by providing the capability to anticipate potential failures, ensure effective equipment servicing and minimize system downtime through real-time monitoring and control of critical network equipment.

Long-term strategy

One way to look at integrated network management is to break it down into three distinct layers of management. See the accompanying figure.

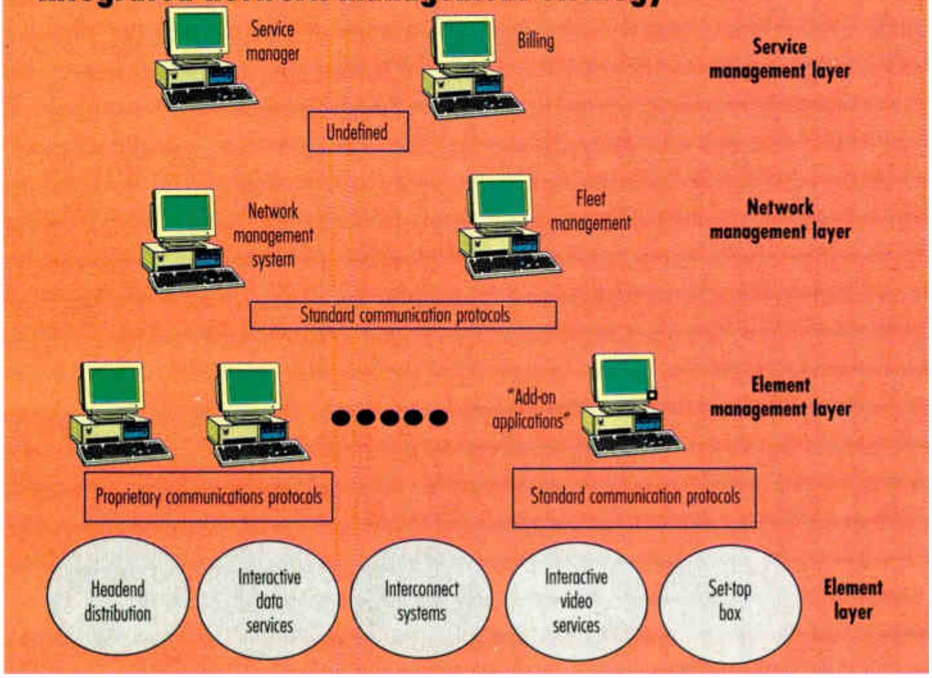
The *element management layer* provides a complete set of management features for a specific set of network elements or "subnetworks." Equipment managed at this level includes headend and distribution plant elements, interconnect equipment and interactive video and data service elements.

Next is the *network management layer,* which binds multiple element management systems together to provide a seamless, global view of the end-to-end broadband network.

Finally, the *service management layer* integrates various network management systems to provide enterprisewide operational support applications such as customer service, billing and fleet management. These applications can provide value-added information needed to manage the overall business and service offerings of the network.

Each ISO (International Standards Organization) management layer builds on information and features of previous layers. Thus, establishing the initial element management system to easily incorporate new network management and service management functions over time remains the most critical concern.

Integrated network management strategy



Open, industry-standard

Incorporating open protocols in the initial element management platform will allow for continued network management interoperability over time and easy third-party integration of value-added applications.

The element management system establishes an open, standards-based architecture that extends well beyond the limited status monitoring capabilities of present systems. The element management system provides a rich feature set as outlined in the ISO network management hierarchy. Functions include:

- *Configuration management capabilities define, obtain and maintain data on the complex array of equipment that monitor and control elements of the broadband network.* This function gathers information about the current network's physical plant configuration and uses this data to provision, modify and monitor the configuration of each piece of network equipment. Data is stored to allow users to generate reports and graphi-

cal diagrams of the network equipment configuration.

• *Fault management helps manage problems in the network by isolating and resolving their root cause.* This subsystem immediately reports problems so technicians can correct the fault before the end user is aware of the problem. In many cases, this system will automatically resolve the problem without technician involvement. Alarm monitoring and filtering, event correlation and notification and predictive analysis can all help network operators anticipate failures before they occur.

• *Performance management provides the ability to collect, store and analyze data related to the past, present and future condition of the broadband network.* Real-time and historical data analysis is accomplished through easy-to-understand graphical displays and report-generation capabilities. Users can produce statistical and trend analyses, conduct automatic and on-demand measurements, perform diagnostic and compliance testing, maintain performance logs, and monitor remote equipment performance. Operators can monitor distortion, RF levels, audio/video frequencies and other device parameters for real-time and historical analysis.

• *Accounting management collects detailed data records to measure the use of various network resources.* This transaction-based information can be used to bill or charge-back customers/users, monitor system use and control costs.

• *Security management maintains system security by controlling access to system features, network equipment and data.* A multitiered security system provides various layers of security at the user level, equipment level, and network and domain levels. It also provides audit trails of attempted and actual breaches of security.

For network operators, the element management system is designed for ease of use. Hierarchical topology and geographic maps and submaps provide a "big picture" view of the network and allow operators to zero in on a particular area of interest. Since each management tool is integrated, system users can easily generate custom reports and network performance analyses. Complete on-line help is standard.

Investment protection

An integrated network management strategy based on open standards incorporates a robust feature set with power ful management tools at the element management layer that fully protects present investments. The element management system remains compatible with installed equipment and interfaces with all installed status monitoring hardware of today. Operators protect their present investments and will not be required to change out transponders, end-of-line monitors, headend controllers or other equipment.

In the future, this same scalable platform allows operators to add new network equipment and management functions. When new telephony, data and video services emerge, the operator will be fully positioned to manage, control and add new services to the interactive broadband network more efficiently and profitably.

As the overall network management system grows and incorporates the network and service management layers, the bottom line will be a more reliable, flexible network, a more proactive approach to customer service and, ultimately, more satisfied, long-term customers. **CT**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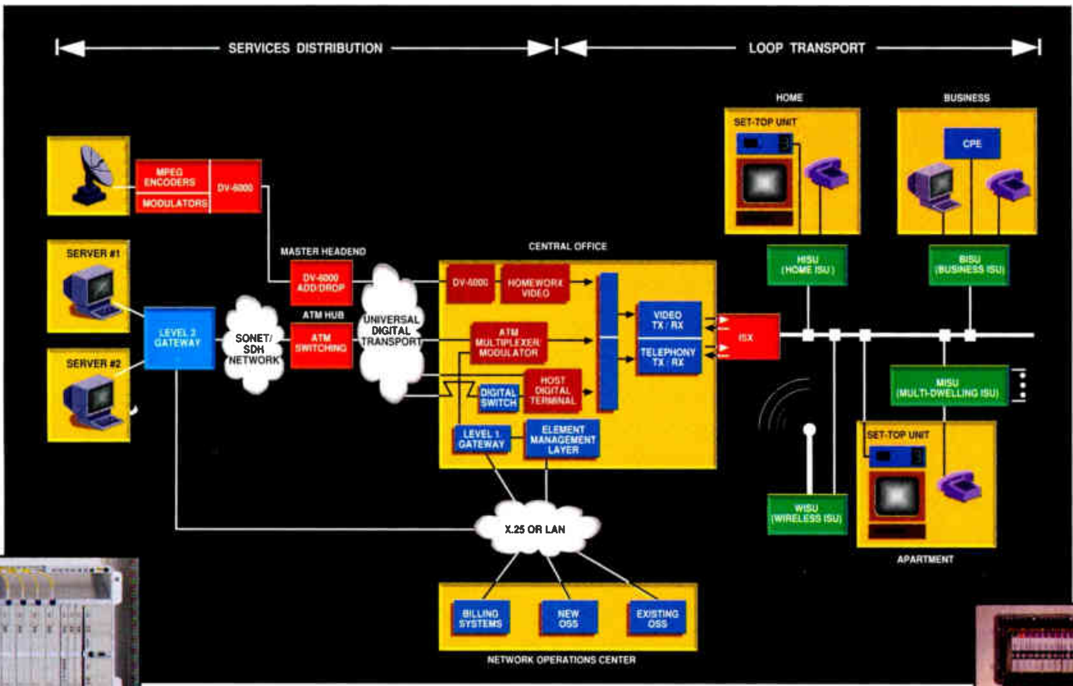

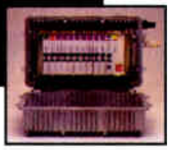

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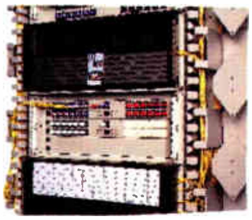

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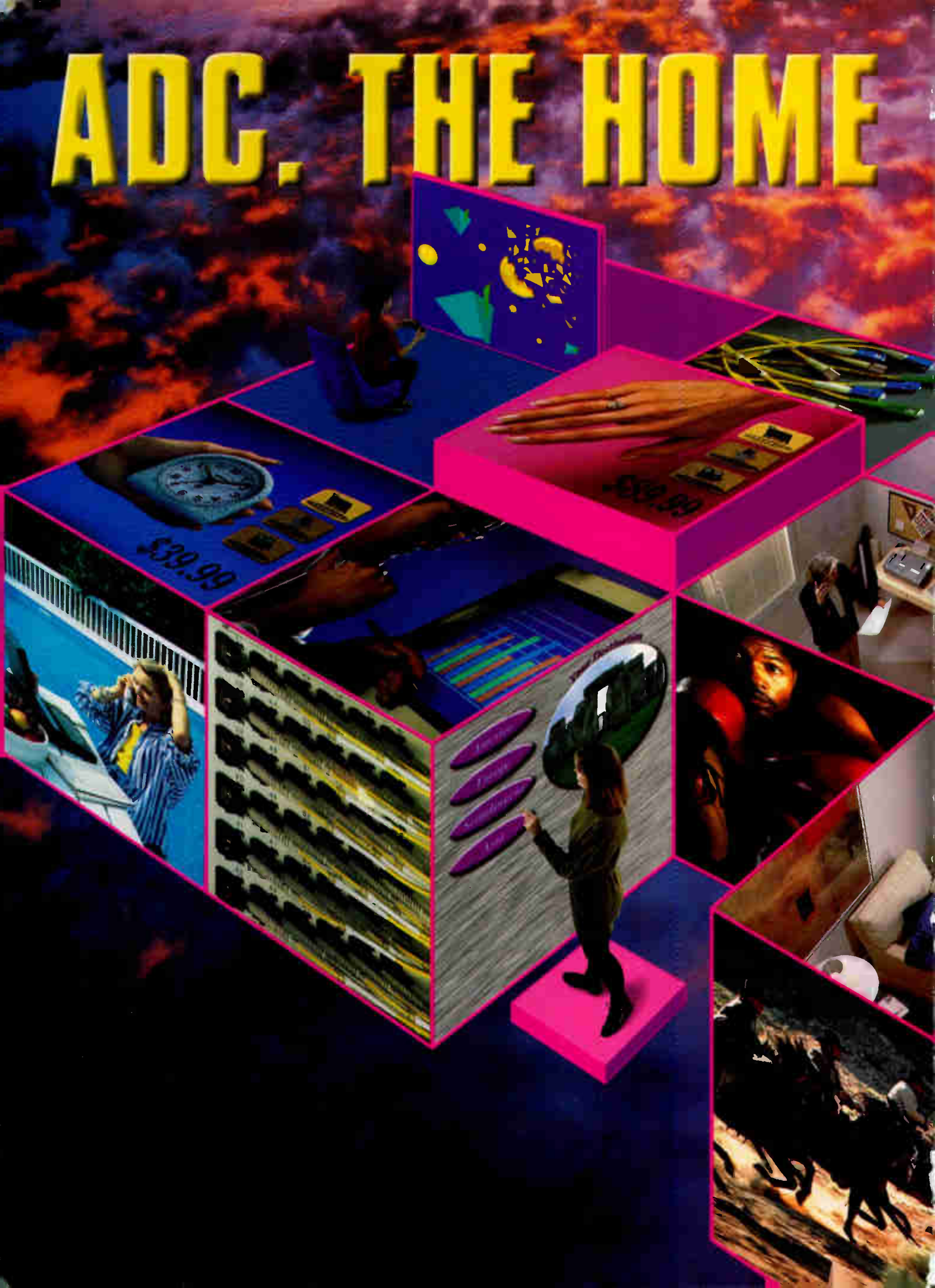
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Reader Service Number 42

By Frank Rivest, Senior Manager, Sales Development, Northern Telecom

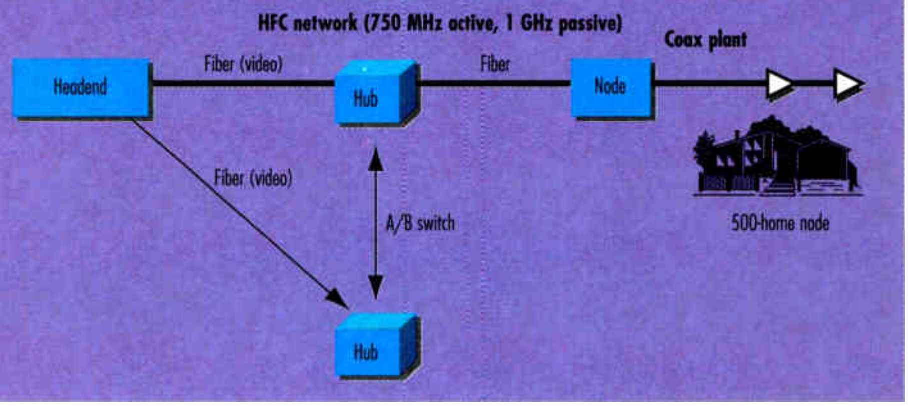
Future-proofing investment in HFC plant construction

Considerable engineering and management efforts are being expended as CATV operators prepare to defend their traditional video distribution business against the telcos and to position themselves to compete head-on with the telcos in the yet unfamiliar technologies of telephony, data, wireless and undefined future services.

The design objectives are clear, however. Design a network that is the following: reliable, cost-effective, salvages to the best extent possible existing plant, supports new services with minimal incremental cost, meets or exceeds all prevailing industry standards regarding signal quality, reliability and availability, and will permit service expansion on an incremental cost basis. All factors are prerequisites to succeed in a dynamic and ever more sophisticated communication market.

A consensus has developed in the CATV industry that the hybrid fiber/coax (HFC) network is the preferred means of achieving the defined objectives. This article proposes an architecture based on HFC coupled with synchronous optical network (SONET) transport technology to realize a solution that is compatible with the stated objectives and ensures that the anticipated near-term and future services will always be supported in a cost-effective and reliable way.

Figure 1: AM/VSB broadcast distribution



Headend, hub, optical node

For the distribution of broadcast signals, a headend, hub and optical node arrangement as shown in Figure 1 is proposed. Large headend service areas are subdivided into hubs that support nominally 20,000 homes passed. For short headend-to-home spans, a full bandwidth AM-VSB signal is launched over fiber from the headend to the hub. This signal is then cascaded with a second optical span at the hub for delivery to the node. For longer spans, where the critical parameters of carrier-to-noise (C/N), composite second order (CSO), and composite triple beat (CTB) are not met, a split-band arrangement could be employed for downstream broadcast signals, or alternatively, hybrid optical cascades comprised of distributed feedback (DFB) and YAG technology devices could be used. (See "Increasing Flexibility and Performance in Optical Networks," Patrick Harsham, *CED*, September 1994.)

> **"The high bandwidth offered by systems such as OC-48 (2.4 Gb/s) should not be feared since it reflects the success of the operators new business endeavors."**

Provision has now been made for the insertion and extraction of advanced future services at the hub location. The hub is a physical location in which transmission electronics will be installed to position services near the customer and to reduce the possibility of bandwidth blockage.

Hub signal reliability is achieved by equipping the hub with A/B switches to select the same signal from the adjacent hub by means of an interhub fiber link. Adjacent hubs thus configured provide reliability equivalent to a three-node ring. This configuration also has the advantage of reducing the needed fiber count to the individual network elements. Typically, 12 fibers are deployed between the hub and the optical node to support up to 2,000 homes in clusters of 500 homes each. The node could be configured to serve single home, multiple dwelling unit (MDU) and even business applications.

Since the headend and hub eventually will house hardware needed to support telephony, data, wireless

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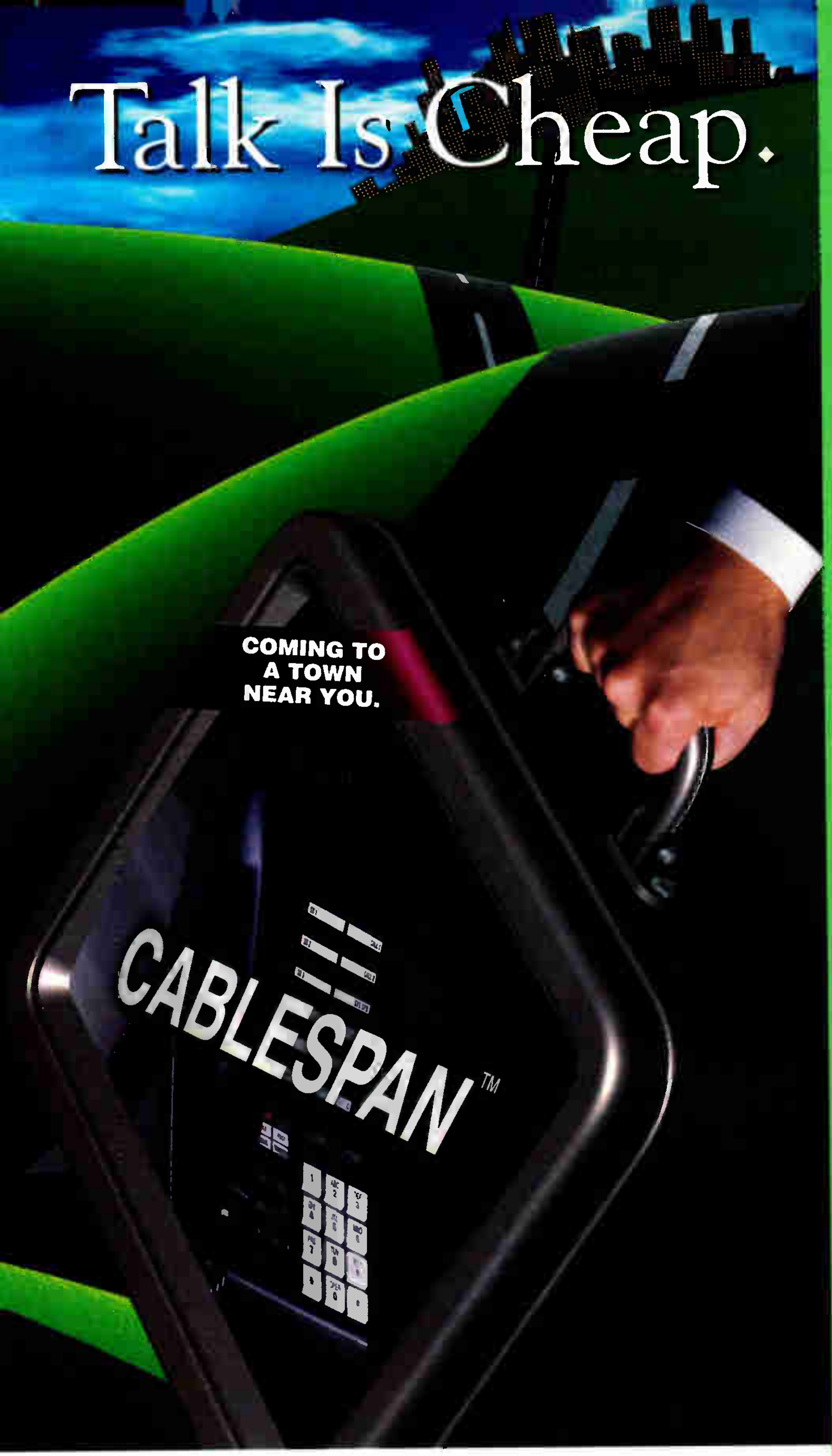

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and SONET transport, which rely on DC power (typically -48 volts) with a battery for backup in the event of power failure, it is recommended that serious consideration be given to having the AM-VSB optoelectronics also operate from the same DC power source and thus eliminate the need for inverters. Minimal inverter capacity can be provisioned if the locations support local coaxial nodes.

The next crucial element in the proposed network architecture is the introduction of an interhub SONET ring with ATM that will transport advanced services from the hubs to the headend. The SONET ring can be deployed with bandwidth granularity from as little as OC-3, OC-12 up to OC-48 depending upon the bandwidth needed to support the hub.

The high bandwidth offered by systems such as OC-48 (2.4 Gb/s) should not be feared since it reflects the success of the operator's new business endeavors. The SONET transport is generally available with DC powering and will be readily accommodated by building infrastructures supporting this feature as recommended earlier.

The bandwidth granularity of the SONET equipment also has the advantage of permitting a variable cost, since bandwidth is purchased and added on an as-needed basis only. SONET is recommended for this portion of the network because of the universal acceptance of the SONET standard, its inherent attributes of survivability, and a prescribed OAM&P standard that can interface gracefully to a network OSS (operational support system) to play a vital role in meeting the initial design objectives pertaining to signal quality and availability.

The SONET ring topography will establish signal presence near the customer base and permit the operator to pursue CAP (competitive access provider) business by offering quality, reliable digital connectivity to the headend and beyond by means of DS-1 or higher rate tributaries for relatively low incremental cost. Providing CAP service also will become a significant source of revenue to defray some of the initial cost associated with this network architecture. These same ring nodes located at the hub also will serve as a platform to provide reliable service to high-capacity MDUs by providing SONET tributaries to support DLC applications located in cabinets near the MDU to be served.

Powering

Before advanced services equipment to support telephony, data and wireless is deployed at the hubs, consideration must be given to how the coaxial portion of the network will be powered. Power to feed the amplifiers can be provided in the traditional way, but the demand for better grade of service associated with telephone, wireless and data services will compel the operator to look at more sophisticated approaches to powering. In essence, the operator will have to provide considerably more power to the coaxial portion of the network.

Proposed telephone wall boxes (approximately 2 to 4 watts each), personal communications services (PCS) wireless distributed antenna and transmitters (approximately 50 watts each), and the need to compensate for additional cable losses will result in power requirements in proportions not before experienced in the CATV industry. Power consumption isn't even the biggest issue. That distinction goes to the distribution and backup of power.

Possible scenarios include: home powering (with and without battery); and Siamese power feed or coaxial feed with standby power source.

Service hardware

Now that a physical HFC plant has been established, service hardware can be positioned at the hub. Considering telephone service, cable modems with supporting infrastructure will be used to transmit robust frequency agile RF carriers to wall units at subscribing homes. Signals originating from the subscriber wall box will be transmitted upstream to be received by the receiver portion of the modem located at the hub location, and processed by the supporting infrastructure.

TDM/TDMA concepts will be used for downstream (typically 350-750 MHz)/upstream (typically 5-42 MHz) transmission respectively in bands of approximately 2 MHz when using robust QPSK (quadrature phase shift keying) modulation techniques.

The transmission of three such RF carriers in a 6 MHz equivalent video channel will yield 72 lines of telephony to be distributed amongst participating subscribers of the optical node. Incremental capacity can be provided by assigning additional bandwidth to the node, or the introduction of RF concentration, which will significantly increase the number of subscribers supported by the initial 72 lines deployed. The improvement factor is a function of grade of service and subscriber usage.

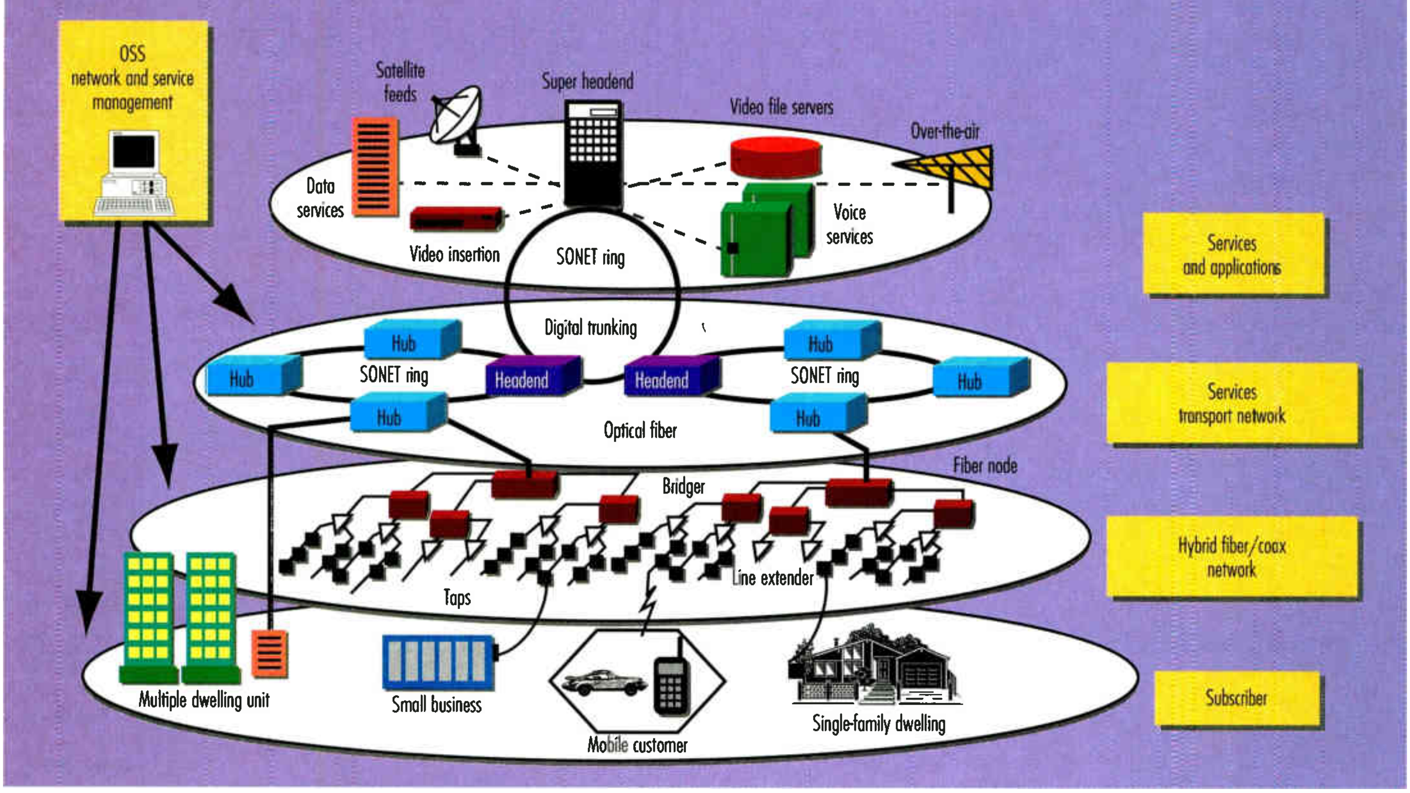
The DS-1 traffic derived from the telephone supporting infrastructure can now be carried by the SONET ring to the headend, or to the local supporting switch. It is considered beneficial to select a telephone access product that has an OAM&P compatible with the SONET ring to facilitate network integration and overall operation of the network. The telephone access product selected also should support the Bellcore TR303 standard to permit concentration information resulting in reduced DS-1 count and inherent reduced transport cost.

Data service hardware also will be placed in the hub location to transmit high-speed downstream data in 6 MHz bands using typically 64-QAM (quadrature amplitude modulation) to realize throughput data speeds of approximately 28 Mb/s. Upstream data will be at a lower speed and be supported by a more robust modulation technique. It is anticipated that access to the data modem common infrastructure will be in increments of approximately 155 Mb/s or at the OC-3 rate. This rate again justifies the deployment of the SONET ring topography.

Wireless service hardware also will be placed in the hub location. The physical hub site could be used as a macro cell, if tower and antenna are permitted, but will be used primarily to launch RF signals to the nodes over the HFC plant. Radio transmit frequencies (nominally 1.9 GHz) will be downconverted at the hub to a compatible HFC downstream frequency (typically 350-750 MHz). At a specified location in the plant, the signal will be upconverted to the original transmit frequency to drive a distributed antenna to illuminate the equivalent of a "mini" cell. Several such antennas, operating in simulcast will establish the basis of a cell. The size of the resultant cell, will depend upon terrain, grade of service, signal obstruction and degree of in-building signal penetration, etc.

The introduction of wireless technology brings back

Figure 2: Overall system architecture



the issue of powering as described earlier. Network powering tends to support this application favorably.

This same SONET ring also could be used to support digital "advertisement insertion" capabilities, which could be programmed for either broadcast to the entire hub population or focused to address only a targeted node or subnode element depending on the coaxial network configuration. Other possible future uses of the SONET ring include the support of video-on-demand (VOD) capabilities with signals originating at the headend and managed by means of ATM functionality.

Signals derived from the proposed new services can be aggregated at the headend for transmission to a centralized location for switch processing for wireline and wireless telephony before interfacing with the public switched telephone network.

Data services also need to be transported and processed to interface with information sources. For this application, the proposed solution is to integrate the SONET hub ring with a subsequent ring to aggregate all possible services for delivery to a common processing location.

The use of a ring to consolidate advanced service signals from diverse headends suggests the possibility of also using SONET technology to consolidate headend locations for the support of video signals. High-capacity SONET rings, when carrying bidirectional telephone and data signals can be extended to carry high-quality digitized video signals from a "super headend" or redundant "super headend" at a relatively competitive incremental cost using full-motion video CODECs. DS-3 CODECs are now available with BTSC capability to significantly reduce integration to the overall network. Transporting the video signals digitally eliminates the distance sensitivity of analog transmission and permits the eventual connectivity with other networks with similar interface at the universal North American DS-3 rate.

Summary

The proposed architecture (Figure 2), through the extensive use of SONET ring technology establishes a cost-effective, survivable network to transport advanced services nearer to the served customer. Rings with their inherent survivability attributes permit the reduction in home-run fiber costs, yet present no blockage potential since electronic upgrades to higher bit rates are available and proven.

The OAM&P protocols of the SONET standards will permit interface to a network OSS with relative ease and ensure that network reliability and customer service is maintained at the requisite level.

The use of DC power to operate AM/VSB electronics at headends and hubs results in improved power efficiency through the elimination of inverters and improved network reliability with reduced overall operating cost.

High-capacity SONET rings can be used effectively for headend consolidation and the transport of advanced signals cost-effectively while offering flexibility and universal networking possibilities.

The introduction of the hub location with SONET connectivity permits services to be deployed nearer to the customer base and provides extensive flexibility for the deployment of telephony, data and wireless, as well as the eventual introduction of local digital ad insertion and VOD, etc., in addition to supporting a CAP business platform.

This architecture fully meets expectations and objectives of the industry and ensures that future features can be readily accommodated. **CT**

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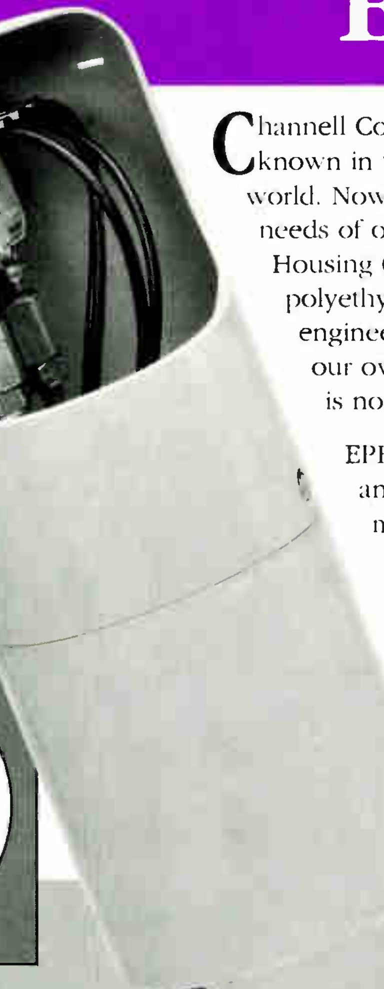

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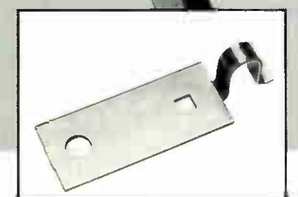
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Reader Service Number 125

By James Goins, Area Technical Manager, TCI of South Florida

Think reliability before you construct

Planning and constructing a communications system requires an analysis of several different factors such as how and where the system will operate. Two of the most important capabilities for consideration are information-carrying capacity and reliability. Of course, cost is always a major consideration. However, paying more for a system does not automatically alleviate the other considerations.

System reliability is usually defined as the percent of time a system is capable of meeting its design standards divided by the amount of total time in a period. Reliability, or lack of it, in a system is often thought of as outage time. Actually, any time the system does not meet its design standards, such as a poor signal-to-noise ratio (S/N) in an analog system or high bit error rate (BER) in a digital system, it is falling below its reliability standards. A client paying to have data transported on the network will certainly expect and demand that the system be online and meeting its design standards a high percentage of the time. One hour of down time per year equates to 99.99988% reliability. This is in the range of what a paying client will expect from the network. Obviously, a requirement for redundancy exists if these standards are to be met.

Design and installation

An engineer designing or upgrading a system must consider total system reliability before the physical construction begins. It is too late to consider reliability standards after clients have signed contracts. Evaluation of the reliability of the different parts, the quality of installation of the parts, the operating environment of the system and the speed of maintenance of the system components determine the total system reliability. The speed of repairing problems is the most important factor in establishing system reliability. →

Typically, the manufacturer will specify the individual system devices to meet or exceed a particular failure rate. On manufactured devices, the usual method is to specify the mean time between failure (MTBF). The MTBF is a specified number of hours arrived at by laboratory experiments on the devices. Warranties are often based, at least to some extent, on the expected failure rate of the discrete devices. The engineer designing a system must consider not only the reliability of the different system components on an individual basis but also their reliability as a part of the whole system.

The quality of installation of the different components in a communications system can easily reduce the reliability of the complete system because of inferior workmanship. The engineer designing for a specified reliability standard must ensure that the procedure for installation work is stringent enough to force the installation group to have quality control.

Intermittent connections caused by poor workmanship is the most prevalent defect in installation. The only way to reduce this problem is by inspection of the work. In addition, a penalty is mandated if poor installation quality causes delays in meeting the activation date. Therefore, if the completed system does not meet the specified reliability standards on the specified date and the cause is related to installation work, the contractor or person in charge of installation must be held accountable. If this expectation is noted in the beginning, higher quality work will result.

Operating environment

The operating environment of the system itself must be known by the system engineer when reliability considerations are evaluated. The environment and environmental concerns are considered when the individual system components are evaluated.

Frequently, the system designer only uses the manufacturer's specifications and wraps them into considerations for the reliability of the whole system. A very important example of this is the heat dissipaters or heat sink fins on electronic equipment. The dissipaters are designed to transfer heat to the surrounding air. Therefore, the air must move continuously for proper cooling to take place. The movement of air will happen naturally by convection unless restricted by enclosures. Quite often, devices are placed in the uppermost slot of a cabinet with no louvers or vents, thus minimizing convection cooling. Since heat rises, any device placed higher in the cabinet than any vents or openings will suffer a severely reduced life expectancy. The manufacturer's specifications are valid only if the devices are installed and operated as intended.

Other considerations in reliability related to the environment will be the quality of the power feed. If the power supplied by the power company has a problem with power surges, spikes, brownouts or other anomalies, proper conditioning of the power is a necessity. In addition, backup power is necessary for reliability considerations. Bonding and grounding only to the NESC and/or NEC standards will not be enough in some high lightning environments. Bonding on every pole in outside aerial plant will reduce the inductive coupling from overhead power lines into the communications cable.

Here in the Florida environment, it is required that we consider the effects of salt spray on devices located outside in coastal areas. Each geographic area

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has its own share of unique problems relating to the environment. A design engineer cannot ignore these different problems. Consideration factors for outside plant in California are different from those in Florida.

Repair considerations

Another factor often overlooked by design engineers is the length of time it takes to repair a problem when it does occur. Many systems are supposedly built to "bulletproof" standards.

Quite often, no thought about the replacement time of a defective component is given. Maintenance consideration is part of the reliability engineering process. In addition, maintenance cost must be a factor during decision-making on the overall system cost.

Using a five- or 10-year system cost analysis will include the maintenance cost factor. The equipment purchased, its location and the installation all impact the ability to maintain the equipment. Proper training, equipping and simulations for emergency repairs are a necessity for maintenance technicians.

Waiting until the first catastrophic outage occurs is not the time to consider maintenance. On the contrary, during installation planning, and during purchasing decisions, the thought of "how long will it take to get to this device and replace it" must be at the forefront of reliability thinking. Therefore, the system design engineer must consult with the maintenance operation staff before final decisions on the purchase and placement of equipment.

Conclusion

Cable companies are no longer just looking at entertainment TV for revenue sources. They are looking at building the information superhighway, or part of it, to increase revenue by carrying data traffic for other businesses or telephone traffic for the public.

The considerations of building the networks of tomorrow are different from those considerations of a few years ago. Reliability standards must now occupy a major role in our engineering thinking process.

Where a two-hour outage used to be acceptable, the network clients of tomorrow expect only a few minutes per year of downtime at the most. When the BER goes higher than specified or the S/N goes lower than specified, the reliability clock starts running.

Several factors that are important to reliability go into the design engineer's thinking process. The quality of the individual devices in the network and their rated MTBF will have an effect on the total system reliability. Thus, this is the first consideration. The quality of installation of these individual devices is a major factor in system failures. Strict adherence to the device manufacturer and the system designer specifications is necessary during the installation process. Designing for the environment in which the system will operate and selection of the components that meet environmental considerations also are very important.

However, the most important factor in reliability engineering is the speed with which problems are solved. Technical problems are inevitable in mechanical and electronic equipment. Therefore, we must prepare our staff to repair these technical problems in the least amount of time. Reliability of the network has become an important part of the thinking process of engineers who are responsible for building the information superhighway. **CT**

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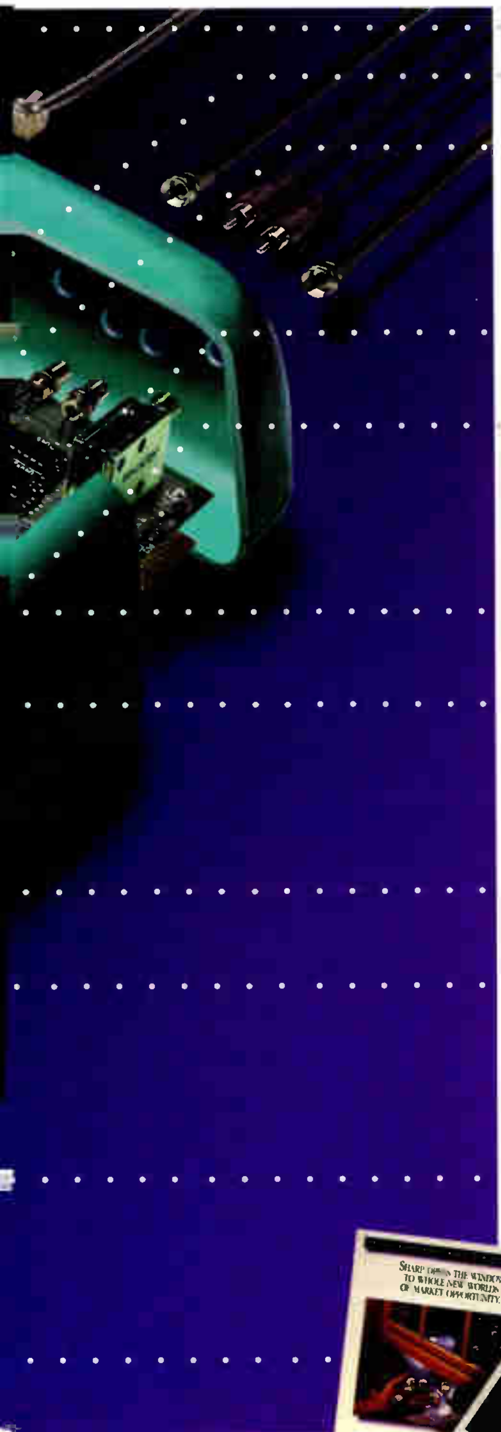

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companies are in the process of a number of trials. Northern Telecom has announced plans for a 1.5 Mb/s bidirectional modem. Jerrold PC LinX will one day deliver data to homes at 30 Mb/s. Scientific-Atlanta and Hewlett-Packard also are planning on creating their own data modem offerings.

But big questions remain. For starters, the cable industry has to figure out how to make these networks work on a highly reliable basis. On the other side, these modems by themselves will only allow cable operators to connect across a single cable network. Operators will probably need to connect to wide area networks (WANs) like the Internet or America Online to attract a large customer base. On the other side of the fence, technology is coming along that will enable broadcasters to put data onto their networks, perhaps in competition with some of cable's businesses.

Putting business on the net

Businesses may be warming to the idea of using cable operators for data. An indicator of this trend can be gleamed from some statistics derived from a direct mail campaign conducted by Lois Levick, marketing manager of emerging network technologies at Digital Equipment Corp. Last October, she mailed out a multi-industry questionnaire to 73,000 businesses of all sizes that asked about their interest in using their local cable company to supply their data networking needs. By the end of December, 9,344 people had responded (or 12.8% of those surveyed). Levick says that 80% of the respondents indicated a moderate to high level of interest in using cable companies for their data needs.

This level of response is extremely high for a direct mail survey of this sort. Most surveys only bring in a few percent response rate over the course of the study. But perhaps their interest was piqued by DEC's offer to send out a free 20-page *Internet Access Guide* to the respondents. At any rate, Levick is planning on using the survey results to target cable operators in areas with a lot of positive responses.

At the moment, the largest single obstacle for businesses moving their data over coax are questions about the reliability and security in the field. Schools and institutional networks could provide an opportunity for cable operators to field test the technology and train their technicians on it with-

out fearing dire consequences if problems emerge.

Wiring the islands

Oceanic Cablevision in Hawaii has been building such a data network on the island of Oahu for the school system and is getting paid for it. This provides the company with the opportunity to learn about the technology without dire consequences if a few problems emerge.

Notes Mike Goodish, vice president of engineering at Oceanic, "Our learning curve is telling us that you want to get your feet wet with this stuff if you can. I would not want to roll out service commercially until we better understand how it works. You are getting into two-way applications on coax, which has its demands. Then you have to get your people understanding data transmission in addition to understanding RF technology. That is something that takes time and if you can find an application to help get your people exposed to that, all the better."

Oceanic's network feeds 240,000 out of Oahu's 250,000 cable subscribers. As part of its obligations, the company must give the state some dark fiber throughout its network. The school system decided to use some of this capacity for interconnecting schools at high data rates and videoconferencing. It is planning on hooking up 70 schools by June 1995 and 200 by the end of 1996. It will cost the school district $660,000 to equip the first 70 schools and cable network with data equipment, and Goodish estimates it will cost about $1.8 million to equip all the schools.

In addition, the state administration that runs all of Hawaii's public schools is planning on extending the network to other islands in Hawaii and connecting it up to cable data networks there. However, these will be relatively sparse in relation to the Oahu network because there are only about 40 public schools on all of the other islands put together.

The chief bottleneck at the moment is Oceanic's fiber deployment plans. It is in process of running fiber to 600 sets of 500-subscriber nodes in each neighborhood. As the company deploys the fiber, it also is installing ChannelWorks networking equipment from LANcity Corp. in each school and local node. This equipment enables it to put a 10 Mb/s bidirectional network onto a single 6 MHz channel on the coax network going to the school. At the local node, RF converters transfer the signal from the coax to a 100 Mb/s ADC FiberMux Magnum 100 proprietary network. The FiberMux network is broken up into 10, 10 Mb/s channels.

Inside the school, a splitter splits the signal to a coax video network and a ChannelWorks router. Data goes from the router to one or more LANs set up in each school. Many of the schools have separate networks set up for administration and education. The most popular applications on this network are Internet access; e-mail between students; school-to-school file transfers and administrative applications that ship schedules and student records around; and desktop conferencing. But Goodish pointed out, "Desktop conferencing seems to have immediate appeal but also has some limitations in terms of quality and the cost of terminal equipment."

Although the state is paying the cost of the network, it did get some funding for other aspects of the pro-

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ject. The National Science Foundation is funding $4.21 million over the next three years to train teachers how to use the network.

Goodish believes this type of network has some potential for business. He said, "But at this point, one of the concerns is the traffic-handling capability. If someone is in there doing huge file transfers, it could take very few users to create a latency problem that restricts your ability to commercial users. I think it is something that you complement with other technology. Switching could help, and we may implement switching in the headend, but this is too early to make a decision."

How the Internet fits in

One of the most exciting applications for these modems will be high-speed connections to the Internet. The Internet is a network of computers that communicate using the TCP/IP protocol. It has been around in one form or another since the '70s when researchers turned on the ARPANET, a Department of Defense network designed to be reliable even if several of the switching centers were knocked out. The end result was a "network of networks" capable of tying together a large number of individual networks.

Until recently, the Internet remained an intellectual curiosity for schools and hobbyists. The nerds that surfed it all new the cryptic UNIX commands required to get around. One of the more interesting developments was the creation of the World Wide Web (WWW) in 1992 by Tim Berners-Lee at CERN in Switzerland. It provided an environment for creating hypertext documents on the Internet that contained references to other documents. However, the WWW remained an intellectual curiosity until March 1993 when a team of undergraduate students led by Marc Andreessen at the National Center for Supercomputing Applications in Champaign-Urbana, IL, created a graphical user-interface called Mosaic.

Mosaic and other browsers it inspired enabled people to view documents with text, graphics, audio and even video clips mixed together. According to the Internet index compiled by Win Treese, WWW traffic grew 443,931% in 1993 and another 1,713% in 1994 to about 269 billion bytes of information.

Andreessen and his team have since graduated from the university and gone to California where they launched Netscape Communications. Initially the company created a better browser for the Internet. Mosaic was optimized for the high-speed 45 Mb/s links the team had access to at the University, but was a bit poky on the slower 14.4 kb/s modems common for most computer hobbyists.

The company created Netscape as a welcome improvement that uses a number of tricks to make Internet surfing a far more enjoyable experience. The program is downloadable from the Internet and is free for individuals and schools but businesses are requested to pay a modest licensing fee.

Securing the Internet for commerce

However, the most interesting thing about Netscape is not the browser but the server being been developed for secure transactions on the Internet. The Internet has had a history of bad security. Hackers have shown that it is not too difficult to intercept data packets as they travel down the net and look for sensitive information.

For example, Mark Mitnick was recently busted for putting sniffer programs on the Internet that tracked down credit card numbers and passwords. His sniffer had acquired 20,000 of them by the time he was found. A special task force finally managed to apprehend him in North Carolina last February where he was hacking from a cellular telephone.

One of the most exciting technologies for securing the Internet is the RSA encryption algorithm developed by a team of researchers at MIT in 1977. It is named after its developers, Ron Rivest, Adi Shamir and Len Adleman. The algorithm enables people to do very secure communication with digital signatures to ensure that messages are not tampered with or forged. Every person that uses it is given two keys — public and private. When you want to send a message, you use your private key and the recipient's public key to encrypt the message. When the recipient receives it, he uses your public key and his private key to decrypt the message.

Public key cryptography not only secures communications, but also gives you a measure of proof of who sent you the message because a message from someone will only decrypt if the sender had access to the right private key. Consequently, it provides an authentication mechanism for financial transactions on the Internet. Netscape incorporates RSA's encryption algorithms to companies to put information on WWW servers that can only be accessed by authorized people. It also can enable credit card information to flow over the Internet without fear of hackers stealing or forging the information. In fact, Netscape already has negotiated a deal with MasterCard to provide vendors with secure connections for MasterCard transactions.

But how secure is RSA? It is so secure that the U.S. government is scared of letting it get into the hands of foreign governments and organizations. All software programs with RSA encryption technology are considered military-grade munitions and are illegal to export. By some estimates it would take several hundred years to crack a properly implemented RSA key using existing technology.

RSA technology also is making the Internet secure for business networks as well. Businesses have traditionally shied away from the Internet for fear hackers might try to steal their data or corrupt their computers. The easiest way around this has been to set up firewalls that limit Internet access to a company's computers. But this also has meant that the company employees could not access their office computers from the Internet either.

The Internet promises to offer companies a far cheaper alternative for tying together offices than traditional value-added networks or leased lines. The key reason is that Internet usage is often priced by the capacity of the connection and not by the quantity of packets sent or their distance. In many cases a company could connect multiple offices through the Internet for as little as $30 per month per office for a 28 kb/s dial-up connection, or $150 a month for a full-time connection. Enterprising cable operators could offer them several megabits a second for a few hundred a month and still have a far more attractive alternative than anything else around.

Premenos Corp. is one software company going after this market. It

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has developed Templar (an extension to its Electronic Data Interchange software) that enables companies to perform secure business transactions over the Internet using digital signatures. Templar has been a leading player of EDI software for mid-range systems, but it is just one fish in the pond in the overall EDI market. According to Daniel Federman, president of Premenos, the EDI market hit $1.7 billion last year. Only $250 million came from software. The big chunk of that came from value-added networks (VANs) ($400 million) and direct connections ($300 million). According to Federman, some companies will be able to cut their communications costs associated with EDI in half or more by using the Internet.

For businesses, the best news about the Internet is not just that they can send transactions to one another, but they also can send data, like CAD/CAM drawings used to build the products described in the EDI forms. Mike Gordon, manager of advanced systems at Avex Electronics, has been doing a pilot with Premenos for the last month. He said the key to EDI transactions is their ability to reduce the cycle time for creating new products. Avex did not use VANs to send engineering data because it got charged by the byte, and with megabyte-sized CAD drawings it was cheaper to just pop them in the mail. But with the Internet system Avex can send any data back and forth to its customers and this has helped the company reduce cycle time from a few months to a week.

But Templar does nothing to prevent hackers from breaking into a company's network. Network managers often use firewalls that limit Internet access to a few publicity documents set up on the Internet. This also prevents employees from taking advantage of the Internet for doing work on the road or in an outside office.

For employees in a large fixed location, Semaphore Technologies has developed a line of products that enable companies to interconnect remote offices via dedicated lines, frame relay or TCP/IP over the Internet. The TCP/IP product has been shipping for about a year and the company is just getting ready to roll out a new version for frame relay. A single $4,500 box can handle 15 computers over a TCP/IP net.

The Semaphore technology is best suited for large offices, not the mobile worker. Virtual Open Network Environment in Rockville, MD, has been demonstrating a new concept in mobile firewalls. It is based on an interface it developed to Trusted Information System's firewall that enables employees to securely telenet into the system. It also supports WWW, FTP and Gopher transactions in a nonsecure way. The firewall costs about $18,000 for all software and hardware. The card readers cost about $100 each. The cards themselves are smart cards that are being adopted by the financial industry today. Tom McCreary, product manager of the Smart Wall, said that although these cards cost $15 today, volume deployment by the financial industry will drive their cost to $1 each in a few years.

The exciting thing about the Smart Wall is that it is cheap enough for a consumer purchasing model. McCreary pointed out that these cards have compartments for up to eight different pieces of data. People could store their ATM number, Visa number and infor-

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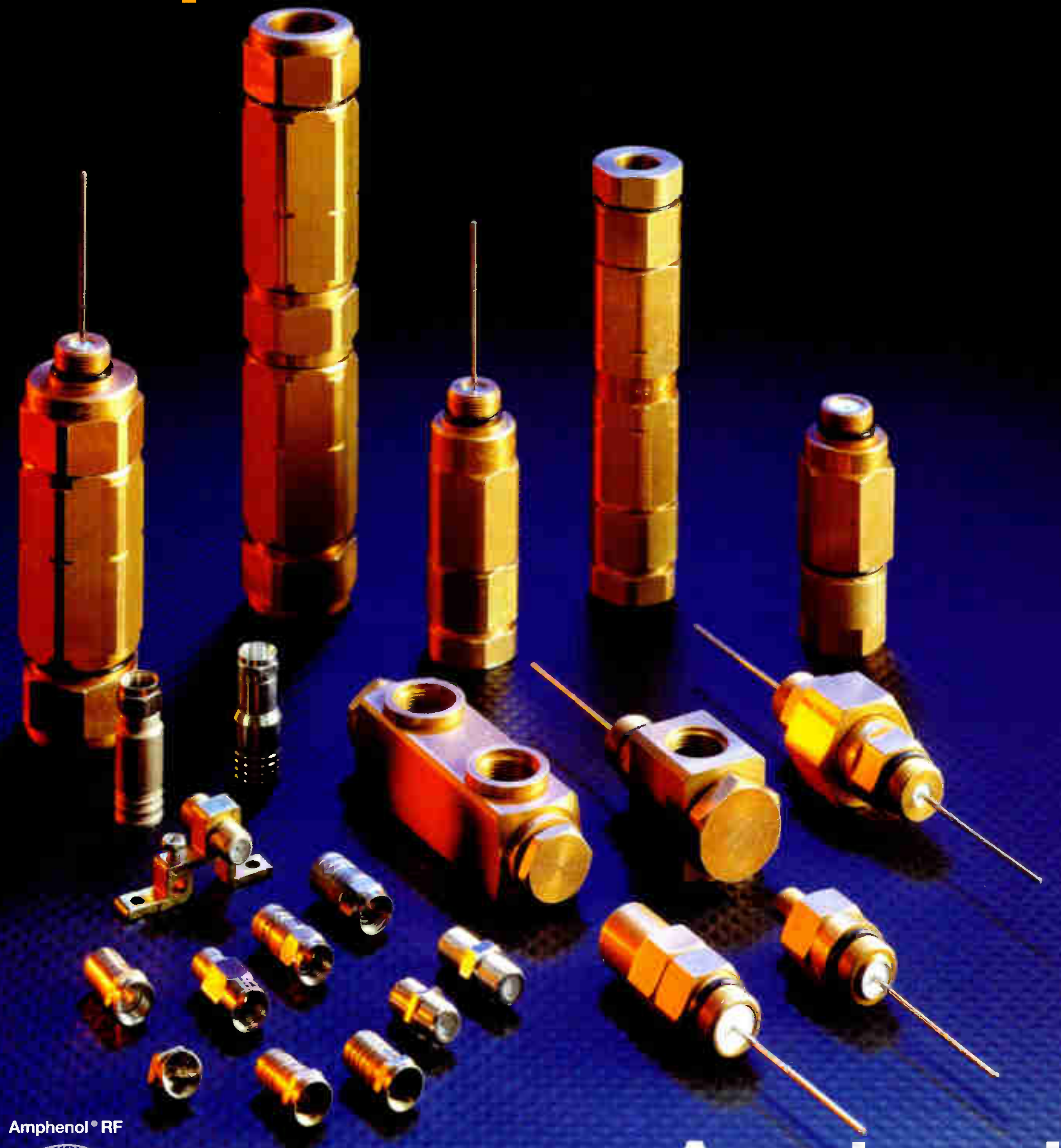

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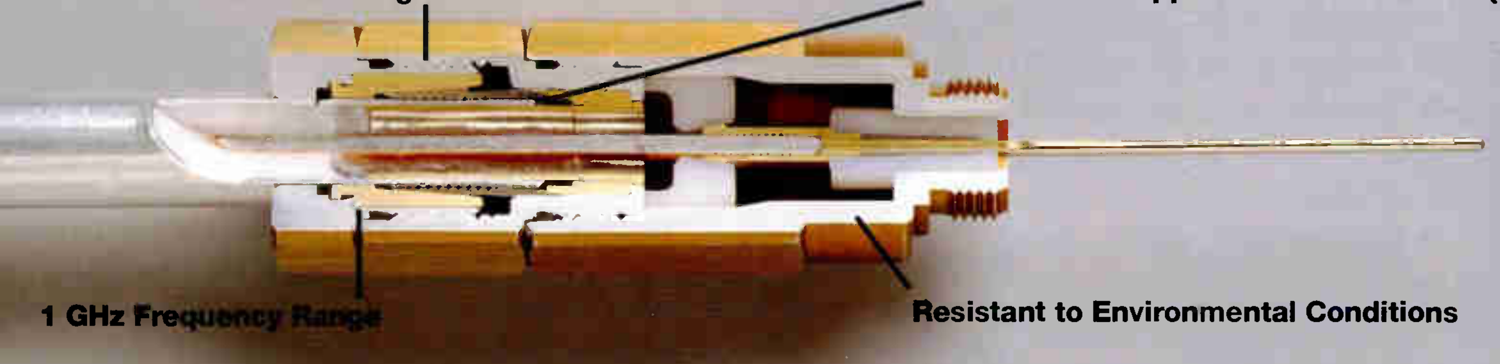

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Amphenol CATV Hardlin

Feature	Benefit
True non-rotational design	Eliminates installation stresses and latent cable defects
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Return loss to 1 GHz, guaranteed	Reduces need for repeaters on long runs
Attenuation, max. dB	Reduces need for repeaters on long runs
Hex nuts all same wrench size	Reduces costs for installation tooling and makes installation foolproof
Positive stop installation	Gives positive proof of proper installation
2" long pin as standard on all items	Reduces inventory when both short and long pins may be required
3-piece connectors, for visible conductor entry	Gives positive proof of proper installation - both insertion alignment and center conductor grip
Aluminum Finish	Superior corrosion resistance

Amphenol CATV hardline Non-Rotational Gold Series connectors

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- Impedance: 75 ohms • Return loss: ≥ typical 40 dB @ 1.0 GHz
- Insertion loss: ≤ 0.05 dB @ 1.0 GHz

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Mating: Pin type has standard 5/8-24 UNEF thread. Full cabl retention over temperature range. Designed to release cable prior to cable tensile failure.

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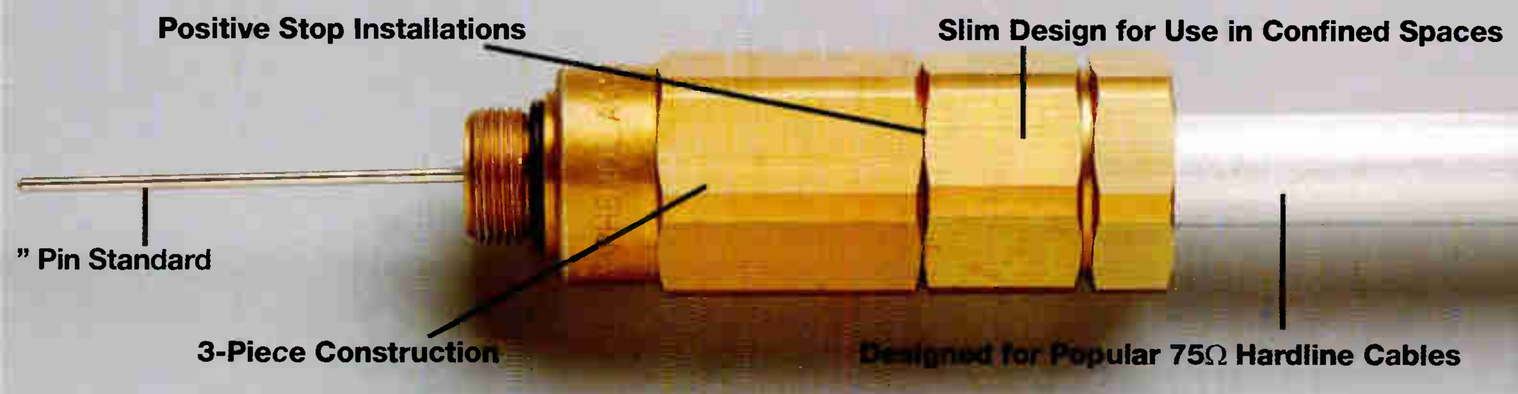
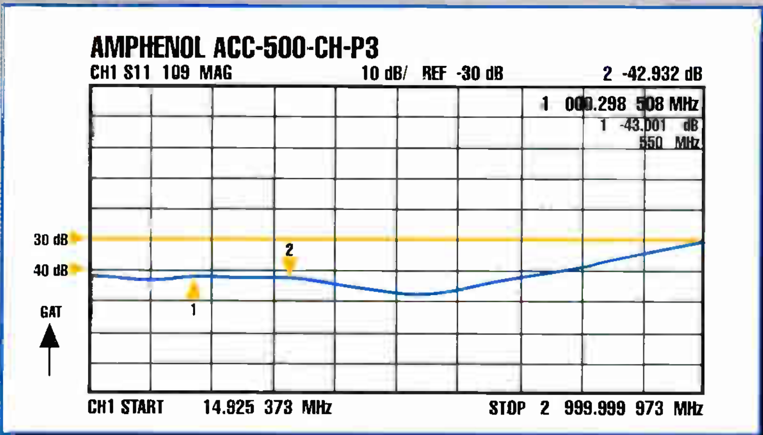
GHz Hardline Connectors



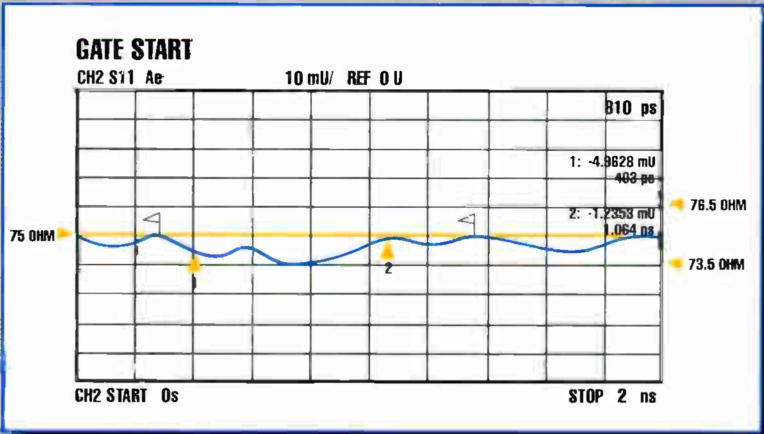
nnector Advantages

enol	Competitor A	Competitor B
s	No	No
!s	No	No
dB	30 dB	30 dB
2	Not Reported	Not Reported
•s	No	Yes
•s	No	Yes
•s	No	No
•s	Yes	2-pc. = No 3-pc. = Yes
avy	Light	Clear - Not Visible

Return Loss



Impedance



Test Procedure - Launch off 75 ohm Amphenol precision lab connector into tested connector gating out cable. Test equipment used - Hewlett Packard 8753D.

Material & Finish

Materials: • Aluminum - 6262 type • Brass - Alloys to QQ-B-626
• Plastics to various specifications

Finishes: • Aluminum - Chromate conversion • Brass - Nickel plate
• O-Rings - Ethylene propylene

Environmental

Temperature range: -40°F (-40°C) to +140°F (+60°C)

Corrosion: Designed to meet ASTM 368 CASS corrosion test when assembled onto cable.

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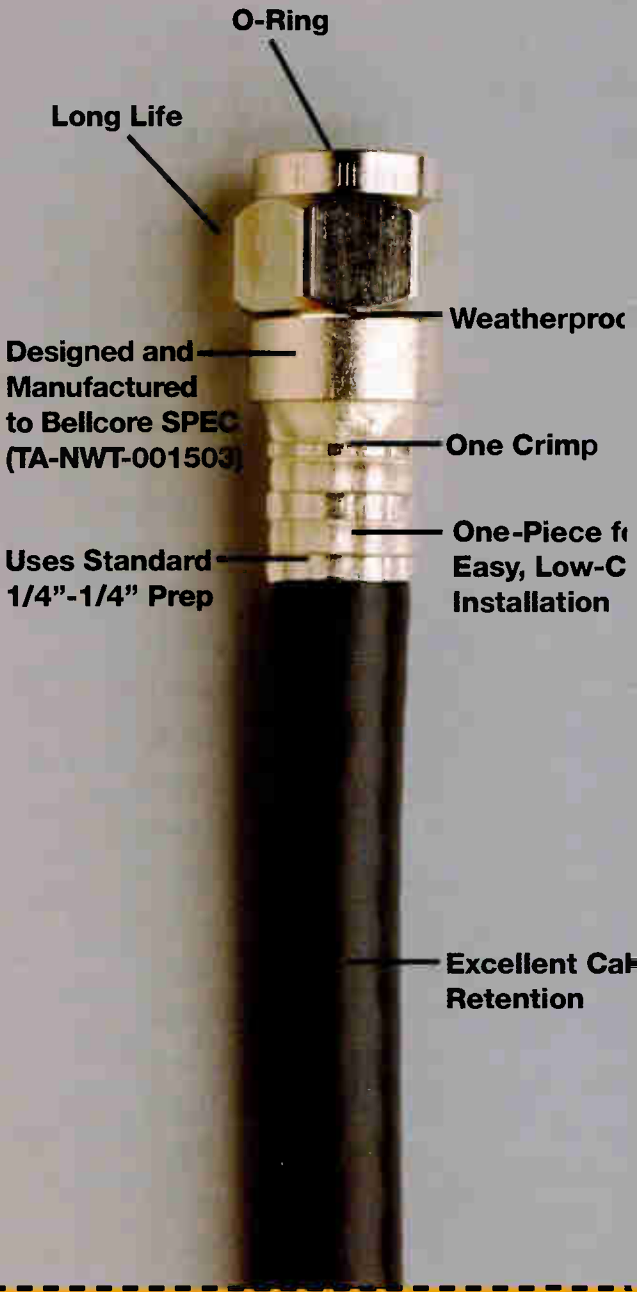

Weatherseal F Connector Features:

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Amphenol Weatherseal CATV F series connectors

Electrical
- Impedance: 75 ohms
- Frequency range: DC-1GHz
- RF leakage (screening effectiveness): -100 dB minimum @ 1 GHz
- VSWR: ≤ 1.06 @ 1GHz

Material
Coupling nuts and bodies: Brass
Plating: Crimp Ring: Tin-lead
Coupling nuts: ASTROPLATE® (Bright Nickel)

Environmental
Temperature range: -40°F (-40°C) to +140°F (+60°C)
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mation on the card. Then when they log on, they could transmit their data securely to the firewall where the payment could be processed. Of course, that will require the widespread distribution of the card readers to consumers.

Some options for cable ops

In the business world, bidirectional communications is of course important. A company may want to shunt large files all over the network. But consumers may be quite satisfied with asymmetrical communications that enable them to quickly receive video and audio clips at high speeds, but only send data at a slower rate. Hybrid Networks has teamed with Intel to provide a 10 Mb/s downstream and 64 kb/s upstream network.

The companies are working on trials of the technology with both TCI and Viacom. Intel will sell the cable modem itself and Hybrid will work with cable operators to set up connections to WANs like the Internet, CompuServe and America Online. Notes Ed Moura, president of Hybrid, "We just want to make this available in large quantities. We have the high speed and low cost plus the networking technology to put this together, and show the operator there is a business here."

The one limitation of this approach is that the bandwidth is shared between all of the users on the network at any given time. Jake Smith, president of Cactus Computer, believes the vendors are setting themselves up. Although several hundred people could still share the cable network and get much faster access to the Internet, the Internet would slow down significantly if a substantial number of people with higher speed modems were to plug into it.

Smith notes that most of the servers on the Internet are sized for 10 kb/s connections. Cable customer who pay more for high-speed access may feel cheated if they see little improvement because of the latencies inherent in the Internet itself.

Cable operators do have some options. They can set up a server that caches frequently accessed data locally on the network. Then when others want the same data, it only has to come across the local network to get to them.

Another option is for cable operators to set up their own Internet servers, and then sell the space to shops and businesses in each local community. At the last Western Show, Analytical Sciences Corp. demonstrated the Neighborhood USA system, which is a multimedia WWW server for delivering video, audio and text over a cable operator's data network. Hundreds of other companies are setting up shops on the Internet that sell everything from pizza to sex toys. There is a tremendous opportunity for server providers, particularly if they can guarantee merchants that potential clients will have enough bandwidth to view audio/video catalogs and ads without annoying delays.

Subsuming it into the box

Even with the latest generation of PC-based graphical user-interface software, getting on to the Internet can still be expensive and complicated for many consumers. They have to buy a PC and then pay a minimum of $10 a month for just casual surfing. But many of them just want to surf around, look at catalogs, weather maps and other goodies found freely on the Internet, without having to get a computer to do so. Perhaps this was be-

He Can Find Drugs, Explosives, Termites and People...

but this RF leakage thing has got him depressed.

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His tracking days are over, but the thought of trying to track RF leakage still intrigues him. It takes a special talent to find that stuff.

Cable Leakage Technologies has been in the RF leakage detection business for over 5 years and has patrolled over 4.8 million miles of cable all over the world. Wavetracker boasts positive identification, 2-5 meter positioned accuracy and one step prioritization. And all of that because CLT *invented* the original Wavetracker...it's that simple.

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hind GTE's thinking in its mainStreet data service for cable TV systems. The service is being rolled out to 550,000 homes in New England by Continental Cablevision.

Although the service has no tie in to the Internet, it does enable a cable operator to put about 75 interactive data services onto a single 6 MHz cable channel. Consumers pay $9.95 per month to access encyclopedias, stock quotes and interactive games. Interactivity is accomplished either over a two-way cable plant or a telephone line. A GTE chip in the set-top box converts the data into virtual channels that mouse potatoes can surf. However, according to Tom Grieb, mainStreet general manager, the company expects to get out of the hardware side of the business soon. "We are an interactive cable channel. We are not a hardware or systems provider," he said.

But at the moment, GTE is willing to do whatever it takes to get the service out on cable systems today. Grieb said, "We built the business model that assumed we did everything. Then we negotiate with the cable company a deal that makes sense to us and them. One example is billing. It would cost us $1 per subscriber to do a separate bill, but cable operators could add another line to their bill for about 5 cents. As long as the overall business model makes sense, you can split the revenues based on who pays the costs."

Grieb said his strategy is to work with the top MSOs. He is planning on rolling out mainStreet to the top 20 TV markets in the next five years.

The most popular application on mainStreet in terms of time spent are the games. Some of them, such as QB1 (a play-along football game) can last for hours. But information and financial applications receive far more accesses for short durations of time as people look for information. Grieb said that other applications help to sell the service, even though they may not get accessed very often or for very long. For example, a kid may look at the encyclopedia for 15 minutes a month but it obviates the family's need to go out and buy one.

Grieb believes the chief competition is the way people do things today. He said, "We have to change people's behavior in much the same way the ATM did. I think it will be a decade before interactive channels have to take customers away from each other in order to grow. The real challenge will come from trying to get people to pay their bills over this instead of writing checks and sending them out. Cost and convenience are on our side and it will happen.

The broadcasters are coming

Broadcasters may be getting into the data communications game as well. A number of companies are working on schemes for inserting data onto TV signals and one of them claims to have developed a bidirectional system that operates over the vertical blanking interval (VBI). Wavephore Corp. based in Tempe, AZ, has been developing a technology that is capable of piggybacking a 384 kb/s signal on top of a single TV channel without interfering with it.

The encoder costs about $15,000 for a single channel, or $75,000 for a version that can put a data transmission onto multiple channels. The decoders currently cost about $1,995. Bruce Cross, vice president of sales and marketing, claims it will be reduced to a $200 card or a $100 chip set suitable for fax machines and

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other OEM applications by the end of 1995. Cross said the unit will be portable but not mobile for some time because it will require a tuner and antenna.

Wavephore has been conducting a trial in Phoenix for some time on Chs. 3 and 45 and some ITFS channels. The first commercial application will be WFLA in Tampa, Fl, which will use the broadcast signal to transport digital programming to cable headends as part of a retransmission agreement. The signal will be decoded by the cable company and converted into a virtual channel on the cable system.

BleuMont Telecom in Montreal has developed a data broadcasting service called Skyway that also uses a TV signal's VBI. Information providers can put information on the service that can only be accessed by those consumers with the proper electronic key. The service can piggyback up to 150 kb/s onto a single TV channel.

Consumers can buy the decoders for C$350. Then they must pay the information provider to have access to the information. The decoder can be programmed remotely by the data broadcasting to receive or exclude any broadcast data.

Twenty information providers have already signed up to sell to information about provisional government updates, news, traffic information and weather reports. They pay a monthly administrative charge of C$500 per month, plus 20 cents to C$1 per kilobyte depending on volume delivered.

Another company, Radio Telecom and Technology based in Riverside, CA, is working on a technology that is supposedly capable of bidirectional communications using the VBI of a TV signal. Louis Martinez, president of RTT, says its technology can transmit 20 watt peak pulses in the VBI of a channel but that the average power is a few mW. He said this enables a single transceiver to send and receive data over a 30-mile radius or enough to cover most cities.

Martinez believes a single transceiver could handle 20,000 to 30,000 subscribers using an omnidirectional antenna and as many as 120,000 subs with a directional antenna. Martinez said subscribers will pay $5 per month for the service. RTT also will receive money from advertisers and a pay-per-view scheme.

However, there are serious engineering questions about the feasibility of this technology. Although the company has done some small-scale trials with GTE, it has not done a field test with thousands of units. The company refused to disclose much technical information other than to say that it is able to send return path data over the VBI. But even if they were able to do a successful demo with a few field units, how would it respond to thousands of transmitters all trying to stay in sync with the VBI? And what about reflections or the unit that gets out of sync with the TV signal?

Conclusion

Data communications provide an opportunity for cable operators to get into new services with only an incremental investment, especially if they have already made their plant two-way capable. Schools, businesses and consumers are all discovering the Internet and other data services. Cable operators have the potential to make their bandwidth available for a variety of applications and possibly supply substantially more bandwidth at a reasonable price than any of the means available. **CT**

By Helen Chen, Development Engineer, Hewlett-Packard Microwave Instruments Division

Testing digital video — Part 2

In Part 1 of this article (May 1995 "Communications Technology,") we saw that power and interference measurements are essential to both digital and analog cable systems. In addition to power and interference tests, digitally modulated cable transmissions create a need for new measures of signal quality. Emerging services, such as data transport and personal communications services (PCS), depend on the integrity of the bits transmitted. Digital modulation formats employ multiple strategies to preserve the clarity of the data, such as adaptive equalization and error correction. When these strategies fail, digital services abruptly descend from acceptable quality to complete failure. New digital modulation tests must permit service providers to spot performance trends and to prevent problems before they affect service delivery. We'll explore that in this part of the article.

Digital video modulation measurements are very different from those used in analog video. Analog signal characteristics such as FM deviation and chroma/luma delay have proven over time to be practical tools for assessing the performance of the analog modulation system. Many digital modulation metrics could potentially be used in digital cable systems.

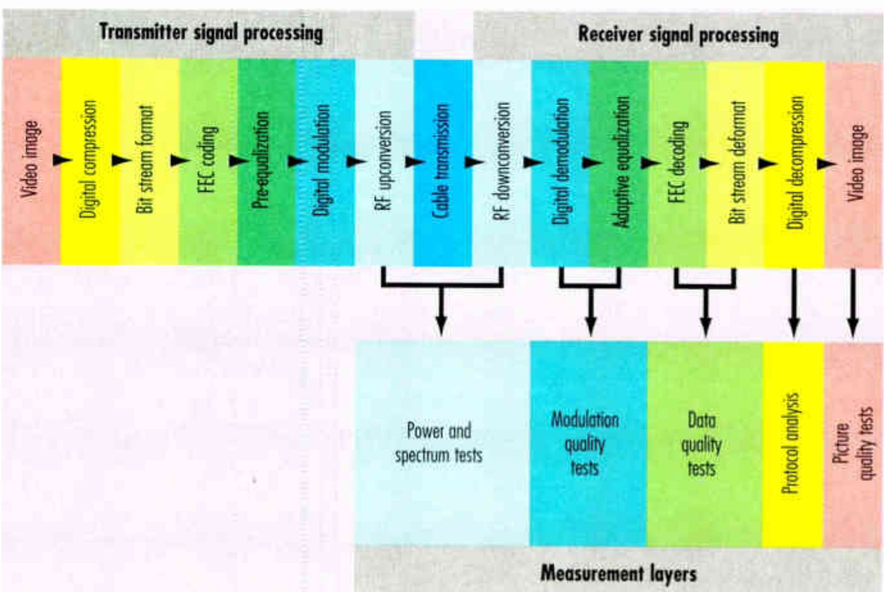
The key digital tests will be determined in practice as the setup and maintenance of digital cable systems increases. Several possible measurements are: bit error rate (BER), margin-to-critical BER, modulation error ratio (MER) and constellation/eye diagrams. Let's define each measurement and consider how to apply them to a digital cable TV plant. Using the right modulation tests at the right points in a digital cable system helps to ensure reliable service — a key competitive advantage.

Probing layers of digital signal processing

Every digital cable format is designed to maximize the transportation of data through the linear and nonlinear distortions of the transmission channel. Figure 8 shows the layers of signal processing in a digital transmitter and receiver. The video image is digitized and compressed to form a bit stream. Forward error correction coding and pre-equalization may be applied to protect the data from corruption because of impairments in the transmission channel. The bit stream then enters a digital modulator, such as a 16-VSB or 64-QAM modulator. The resulting baseband digitally modulated signal is upconverted to the desired RF carrier frequency. Each successive layer of processing transforms the signal, hiding the information of previous layers.

To recover the information hidden by the transmitter signal processing, the receiver must undo each level of concealment. The quality of the data bits retrieved by the receiver depends on how channel distortions have affected each layer of the transmission. To measure the transmission quality, a test instrument must recover the signal at the correct layer for testing. Each level of signal recovery holds a different view of the performance of the system. Figure 8 shows how each type of measurement corresponds to a signal recovery layer. As we have seen, power and interference tests are applied to digitally modulated RF transmissions. The next layers of measurement are modulation and data quality tests.

Figure 8: Layered signal processing in digital transmissions



Navigating test points

Choosing test points in the cable system requires considering what layers of signal processing are present in the signal and how much signal processing the test equipment must apply. Navigating the layers of signal processing in the digital cable plant is essential to any test plan. Figure 9 on page 82 is a block diagram of the components of a digital cable system highlighting possible test points in purple. Key layers of signal processing are shown in gray.

In the transmitter, bits are processed into digital transmission formats. Forward error correction (FEC) coding is often applied to the symbol

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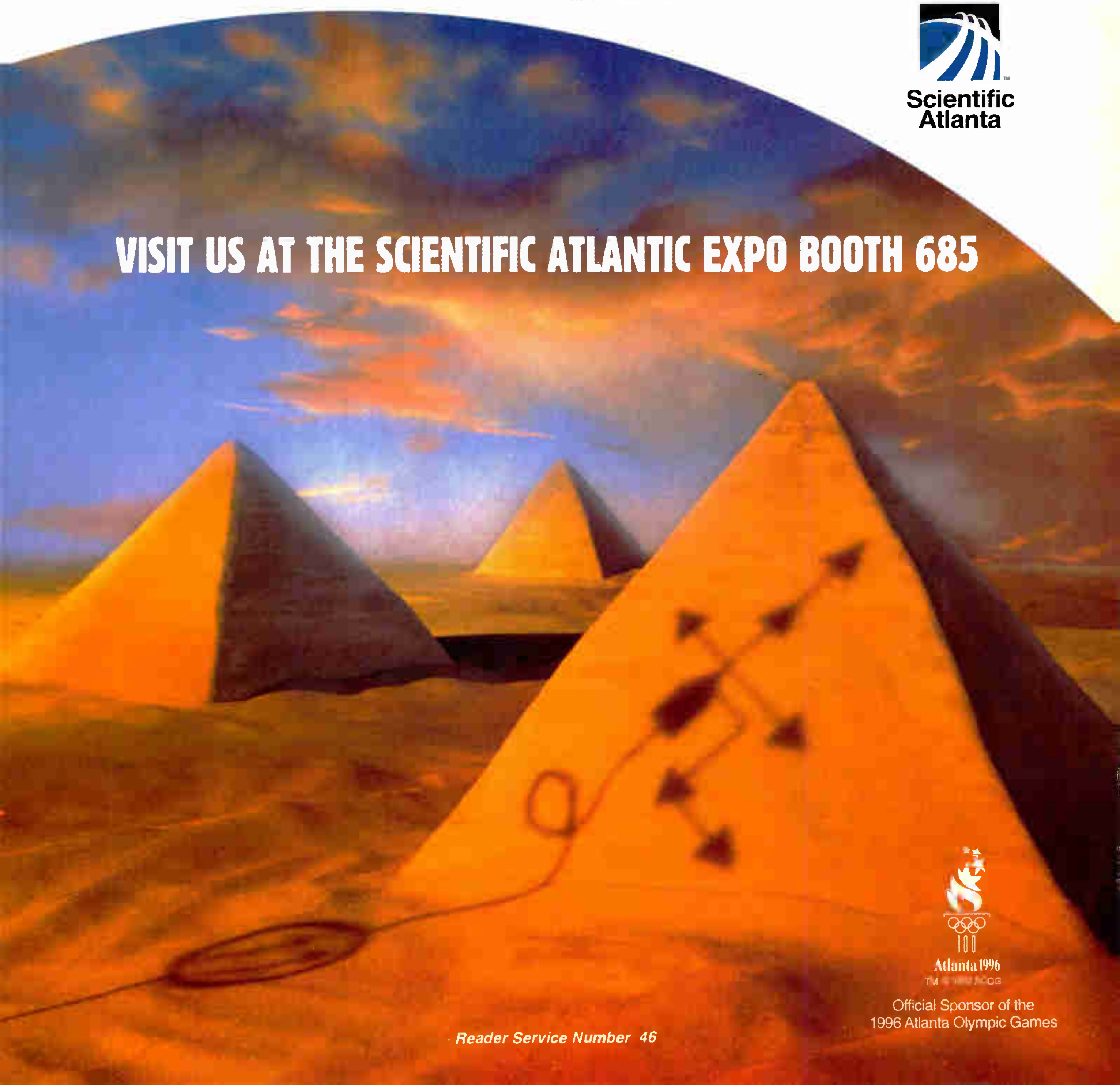
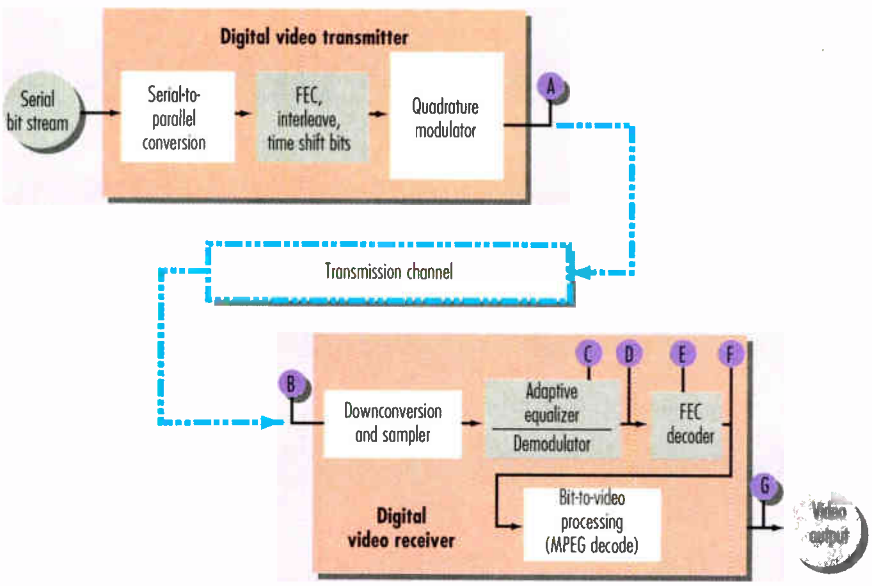


Figure 9: Digital cable system test points



stream. FEC adds redundancy to the bit stream, making the correct data sequence recognizable even with one or more bit errors. The FEC is unique to each digital transport format. In the European 64-QAM digital video cable standard, a Reed-Solomon t = 8 (204,188) error correction code is used. This 64-QAM code adds 16 Reed-Solomon parity bytes to 188 bytes of data, yielding 204 bytes of data to be transmitted. This code can correct up to eight byte errors. In the quadrature modulator, the coded data is mapped to I/Q values (symbols) and filtered by a shaping filter to control the spectrum of the RF transmission. At a test point attached to the output of the headend modulator (A), the original bit stream is buried in the effects of the FEC, the digital shaping filter and the digital modulator.

The transmission channel imposes linear and nonlinear distortion. Linear distortions include group delay and amplitude ripple. Nonlinear distortion can result from amplitude compression and spurious interference caused by ingress or intermodulation distortion products. Noise may be added. The impaired RF signal is probed at Test Point B in Figure 9.

In the receiver, the digitally modulated signal is downconverted and sampled. Digital transport systems often include an adaptive equalizer to remove the linear distortions of the transmission channel. An adaptive equalizer is a digital filter that continuously reprograms phase and amplitude characteristics to exactly compensate for the phase and amplitude distortions of the transmission channel. The 16-VSB digital cable format

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uses a two-part adaptive equalizer: a feedforward transversal filter followed by a decision-feedback filter. Test Point D allows probing the received symbols after the adaptive equalizer. The equalized I/Q symbol vectors are demodulated to recover the coded symbol stream. FEC is decoded to recover the original data bits. Test Point F permits examination of the corrected bit stream. Test Point C and Test Point E represent information that can be made available from the adaptive equalizer and FEC chips.

Digital video metrics must be matched to the correct test point, optimizing the value of the measurement. First, we look at the overall quality checks provided by assessing the quality of the received data. Next, sensitive troubleshooting measurements of modulation quality will be examined.

Testing data quality: BER

BER is an overall measure of the quality of the received bit stream. BER is the ratio of the number of bit errors to the total number of bits sent in a given time interval:

$$BER = N_e/N_t = N_e/b \times t$$

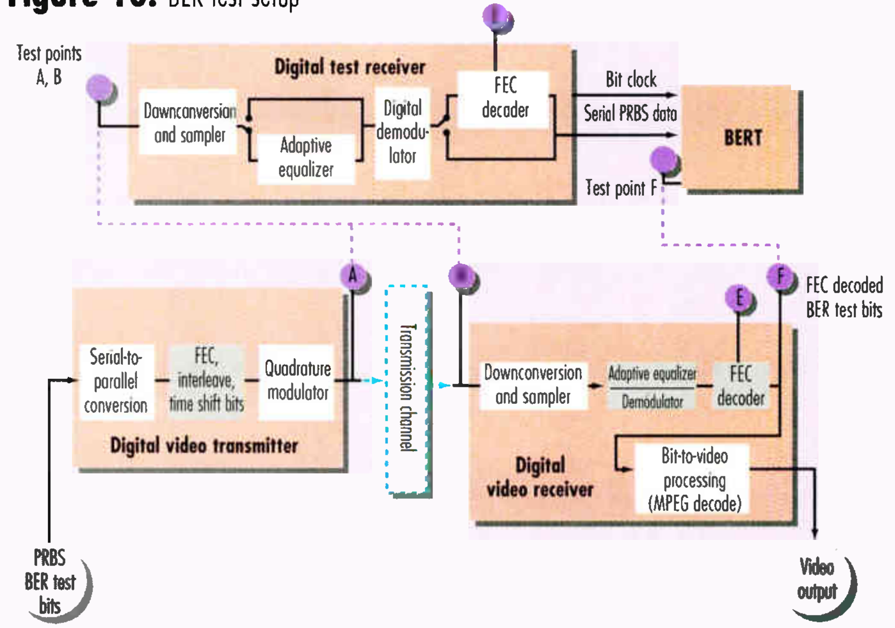
Where:
N_e = number of bit errors in time interval t
N_t = total number of transmitted bits in time interval t
b = bit rate of signal

Measurements derived from BER provide a distant reflection of picture quality, separated from direct picture quality metrics by several layers of signal processing. Note that accurate measurement of BER requires long measurement times. For example, a BER of 1×10^{-8} in a digital video system with a bit rate of 30 Mbits/sec will experience a bit error every 3.3 seconds, on the average. Gathering enough bit errors to form a statistically accurate BER can take many minutes, or even hours, at low BERs.

Bit error rate is typically an end-to-end system measurement that includes the error correction processing of the FEC. Figure 10 (page 86) shows a block diagram of an intrusive BER test. A known bit stream is injected into the data to be transmitted. Standard pseudorandom bit sequences (PRBS), such as CCITT 2^{-23}-1, are often used. In the simplest version of BER test, the known bit stream passes through the transmitter FEC and the shaping filter. A bit error rate tester (BERT) measures the received bit stream after shaping filter compensation, adaptive equalization, digital demodulation and FEC decoding in the digital cable receiver in the set-top box. BERT input comes from Test Point F. Note that either the known bit stream must be transmitted on a separate channel or the BERT must know how to extract the known bit sequence from the program data stream. Since the known bit stream displaces cable TV program data, this is an intrusive test.

Measuring BER at intermediate test points (A and B) in the digital cable system requires more complexity in the test equipment. As shown in Figure 10 (page 86), a digital test receiver performs a high-quality downconversion and demodulation of the digitally modulated signal to recover the symbol stream. The test receiver selectively applies the desired signal processing layers to reveal the bit stream. A BERT can then measure

Figure 10: BER test setup



BER from the data output of the test receiver. Note that the BER reading will be different depending on whether the adaptive equalization and the FEC are applied in the test receiver. A cable operator must know what layers of processing are included in his test receiver. The test receiver may have to include an adaptive equalizer and FEC decoder for every format to be tested in the digital cable system.

Alternatively, a nonintrusive BER test can be done using the error information in the forward error correction chip using Test Point E. The FEC decoder recognizes bit errors and corrects them. The decoder also can count and record the number of bit errors that have been corrected. If the pathway to read this information is available, the FEC chip can supply an accurate BER without injecting a known bit stream. This nonintrusive BER depends on the power of the FEC to detect bit errors. Different FEC codes have different error detection sensitivities. A Reed-Solomon code, for example, can correct bursts of bit errors as well as single bit errors. If the BER exceeds the error correction power of the FEC, the

Figure 11: Transmitter margin test setup

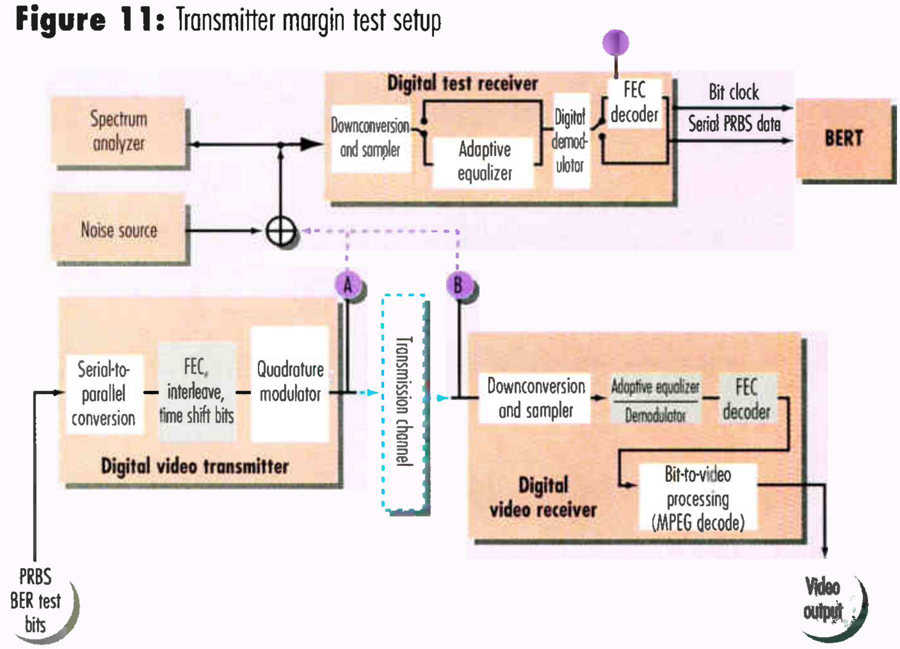


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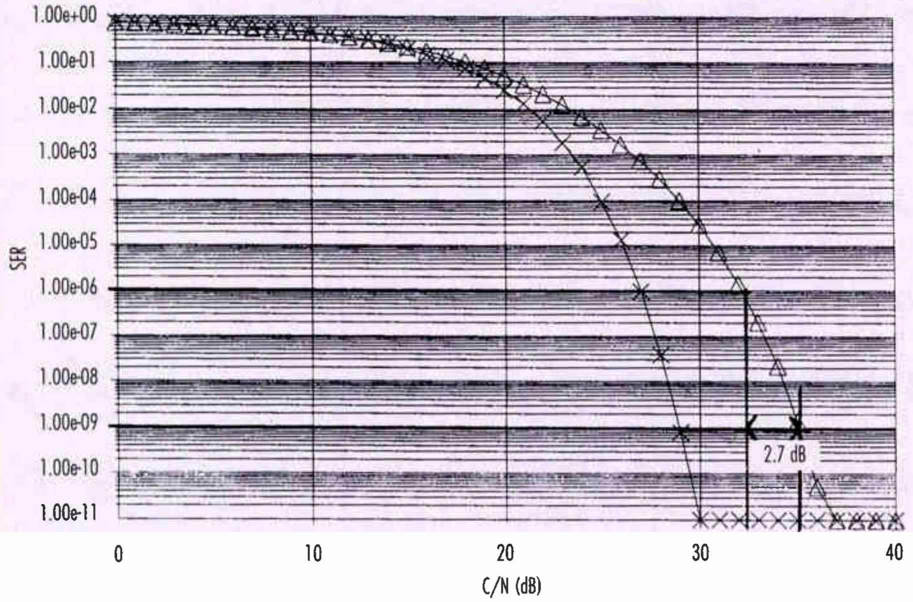
Figure 12: 64-QAM margin-to-critical BER test



error statistics will not accurately reflect the true BER. Applying this method requires understanding the FEC limits.

BER reflects only modulation impairments severe enough to cause bit errors, remaining insensitive to subtle trends in the digital modulation. A good BER indicates proper service delivery. A bad BER highlights impaired service but does not identify the cause of the problem.

Margin-to-critical BER

A single BER measurement is a performance measure of the digital cable system at its current operational level, giving no indication of how close the system may be to critical BER. At critical BER, the subscriber encounters severe impairments, such as freeze-frame of the received video. A margin-to-critical BER combines signal-to-noise (S/N) measurements with BER measurements to test the robustness of the digital cable system. Margin-to-critical BER, or margin test, is a stress test of the digital TV system.

Figure 11 (page 86) shows a block diagram for margin test. In addition to the test receiver and BERT required for BER measurement, a spectrum analyzer and calibrated noise source are added. Margin measurement begins with obtaining the BER at the current operating point. The S/N is measured with the spectrum analyzer. Next, measured levels of white noise are then added using a calibrated noise source. The noise level is increased while the BER and corresponding S/N are measured. Noise obscures the bits recovered at the test receiver demodulator, degrading BER as noise is increased. When critical BER is reached, the S/N at critical BER is recorded. Margin-to-critical BER can then be calculated as:

Margin-to-critical BER = $S/N_{operational} - S/N_{critical}$

Critical BER must be separately defined for each digital cable format. Margin-to-critical BER indicates the amount of additional noise that can be tolerated by the digital cable system.

Figure 12 shows a margin test on a 64-QAM transmitter, performed at the output of the transmitter without adaptive equalization or FEC. The operating BER is 1×10^{-9}. 2.7 dB of noise could be added to reach a critical BER at 1×10^{-6}. Margin results must state which layers of signal processing are included. The adaptive equalization filter alters both the BER and the noise bandwidth. The FEC improves the measured BER, changing the margin test result.

Margin measurement offers an indication of the robustness of the digi-

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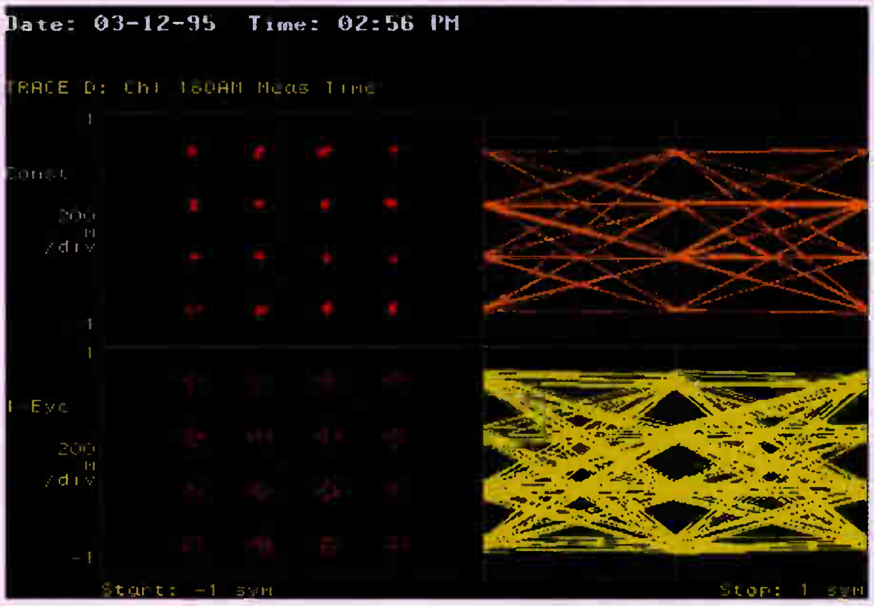
tal cable system to noise and ingress. The margin test does not, however, give a calibrated picture of the quantity of spurious or compression impairments that might be tolerated. In addition, this test is cumbersome to perform, requiring multiple test instruments. Since several accurate BER measurements must be made, measurement time is long. The margin test is perhaps best suited to qualifying the performance of new digital cable installations.

Figure 13: 16-QAM eye diagram/constellation plot

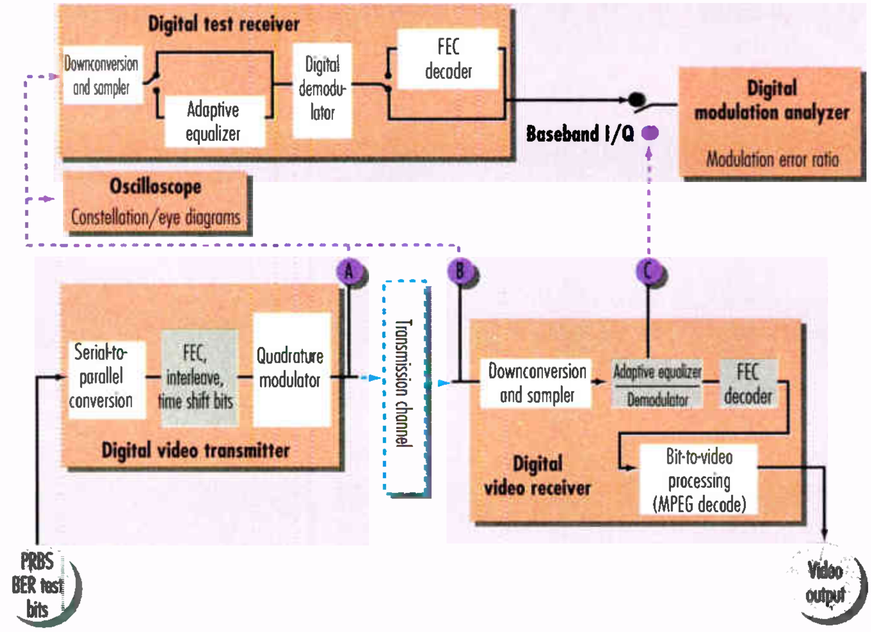


Constellation and eye diagrams

When using digital modulation to transport video, signal impairments do not affect the picture quality unless they cause uncorrectable bit errors. The error retrieval power of the adaptive equalizer and the FEC masks modulation distortion problems. BER tests will not expose digital modulation impairments. Direct measurement of the quality of the baseband digital modulation, however, permits the cable operator to assess the magnitude of the distortion being concealed by equalization and error correction. Understanding the source of the degradation of the digital modulation allows the problem to be repaired before the BER is affected.

Eye diagrams and constellation plots are graphical views of baseband digital modulation. RF downconversion, digitizing, digital demodulation and adaptive equalization are applied to the RF transmission to expose the baseband modulation layer for measurement. A constellation plot displays the modulation phase and amplitude points that correspond to bits

Figure 14: Modulation metrics setup



in a digital modulation format. For example, a bit stream passed into a 16-QAM modulator is first grouped into sets of four bits. Each set of four bits is a symbol, creating $2^4 = 16$ possible symbols. Each symbol is mapped into a phase/magnitude, or I/Q plane position to be modulated onto an RF carrier. I/Q position is related to the modulation phase and magnitude by:

I = Magnitude x cos(phase)
Q = Magnitude x sin(phase)

The constellation plot shows the actual I/Q modulation values that were sent. An eye diagram shows how either the I or Q modulation component changes over time, superimposing segments of I or Q trajectory. Figure 13 (page 91) shows 16-QAM constellation plots and eye diagrams.

The constellation plots of the left side of the figure show the 16 target phase magnitude states of 16-QAM. The eye diagrams on the right side of the picture show the four amplitude levels of the Q component of the baseband modulation and the transitions between amplitude levels. In the upper section of the display, no impairments are seen in the diagrams. In the lower section of the display, a spur 35 dB below the average signal power level has been added at a frequency 1.5 MHz higher than the 16-QAM carrier. The spur disturbs the modulation phase, causing the transmitted states to form rings on the constellation diagram and closing the eye.

Figure 14 shows a test setup for

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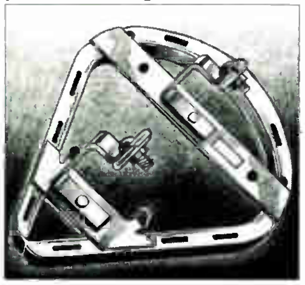

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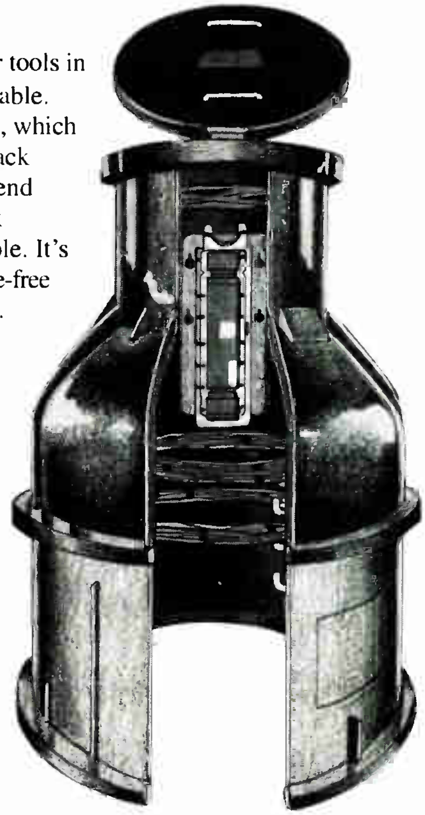

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obtaining these diagrams. A test receiver with a digital modulation analyzer or a high-speed oscilloscope may be used. Eye diagram and constellation plots require signals with low distortion to produce defined graphical plots. Measurements done at the output of the headend (A) give a quick check on the quality of the digital video transmitter before cable channel distortions. If the test receiver can apply adaptive equalization, the linear distortion of the channel can be removed, permitting clearer views of baseband modulation impairments caused by noise, compression and spurs at the set-top receiver (B). Note that these graphical diagrams are limited by the display hardware resolution in the test equipment. A 64-QAM or 16-VSB eye diagram has many finely spaced levels requiring a very high-resolution display for quantitative measurements.

Eye diagram and constellation plots are most useful as fast, qualitative indications of modulation problems. Noise, group delay distortion, compression and spurious interference each have a characteristic effect

Figure 15: QAM modulation error

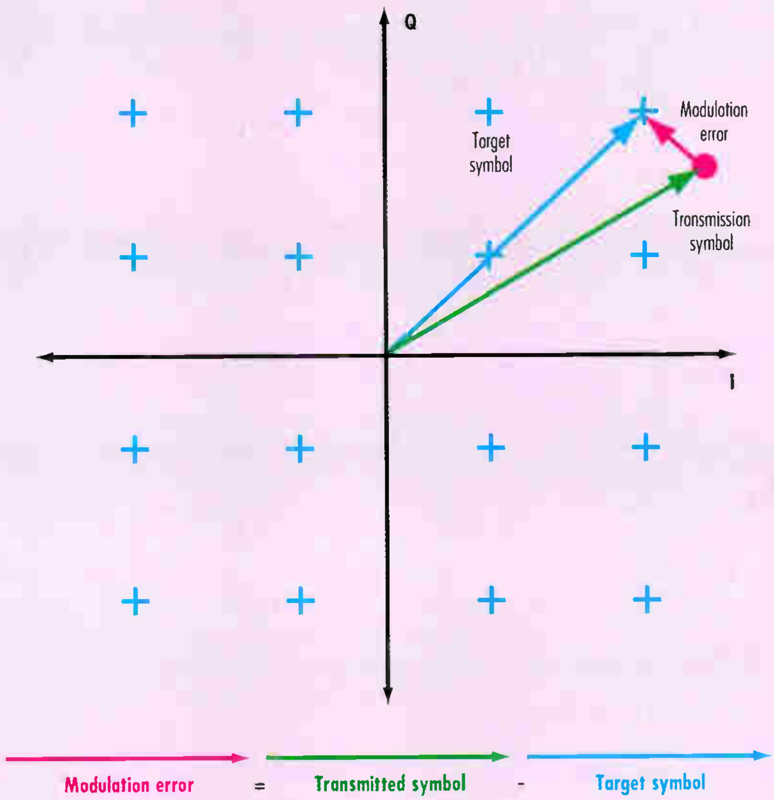
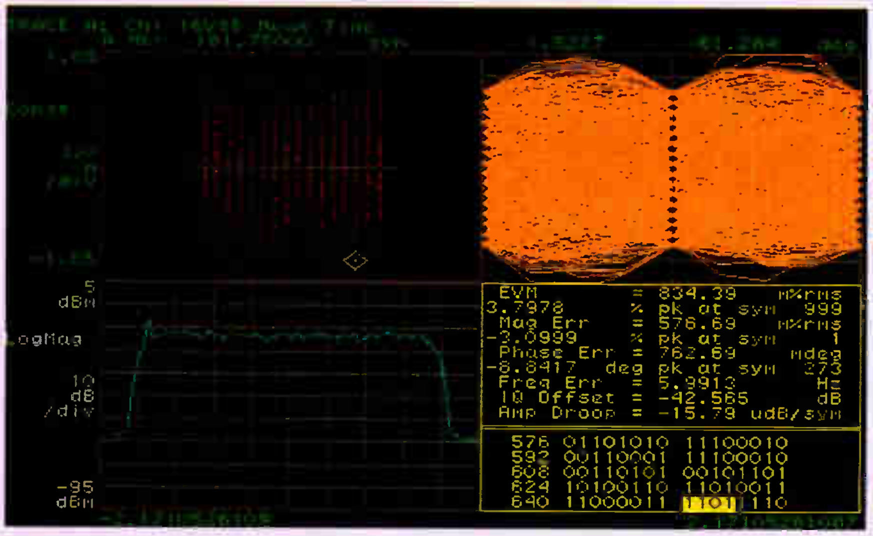


Figure 16: 16-VSB modulation error measurement



on the eye and constellation. Recognizing these display effects can help the service provider identify and troubleshoot a problem.

Testing modulation quality

Assessing the quality of digital video requires not only qualitative views of the modulation but also quantitative modulation metrics. Modulation error is a measure of the digital modulation impairments that obscure the transmitted data. Modulation error measurement relies, however, on correctly recovering the bits that were transmitted. If the correct data bits are known, the perfect phase and amplitude variations of the carrier due to digital modulation can be reconstructed for any digital modulation format. This perfect baseband modulation reconstruction can be subtracted from the actual baseband modulation recovered by the digital demodulator to yield the error in phase and magnitude of the received digital video transmission. Figure 15 (page 95) shows the modulation error vector on a 16-QAM constellation plot. The modulation error can be averaged over many symbols. A useful ratio is:

$$\text{MER} = 10\log\left(\frac{\text{Average modulation error magnitude}^2}{\text{Average baseband signal magnitude}^2}\right)$$

Modulation error ratio (MER) is analogous to a signal-to-noise ratio of the baseband digitally modulated signal. MER is a comparison of modulation error power to the average transmission power in decibels. MER measures the modulation impairments that affect the ability of the digital receiver to recover the data bits. In addition, the MER can be analyzed to identify phase and amplitude error components. High MER caused by linear phase errors is usually due to carrier frequency error or spurious

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interference. MER caused by amplitude errors indicates amplifier compression problems. MER is most useful when considering digital video system margin or S/N issues.

Figure 16 (page 96) shows a modulation error measurement on an 16-VSB signal. In this example, the modulation error is expressed as a linear amplitude ratio called error vector magnitude (EVM).

$$\text{EVM} = \sqrt{\frac{\text{Average modulation error}^2}{\text{Maximum symbol magnitude}^2}} \times 100\%$$

EVM is a measure of the modulation error magnitude normalized to the peak symbol magnitude, expressed as a percent number. For 16-VSB, the maximum symbol magnitude is at the points on the I axis furthest from the I/Q origin. In the lower right quadrant of the picture, EVM and its phase and magnitude components are shown with the recovered bit sequence. EVM gives a measure of the size of the clusters of symbols about the target symbol points on the constellation.

Figure 14 (page 92) shows a modulation error measurement setup. The digital test receiver downconverts

"Using the right modulation tests at the right points in a digital cable system helps to ensure reliable service — a key competitive advantage."

and demodulates the RF digital video transmissions at Test Point A and Test Point B. Adaptive equalization may or may not be applied, depending on whether or not the desired modulation error reflects linear distortions of the transmission channel. The baseband digital modulation is routed past the FEC to a digital modulation analyzer. The digital modulation analyzer reconstructs the perfect baseband modulation trajectory and calculates MER and EVM. Unlike BER, MER or EVM can be measured over several hundred symbols, making measurement time very short. These metrics are fast and sensitive measurements of digital modulation impairments. Note that modulation error measurements reach a sensitivity limit when bit errors in the recovered bit stream cause the perfect baseband modulation reconstruction to use the wrong bit sequence.

Note that the adaptive equalizer also contains information about linear channel distortions, analogous to the magnitude and phase components of the MER. Since the adaptive equalizer compensates for channel amplitude ripple and group delay distortion, the shape of the adaptive equalizer filter reflects linear impairments of the digital modulation. Modulation error information can be drawn from the adaptive equalizer chip, if the access pathways are present. The digital modulation analyzer probes Test Point C or the adaptive equalizer in the test receiver.

Different adaptive equalizers have different compensation abilities. Correct interpretation of adaptive equalizer results requires understanding the limits of the exact equalizer used in the cable system or in the test receiver.

Conclusions

We have explored four types of digital video measurements used to assess modulation and data quality. Setup and maintenance of digital cable services requires choosing a balanced set of metrics to provide both overall system checks and useful troubleshooting tools. Both intrusive and nonintrusive tests may be desired. Designing a test strategy for digital cable systems includes identifying key test points in the plant to apply the right tests to the right digital video signals.

Cable operators can look for new capabilities to be added to test equipment to probe the layers of a digital transmission. The exploding possibilities in the emerging digital cable services may place many different digitally modulated signals on the cable. Measuring the modulation and data quality of each one will require more capabilities in the equipment. Obtaining low-cost, flexible tools for digital video testing is a key challenge in implementing digital video services.

Digital transmissions on cable systems require new measures of signal quality. Understanding the advantages and limitations of the possible measurements is critical to tailoring a test strategy to a real digital cable system. As digital services are implemented, the key digital video tests and tools will be determined in practice. **CT**

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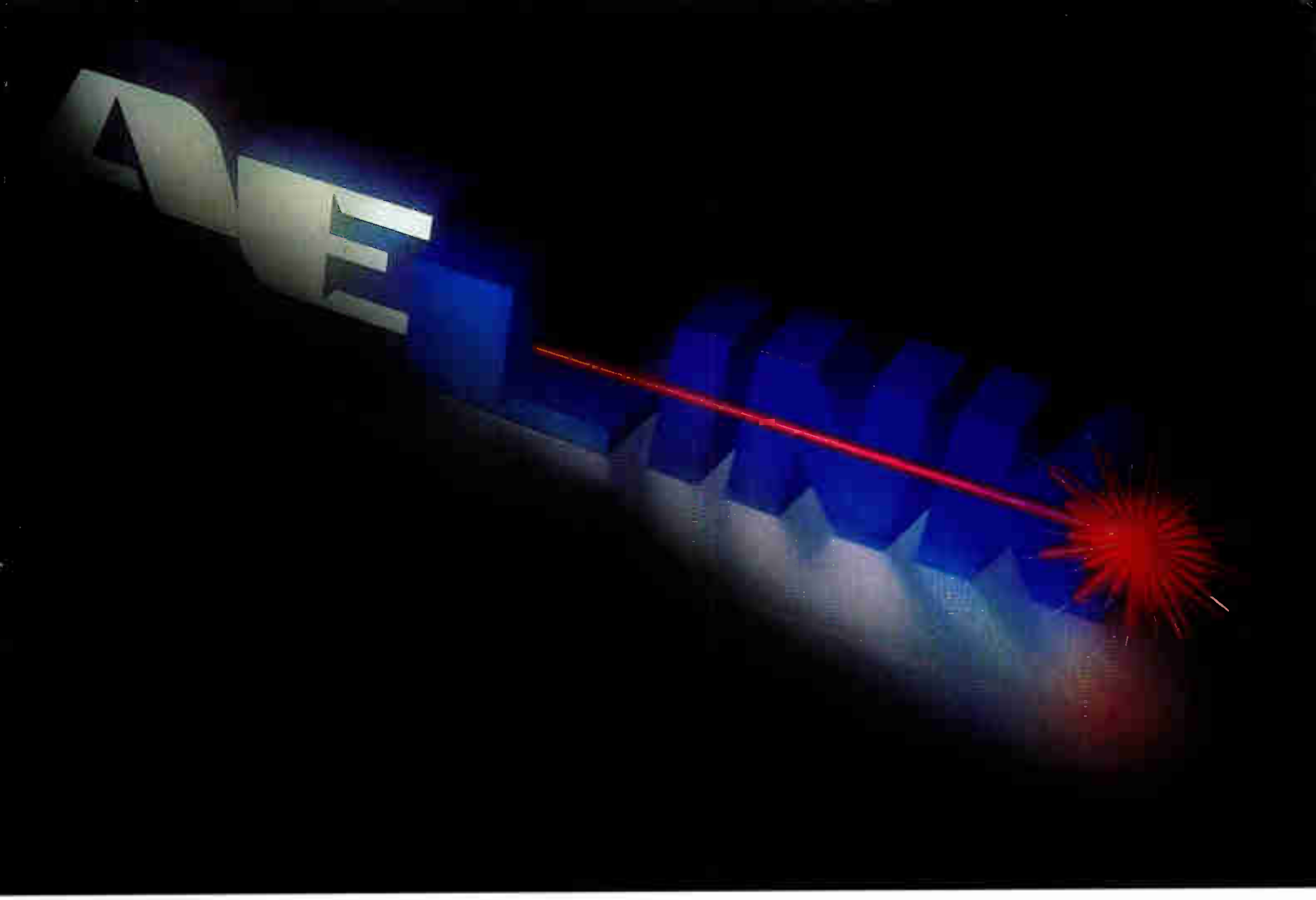
1) Watkinson, John, *The Art of Digital Video*, Second Edition, Focal Press, 1994.

2) *ATSC Doc T3/269, Annex E. Draft VSB RF/Transmission Characteristics*, Dec. 30, 1994.

3) *IEEE G2.2.3 Working Draft Standard, Draft for Standard Test Methods for Measuring the Performance of Digitally Modulated Signals in Television Transmission Systems, Document G2.2-203*, Rev. 5, Sept. 22, 1994.

4) *European Telecommunication Standard Institute Draft pr ETS 300 429, Digital framing structure, channel coding and modulation for cable systems*, ETSI, 1994.



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Wavelength	1300nm	1300nm	1550nm

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By Don Williams, Technical Services Supervisor, Columbia Cable of Oregon

Reflecting on service drops

Many of you have probably heard or read a lot recently about quality issues surrounding cable drops. The reason in part is the future services our industry will be carrying and providing to customers. Entertainment will eventually become just one of the many service offerings our systems will carry for customers.

As you may know, our future transformation may include telephony service to the residence, interactive services, computer online services, meter reading of utilities, and video-on-demand (VOD) or near-VOD (NVOD). Any or all of these services may be offered by your system.

These types of services bring very complex and state-of-the-art digital technologies such as MPEG, pulse code modulation, quadrature amplitude modulation (QAM), quadrature phase shift keying (QPSK), and a host of others. Most of the services I outline will indeed utilize or require some form of digital signaling.

The importance of installer/techs

I would bet about now you are probably thinking, "Well, I am an installer (or technician) and I have very little to do with all that is changing in our industry." If I am right regarding what the future holds for us, then you are dead wrong! It is our installer/technicians that play the important role in our goal to deliver new technology and provide quality service to our customers.

Your job is as important as the engineer who builds the technology. And in all truth, if an engineer designs a product that is capable of being transported through a fiber/coaxial transportation system, but it does not work because of craftsmanship problems through the cable plant, whose work is most important? One job is as equally important as the other in making the technology work.

Is the drop ready?

There are many concerns today as to whether or not the majority of service drops will be ready to carry the additional capacities and digital formats. This is a valid concern mainly because of the importance of low return losses and microreflections as related to digital delivery.

What is all this talk about return loss and microreflections? We must understand some basic electrical principles to comprehend in very simple terms their impact in digital delivery.

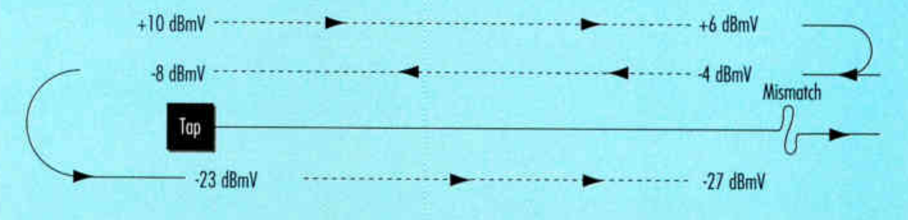
Our signals are introduced to a characteristic impedance of 75 ohms. For our broadband signals to have a maximum transfer of energy through a cable circuit, we must maintain the 75 ohm impedance. In essence, we must keep a very consistent electrical match from the start of the coaxial cable at the headend or fiber node all the way into the customer's home.

The impedance of cable is dependent on its physical dimensions. If a section of cable has a kink or structural change in the spacing between the center conductor and the outside shield, the capacitance of the cable at that point will change, also changing the characteristic impedance.

When this occurs, a portion of the signal is reflected back against its forward path toward its origin. This reflected signal power is measured against the original signal power in decibels (dBs) from the transmitting end. The difference in the two powers is a ratio known as return loss. A low return loss number means a stronger reflected signal. The higher this number in dB the better.

If there is more than one point of mismatch, a portion of the reflected signal is again reflected in the forward direction where it bounces back and forth. Some of the energy that was reflected back again in the forward direction will continue to travel with the desired signal. If the mismatch is significant enough, this will have an effect on the delivered signal to the consumer interface. See Figure 1. In this figure we have a tap output level of +10 dBmV with 4 dB cable attenuation to a point of mismatch that produces a return loss of 10 dB. The signal is then reflected back to the tap output 10 dB below that at which it arrived. It then travels over the 4 dB loss back to the tap. The tap return loss is 15 dB.

Figure 1: Impedance mismatch that produces 10 dB return loss

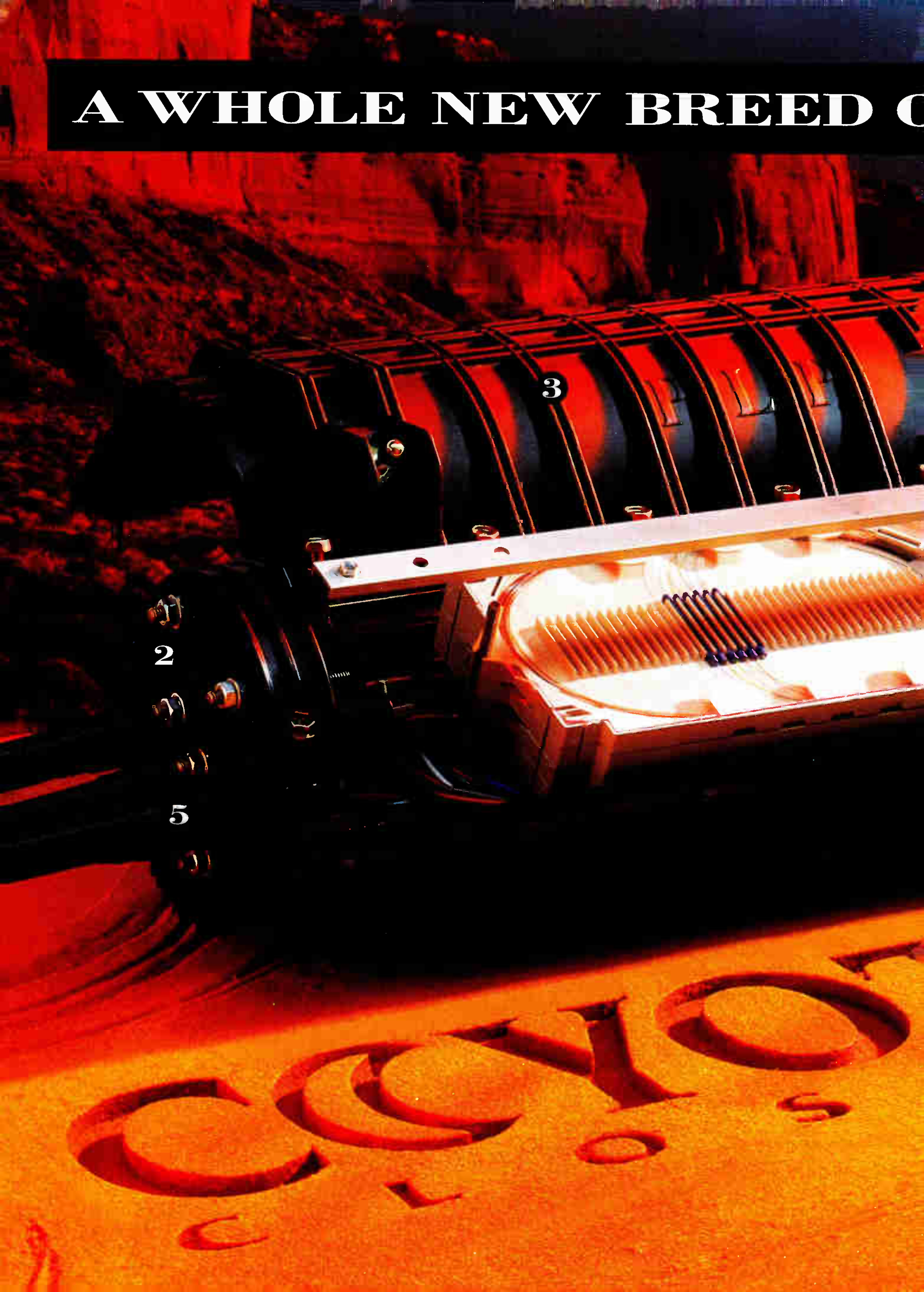


The signal is then again reflected in the forward direction -15 dB lower than when it arrived at the tap. The signal travels through the cable over -4 dB of coax attenuation and becomes a delayed signal in the forward direction down -27 dBmV from the primary forward signal. This results in a 33 dB difference between signals and would produce objectionable trailing edges on video. Also, it would likely create extremely high bit error rates (BERs) in a digital signal.

In a periodicity scenario this example would be duplicated many times by each point of mismatch.

Because the reflected signals are bounced back and forth between two points of mismatch, they become delayed in time and are reduced in amplitude as compared to the desired signal. The result is one you are probably familiar with: It appears as a trailing edge on analog video picture.

The effect of a reflected signal on a digital signal can be potentially dev-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P.O. Box 91129 Cleveland, OH 44101 216/461-5200 Fax 216/442-8816 astating. High BERs can occur as a result. A BER is the percentage of received bits in error as compared to the total number of bits received. This is usually expressed in powers of 10. When a digital signal becomes polluted with a reflected signal it can confuse the receiving device. A 1 bit that was sent by the transmitting end may now look like a 0 bit to the receiver or it may be indistinguishable.

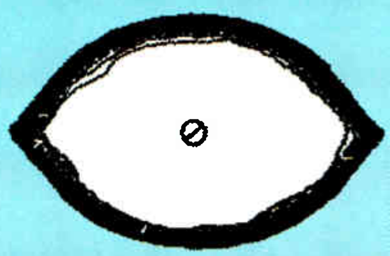
If BERs are high enough and overrun a digital receiver's correction ability, the receiver throws up its hands and says, "I give up!" For those of you who have systems offering digital audio, you have probably experienced this.

If you feel digital music was a challenge, you have not seen anything! The amount of data we need to push through our pipes to do MPEG-2 digital video is a Goliath compared to the little bit of data transmitted for digital audio.

Improving the drop

How can we make a difference today to deliver tomorrow's technology? Believe it or not, there are many areas we can improve upon in our installation practices or procedures. Let's take a look at a focus area that needs our attention: The drop.

Figure 2: Outside force pushing against coax



Anytime moisture can enter a cable it will. Underground drop splices almost always fail electrically and reduce return loss in a drop cable. If it does not immediately, it is generally just a matter of time. When water migration occurs, we are set up for a change in impedance and that equals a reflected signal energy with potential significance in our drop system.

If at all possible, the best solution to prevent a future service call for a grainy picture or digital service problem is to replace a damaged drop so it is seamless with no underground splices. Burying a drop at least 8 inches without any splices is today's best medicine for reducing future service calls and ensuring a full service drop.

Using staples to attach cabling to the residence or fasteners that push up real tight to the coax is old thinking and a bad idea. The reason is that staples typically squeeze the cable downward as do some other types of fasteners. As a result, it can be one of the worst things we can do electrically to the service line. Remembering that characteristic impedance is based on inner and outer conductor size and distance, this particular practice clearly indicates that changes in impedance are occurring in regularly spaced intervals since fasteners are generally attached at regularly spaced intervals in any clean installation.

See Figure 2. As outside forces push against the coax, the outside walls become elongated. As a result, the distance from the center conductor to the top and bottom outer shield

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becomes shorter as the distance from side to side becomes longer. The result is a change in characteristic impedance.

The distance between discontinuities will end up as a half wavelength for some given frequency. And for this given frequency and all integral multiples of this frequency, the standing waves caused by reflected power are in phase and add to one another. As a result, most of the power at the primary signal and multiples of the primary is reflected and any signals at these frequencies become greatly attenuated. Now is a good time to re-evaluate your choice of fasteners and determine whether they are actually holding the coax too tight and causing periodic changes in structural circular size of the outer conductor.

There are a couple of other key points to consider when performing a technically correct install or rewire. Be careful not to overbend the cable into too tight a radius when forming a drip loop at the entry of the house. A 5-inch circular loop is a good general guideline that will ensure maintaining the designed diameters and electrical integrity of the coax.

Often, I have seen a few feet of coax stuffed and kinked into an outlet box inside the customer's home. This should be avoided. If you come across this in the course of your job, it is recommended that you cut back the compromised parts of the cable to the point of clean undamaged cable. If possible, trim the cable to a length that allows the coax to be properly stored within the confined space, leaving just enough space to be able to remove the wall plate and to cut a second fitting in the future.

Pay careful attention when reinstalling the wall plate so that extreme bending does not occur. The length of cable to be stored depends on how much coax can be stored properly within a limited amount of space.

If the F-connector is installed properly the first time at this location, the stored amount of cable is of infinitesimal use because this location is in a dry and protected environment. If your system requires additional storage, consider another loop at the exterior drip loop that can be taken out if needed. Wall plate boxes and walls were never designed to properly store lengths of coax.

Summary

Perhaps you use one or more of the less than ideal electrical techniques I have mentioned. Keep in mind that we will not be delivering just video services anymore. Digital signals are believed to be much more susceptible to impedance mismatches and microreflections than analog signals. By making these simple changes toward quality in our installation practices today, we will be very successful in delivering these new formats against our competition of tomorrow. Your system needs your help in adopting total quality practices.

There are some superb publications that cover characteristic impedance and return loss in more detail. While it is not possible to cover them all in this article, a few are worth noting. The most notable of these are *Broadband Basics* by Philips Broadband Corp., and the *SCTE Technology for Technicians II Training Handbook*, Third Printing, by Ralph Haimowitz. **CT**

By **Norrie Bush,** Plant Operations Manager, Columbia Cable

The "perfect" install — or how to help your competition

Oh man, they sure do try and get us out of there early every morning. Here it is 9:15 already and I've hardly had more than four cups of coffee.

Let's see here, what am I doing first today? Looks like Mrs. Neusbaum wants a little excitement in her life. New install, three outlets with boxes, HBO, Cinemax and Showtime. Oops, it looks like I spilt some coffee on this work order.

"586 to base."

"Go ahead Bob. Watcha need?"

"That printer messed up the address on my first job. Could you look it up for me?"

"Sure can. That would be 405 W. Elm St. According to the schedule, you were supposed to be there before 9 a.m. Do you want me to call them and let them know you're going a little late?"

"Nah, I'm just around the corner from there, but thanks anyway."

Criminy! This job's over on the west side. I better get this rig turned around and head the other way.

"Hey! What are you all upset about?"

You'd think a guy couldn't turn around. Besides, he was obviously going too fast!

Man, I gotta go. I'd better stop up here for a minute and I can get a free refill at the same time.

OK, let's see now ... Birch, Cedar, Dogwood and of course, Elm. I wonder if they've had any nightmares over here? Ha ha. Dis must be da place!

Wow, this is a nice joint, but it sure is a long walk from the road.

"Base to 586."

Leave me alone, don't you know I'm working? You can't get anything done with those guys always bugging you.

Knock, knock, knock.

"Hi there, did you order cable?"

"Yes I did, but you were supposed to be here an hour ago! I just got done talking with your office to find out where you were."

"I'm sorry about that. I did two other jobs this morning and the last one ran longer than I had thought. Can you show me where you want the hookups?"

"Let me get my husband and please wipe your feet before walking on the carpets." →


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Ham radio operators in the cable TV industry — Part 1

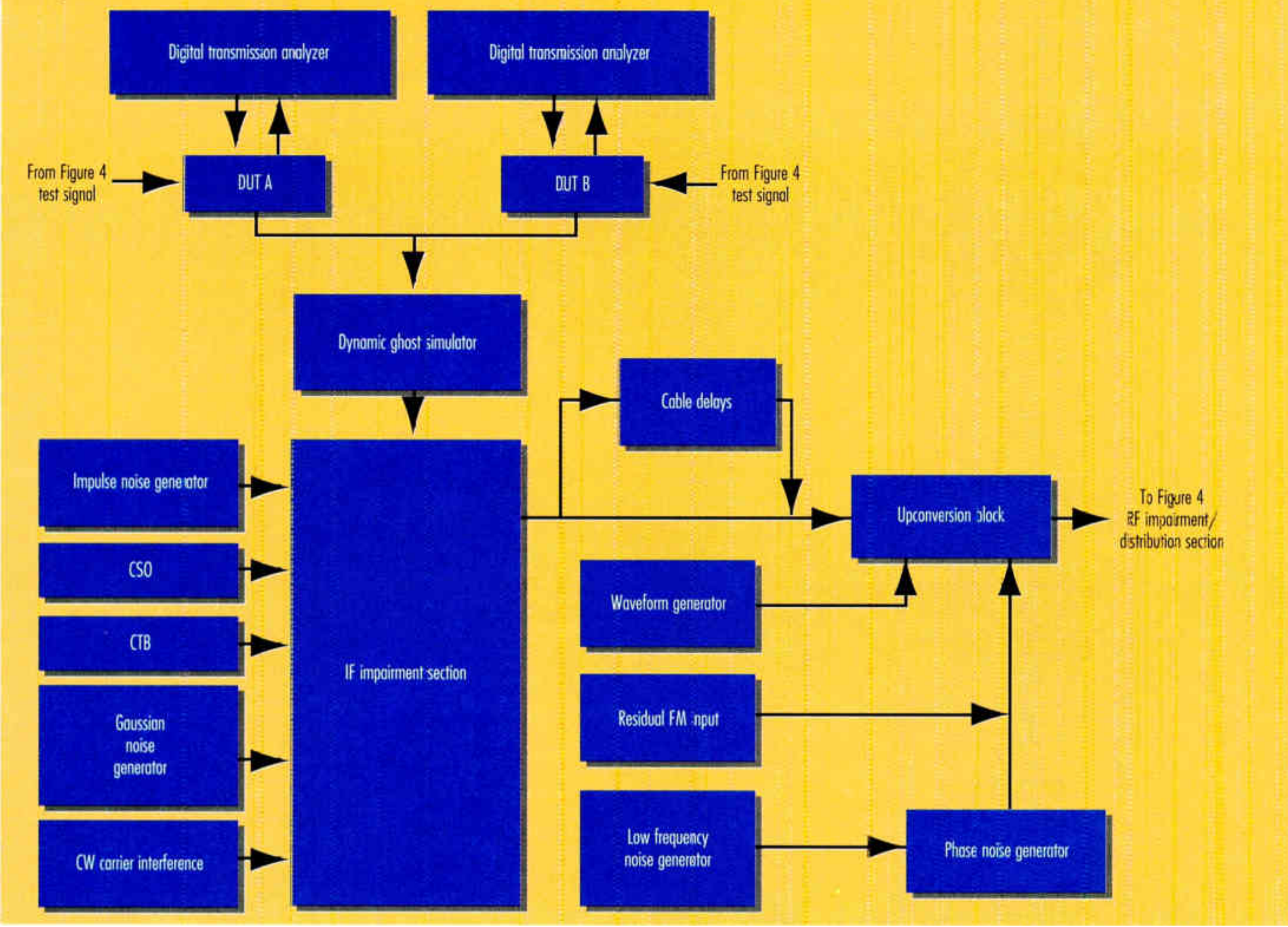
The following is the first part (A-M) of a list (in alphabetical order) of amateur radio operators employed in the cable TV industry. It was compiled by Steve Johnson, N0AYE. Please send any additions or corrections to his attention at Time Warner Cable, 160 Inverness Dr., W., P.O. Box 6659, Englewood, CO 80155-6659; fax (303) 799-5651; e-mail: steve.johnson@twcable.com

Name	Call	Company	City	Packet Address
Acevedo, Nelson	KP4FEN	CATV Noroeste	San Antonio, PR	
Adams, John	AB6ID	Sonic	Sacramento, CA	
Adams, Mark	KA4WCB	S-A	Norcross, GA	
Alexander, Gary	KE5BS	Post-Newsweek	Altus, OK	
Alfred, Arvid	KA7GFQ	Glacier Cablevision	Deming, WA	
Allen, Fred	KA0YAE	TCI	New Hope, MN	
Allen, Steve	KC6VCC	Jones	Roseville, CA	
Almeida, Harry	N1NXI	Dimension	Weymouth, MA	
Almeyda, Jr., William	KN4BX	Prestige Cable	Cartersville, GA	
Amos, Alan	KN1O	Jerrold	Stow, MA	
Anderson, David	N7PQA	TCI	Seattle, WA	
Anderson, Gene	WA7NME	TCI	Bellingham, WA	
Anderson, Jim	N8PBJ	Bresnan Comm.	Houghton, MI	
Andrews, David	N1ESK	Storer	New Haven, CT	
Annibaldi, Rich	N8TBJ	Pioneer	Columbus, OH	
Arthur, Tom	KB5QH	TCI	Englewood, CO	
Ash, Ivan	K4IML	Consultant	Columbia, MD	
Atkins, Gary	W0CGR	CSU Tech Svc.	Ft. Collins, CO	
Austin, Daryl	WD8KJZ	Paragon	San Antonio, TX	
Bach, Thomas	KA9PDM	Clear Cablevision	Saline, MI	
Bailey, Wendell	KC3BU	NCTA	Washington, DC	
Baker, James	N6WRV	USATEC	Jolon, CA	
Baker, Ronald	WB4HFN	Continental	Lawrence, MA	@WB1DSW.NH.USA
Baker, Steven	KA1OEX	Continental	St. Paul, MN	
Bannister, David	KK4FL	Fairfax County	Fairfax, VA	
Barnes, Richard	W4IXN	S-A	Atlanta, GA	
Barnes, Ron	N0PDC	Triad Comm.	Littleton, CO	
Barr, Stuart	AB5PV	AOFR Americas Inc.	Richardson, TX	
Bartlett, Dave	N0CQC	TCI	Englewood, CO	
Barton, Rod	N2UFQ	Comcast	Meadowlands, NJ	
Baur, Wayne	WB9HIE	TCI	Cahokia, IL	
Baxter, Frank	K2ZLA	Tele-Media	Pleasant Gap, PA	
Beckham, Chuck	N4XZV	Voltex Batt.	Doraville, GA	
Beeman, Paul	KA2MUM			
Belyea, Brinton	W4GSF	1st Commonwealth	Gloucester, VA	
Bentley, Bill	N5POB	Dimension	Midland, TX	
Berends, Dennis	N8VWH	TCI	Grand Rapids, MI	
Berry, Ralph	KD4PSM	Scripps Howard	Gray, TN	
Beuret, Kit	KH6JDE	Time Warner Cable	Honolulu, HI	
Biggar, Norm	VE3MTV	Maclean Hunter	Owen Sound, Ontario	
Blackstone, Larry	W8FZ	Dantron	Milton, FL	
Blais, Brian	N1KQQ	Continental	Springfield, MA	@N1MEA.#WMA.MA.USA.NA
Blakeway, Roger	G1PXM	U.K. SCTE		
Blanchard, David	KA0HIB	Municipal Util.	Coon Rapids, IA	
Blanchard, James E.	N1FEC	Adelphia Cable	Sandwich, MA	
Blumberg, David	N1HHI	ACS	Manchester, NH	
Blumsack, Harvey	W1VIK	Superior Optic	Marietta, GA	
Bohnhoff, Mark	WB9UOM	M. Bohnhoff	Wheeling, IL	
Borchert, Marshall	KD0DU	Riser-Bond	Aurora, NE	
Borsetti, Paul	N4PMT	S-A	Atlanta, GA	
Bourne, Dave	WB8TMP	Pioneer Comm.	Columbus, OH	
Bowen, Todd	KB5OVM	Textel Cable	Austin, TX	
Bowick, Chris	WD4C	Jones	Englewood, CO	
Bowles, Tom	W7VA	King Video	Seattle, WA	
Boye, Greg	WB8NGA	Time Warner Cable	Columbus, OH	
Bray, James R.	W0FBC	Time Warner Cable	Kansas City, MO	
Brillhart, Scott	N5JJZ	TCI	Tulsa, OK	
Brinkley, Chris	WA4LSW	Marks Cable	Portage Lake, OH	@WB8BII.#NEOH.OH.USA.NA
Brooks, Clarence	N5VBN	Sammons	Fort Worth, TX	
Brown, Bob	N0EUH	Westec	McLouth, KS	
Brown, John H.	W7CKZ	TCI	Olympia, WA	
Brown, Philip	WA0ZFE	Sumner CableTV	Wellington, KS	
Brown, Charles	KD4BCX	Time Warner Cable	Greensboro, NC	
Brownell, Eric	KB6YI	Sonic	Sacramento, CA	
Brundage, Jeff	N5TCN	Sammons	Fort Worth, TX	
Bryan, Larry	WB8LIG	Time Warner Cable	Lima, OH	
Bryan, Tim O.	WH6CAD	Jones	Hilo, HI	
Bukowski, Paul	KD1OR	Dimension	Amherst, MA	
Bullinger, Rex	N6VYL	Hewlett-Packard	Santa Rosa, CA	
Burns, Bob	K1RB	Continental	Brockton, MA	
Burrell, John	KF0QY	Tektronix	Denver, CO	
Burton, Jack S.	WB2CJS	Cablevision	Woodbury, NY	
Butts, John	N2JUG	MCTV	New York, NY	
Bybee, Jerry	KG7GQ	TCI	Portland, OR	
Caci, Joe	KA2OCF			
Cady, Terry	KC4HPU	King Video	Tujunga, CA	
Campbell, Leroy	W8JMP	TCI	Alpena, MI	
Campbell, Richard	KE6EFB	Simmons	S. Lake Tahoe, CA	
Campos, Javier	AH6MM	Amherst Fiber	San Luis Obispo, CA	
Cappe, Roger	WA4PEA	Cox	Gainesville, FL	
Capron, John	WB2RUQ	Phillips	Manlius, NY	
Carey, Bill	KC4BPK	Time Warner Cable	Fayetteville, NC	
Carr, George	WA5KBH/G0	Cablevision Bedsh.	Luton, U.K.	
Carr, Mike	N4PON	Paragon	St. Petersburg, FL	
Carr, Peter	WW3O	DuCom	DuBois, PA	
Carvis, Timothy	WB9ULP	Wade Cablevision	Philadelphia, PA	
Cash, Hugh	KB6IEM	Paragon	Garden Grove, CA	
Cerino, Charles	WB3HVH	Comcast	Philadelphia, PA	
Chambers, Chris	N8PAS	Cable Link	Columbus, OH	
Charlton, David	N7SDN	HFU-TV	Coleville, CA	
Checketts, Rick	KA0KZB	Jensen Tools	Phoenix, AZ	
Chesney, Tom	WH6CED	Time Warner Cable	Honolulu, HI	
Chicoine, Eugene	WO1W	Cox	Kingston, RI	
Christensen, Joseph	WB7WTS	White Pine Cable	Ely, NV	
Christianson, Tom	N1APV	Tektronix	Boston, MA	
Ciciora, Walt	WB9FPW	Consultant	Stamford, CT	
Clayton, Francis	AH6X	Kauai Cable	Kekaha, HI	
Cohen, Jeff	N1ACQ	Harron	Londonerry, NH	
Cohn, Bill	N9MHT	Antec	Glenview, IL	@W9ZMR.IL.USA.NOAM
Colegrove, Tom	WA6QBQ		Santa Clarita, CA	@K6IYK
Colter, Dave	WA2ZCN	Block Is. Cable	Block Island, RI	
Coombs, Gary	N4OJW	S-A	Atlanta, GA	
Cooper, Ed	WB5RLN	ONI	Englewood, CO	
Cordero, Francisco	KP4CJ	CATV Noroeste	Aguadilla, PR	
Corrigan, Walt	KA4KWQ	Lectro	St Cloud, FL	
Coufal, Jerry	WB0DEK	TCI	Englewood, CO	
Crawford, Jock	N4CVP	GA Cable TV	Clarkston, GA	
Crow, Ron	N5GP	TCI	The Woodlands, TX	
Crown, Ron	KH6JI	Kauai Cable	Kalaheo, HI	
Cvetnich, Joe	N0PXM	Multimedia	Wichita, KS	
Danekind, John	WD8PXI	Coast CATV	Cincinnati, OH	
Davidson, Alan	G4PSU	ABP Ltd.	Bramley, UK	
Davis, Clint	KE7OJ	Entech	Tempe, AZ	
Davis, Gary	WD8LTS	Antietam Cable	Hagerstown, MD	
Davis, Keith	N9IBS	Comcast	Paducah, KY	
Davis, Matt	N8OCO	Cable Link	Columbus, OH	
Dawkins, Al	K0FRP	US West	Denver, CO	
Dean, Brad	K1KEK	TCI	S. Yarmouth, MA	
Dean, Bob	N2ZBI	TCI of N. NJ	Hewett, NJ	

Name	Call	Company	City	Packet Address
DeHart, Steve	N2PFB	Phillips	Manlius, NY	
Deierlein, Peter	KD2LN	Phillips	Manlius,NY	
DellaGuardia, Joe	WB2WLY	UIH	Madrid, Spain	
Dewey, Steve	N8JRJ	TCI	Royal Oak, MI	
Dickinson, Bob	W2CCE	Dovetail	Bethlehem, PA	
Dickinson, Ed	WB2FAC	Dovetail	Bethlehem, PA	
Dineen, Jim	WB7RIQ	TCI	Aberdeen, WA	
Ditlow, Doran A.	WA8EOW	TCI	Grand Rapids, MI	
Dodds, Al	W0KJV	Dodds & Dodds	Huntington Beach CA	
Domina, Frank	N9MXI	Zenith	Glenview, IL	
Donziger, Alan	N3AD	Private Cable Sys	Wynnewood, PA	
Donziger, Robert	KT3M	Digicomm	Englewood, CO	
Driscoll, Sean	WA2CRB	Cross Country	Warren, NJ	
Dryden, James	W6KIS	Buckeye Cable	Toledo, OH	
Duda, Lada	OK2BLD	Cable Plus	Ostrava, Czechoslovakia	
Dudley, Mike	KB7POJ	TCI	Boise, ID	
Dudziak, Ted	WA1GPC	EIP Microwave	San Jose, CA	
Dusbabek, Lee	WB6KAJ	Cableware Elec	Brea, CA	@WB6YMH.#SOCAL.CA.USA
Duval, Joe	AA4JV	Hillsborough County	Tampa, Fl.	
Dzuban, Mark	KB2IT	AT&T	Short Hills, NJ	
Edmonson, Chuck	KA1MIA	E CT Cable TV	Waterford, CT	
Edwards, Jim	KD4TGA	Tektronix	Huntsville, AL	
Eggert, Dana	KE4CWJ	S-A	Norcross, GA	
Ehman, Roy	VE6EV	Retired	Maryville, TN	
Eichenlaub, Frank	N0TPR	ANTEC	Englewood, CO	
Eide, Joe	KB9R	Time Warner Cable	Eau Claire, WI	
Emig, Tim	KK4YU	Storer	Louisville, KY	
Engelman, Paul	N6KZW	Continental	Stockton, CA	
Epling, Jack	KC6HMP	Ventura County	West Lake Village CA	
Evanko, Steve	N2HCR	Blonder-Tongue	Old Bridge, NJ	
Evans, Bill	VE4UD	EB Systems Ltd.	Winnipeg	
Evans, Jr, Bernie	W6JMK	TeSCO	Topanga, CA	
Evanyk, Walt	W8KSW	Cable Health Care	Dallas, TX	@W5YI
Everett, Chris	KB5GGY	Cox	Oklahoma City, OK	
Faber, Randall	WA1NSL	American Cable	Beltsville, MD	
Farmer, Jim	K4BSE	ESP	Atlanta, GA	
Farmer, Jim	N4IBW	Superior Tele.	Atlanta, GA	
Faulkner, Bob	KC6ZLX	Merdan Group	San Diego, CA	
Felker, Lex	N4LF	Time Warner	Washington, DC	@KA4USE
Felt, Glen	N7QHH	TCI	Boise, ID	
Fenwick, George	WB2AEF	RTK Corp.	New Providence, NJ	
Ferguson, Jan	W4REN	Time Warner Cable	Cocoa, FL	
Ferguson, Mac	K5AD	Ferguson Comm.	Grand Saline, TX	
Ferguson, Michael	KQ2K	Cable Tech	Jamesville, NY	
Figal, John	WB0CUC		Denver, CO	
Filipponi, Barry	N6OGE	Siskiyou Cablvision	Fort Jones, CA	
Fischer, Dave	W0MHS.	Superior Cable,	Atlanta, GA	
Fitch, Jr., William	KA2AFG	New Channels	Troy, NY	
Flanagan, Edward	KB8TCF	Rickenbacker Cable	Columbus, OH	
Flessner, Andy	KA9ARM	Star Cable	Dobson, NC	
Flynn, Mike	KA3DDQ	County Cable	Clarion, PA	
Foley, Red	KN4EZ	TCI	Fort Pierce, FL	
Forbes, Celus	N4TDW	Time Warner Cable	Raleigh, NC	
Forer, Dennis	KC6WXK	Viacom	Pleasanton, CA	@WA6KTK.#NOCAL.CA.USA.NA
Forrest, Mark	WB4HJG	S-A	Atlanta, GA	
Fournier, Ray	KD1CQ	Continental	Concord, NH	
Frame, John	N5GHK	Sammons	Fort Worth, TX	
Friedman, Ken	WA1PIR	ALS	Wallingford, CT	
Friend, Neil	W2AMY	Phillips	Manlius, NY	
Frisbie, Al	WA3SVR	Blue Ridge CATV	Ephrata, PA	
Fuchs, Ken	N4JAY	Colony	Naples, FL	
Gall, Don	N0CPN	Time Warner Cable	Englewood, CO	
Galow, Joe	WB0WRW	Time Warner Cable	Denver, CO	
Gardner, Dale	N7RNX	Enterprise Cable	Enterprise, UT	
Garlick, Duncan	G3LCR	Webro	Nottingham, UK	
Garner, Rodney	WB4ZWK	S-A	Atlanta, GA	
Gearhart, Mark	KA5UUI	Sammons	Denton, TX	
Geer, Jeff	N7GFR	Alpha	Bellingham, WA	
Genochio, Frank	W6RXU	Retired	Santa Clara, CA	
Gilbert, Steve	K3SG	Armstrong Group	Butler, PA	
Gilman, Alan	G4GFD	Bolton Cablevision	Bolton, UK	@GB7CRG
Goldsworthy, Steven	KB6TMT	Crescenta Valley	La Crescenta, CA	
Gonzalo, Hermenegildo	LU8ENO,	Pire	Buenos Aires, Argentina	
Goodman, Dale	KD4CVR	PacBell Broadband	San Ramon, CA	@KI6YK.#NOCAL.CA.USA.NA
Goodrich, Bob	KB7TSD	US West	Portland, OR	
Gordon, Neal	WA1TDA	Continental	Portsmouth, NH	
Gourley, Dennis	KA7NFF	Texscan/MSI	Salt Lake City, UT	
Graalman, Mark S.	WB8JKR	Buckeye Cable	Toledo, OH	
Grace, Doug	WA3KFX	Telesat	Fort Lauderdale, FL	
Gradzki, Pat	KA2EKR	Marionics	Toms River, NJ	
Gradzki, Walt	KB2MF	Marionics	Toms River, NJ	
Grahn, Bruce	N9LMU	Crown Cable	Hustiford, WI	
Grant, Chris	W0LA	Wavetek	Indianapolis, IN	
Greco, Vincent	KD2TG	Phillips	Manlius, NY	
Green, Alan	WB2WQY	Paragon	New York, NY	
Green, Richard	KC5CID	Buford TV	Tyler, TX	
Greene, Doug	NQ9I	Jones	Englewood, CO	
Gregory, Joe	N2USK	Cablevision Sys.	Rensselaer, NY	
Grunewald, Peter B.	KA2ZHA.	Cablevision,	Hudson, MA	
Gunderson, Scott	KB0LVI	Meridith Cable	Roseville, MN	
Gunter, Bart	KN4IQ	Intermedia Tech.	San Angelo, TX	
Gunter, Kenneth S.	W5ZJ	Columbia,	San Angelo, TX	
Gur, Eugene A.	W4TFM	Central VA	Winchester, VA	
Guth, Eric	WA6IGR	Adv. Cable Service	Denver, CO	
Gutman, Austin	W3FOG	CES	Wyncote, PA	
Hahn, Richard,	KA2FXH	MCTV	New York, NY	
Haithcock, Gene	N4MYR	Time Warner Cable	Ashboro, NC	
Hamilton, Howard	N2ESK	Service Electric	Sparta, NJ	
Hammond, Bill	KK4YQ	Cable Exchange	Signal Hill, CA	
Hampton, Jim	WA3YXX	Starview	Claymont, DE	
Hanchett, Charles	N8VJC	Cable Link	Columbus, OH	
Hanneman, Jerry	WA1PCP	Wander Telecom	Gualala, CA	
Hansen, Tom	N8DGD	TCI	Grand Rapids, MI	
Hanson, Ron	WA0OGS	S-A	Norcross, GA	
Hardy, Adam	KB7RSF	Falcon	St. George, UT	
Hare, Ed	KA1CV	ARRL	Newington, CT	
Harlin, Michael	WA7AID	TCI West	Bellevue, WA	
Harrington, Joel	N7KOJ		Portland, OR	
Harris, Jerry	K7JPF	Tektronix	Portland, OR	
Harris, Michael G.	N6MH	Century Comm.	New Canaan, CT	
Harrison, Gary	WA0RWS	MO Telephone CATV	Bolivar, MO	
Harrison, Jeff	KD4GPI	Spectradyne	Dallas, TX	
Hart, Gaylord	WB7ODD	XEL Communication	Aurora, CO	
Hart, Jim	N4SV	S-A	Doraville, GA	
Hartson, Ted	WA ULG	Post-Newsweek	Phoenix, AZ	
Hassler, Ed	N3HDS	Armstrong Util.	Butler, PA	
Hatch, Earl	AB4AO	Time Warner Cable	Melbourne, FL	
Hawks, Ros	WB0GKL	Hermosa Cablvision	Durango, CA	
Haworth, Jim	WA4QPP	Time Warner Cable	Orlando, FL	
Hay, Roger	VE3BTH	CableLabs	Boulder, CO	
Hayashi, Ichiharu	JA3ILI	DX Antenna	Kobe-City, Japan	
Hayden, Joel	KA0MRF	Coaxial Int.	Taipei, Taiwan	
Hayes, Al	WB6YIY	Continental	Stockton, CA	
Hayes, Keith	KD4KDG	GCTV	Atlanta, GA	
Hayes, Keith	KD4KDG	Georgia Cable TV	Decatur, GA	
Haywood, Doyle T.	KC9FJ	Applied Instr.	Beech Grove, IN	
Heim, Bob	K8HLH	Erie County Cable	Sandusky, OH	
Heimbach, Paul	WA2YHO	Viacom	New York, NY	
Hemmings, Brian	KA3CTP	Continental	St. Louis, MO	
Henley, L. Lynn	KB4JXY	American Cable	Columbus, GA	
Henscheid, Bert L.	WA7CBO	Beta Engineering	Glendale, AZ	
Herman, Jim	WB7SFP	HCC	Bridgewater, NJ	
Herrman, Tony	KD0ZE	Time Warner Cable	Kansas City, MO	
Hester, Paul	N8NUG	Dimension	Hebron, OH	@KB8GVW.#CENT.OH.USA.NA
Hiatt, Steve	N7XRX	TCI	Seattle, WA	
Hill, Tom	WA3RMX	Tektronix	Beaverton, OR	
Hill, Tommy	KD4EN	Comcast	Meridian, MS	
Hoang, Thao	N7MHJ	Times Mirror	Phoenix, AZ	
Hochman, Mike	KX6F	Multimedia	Norman, OK	
Hodge, Warren	KC4OOS	Time Warner Cable	Rockledge, FL	
Hodges, Marsha	KA0UIN	Time Warner Cable	Kansas City, MO	
Hoffman, Kurt	NT8T	Time Warner Cable	Akron, OH	
Hoffmann, Hans	WA6CXN	Western Comm.	Monterey, CA	
Holmes, Brian	VE3IK	Rogers Engineering	Don Mills, ONT	
Holmes, Fredrick W.	N1GIQ, NE	Cablevision	Ayer, MA	
Honnold, Fred	W6YKM	King Video	Jackson, CA	
Hopengarten, Fred	K1VR	Lawyer	Lincoln, MA	
Horn, Ancel Dan	W7DLQ	Sat. Systems Int.	Falls Church, VA	
Horvath, Robert	N8KPS	Continental	Findlay, OH	

→

Figure 2: IF impairments/upconversion



IF impairment/upconversion

Figure 2 contains detail of the IF impairment/upconversion section of the CTS. Three standard IF frequencies have been designed into the system: 44, 70 and 140 MHz, with an expansion slot for one more IF frequency. The IF frequency is chosen by a front panel selector switch that determines the correct filter to be used. Many of the impairments are inserted at the IF frequency and upconverted along with the test signal. Selection of impairments are independently controlled with programmable attenuators and RF switches. This allows testing with multiple impairments simultaneously while providing a high degree of accuracy and isolation when the impairments are not used. The following impairments are inserted at IF.

Random noise

The test system is capable of introducing random thermal noise into the passband of the signal under test. Precise carrier-to-noise (C/N) measurements may be measured. Random noise is inserted into the system at IF, as shown in Figure 2. The amplitude output and noise is controlled by attenuators capable of a range from 0 to 127 dB in 0.1 dB steps. The system used is a Noise COM 7109 noise generator.

CW interference

The CTS is capable of inserting an interfering CW carrier either into or adjacent to the test signal. The susceptibility to interference from a single undesired carrier in or near the passband of the test signal then can be measured. The interfering carrier is produced by an HP8658B signal generator. This gives the test system the flexibility to place an interfering carrier at an arbitrary frequency and any chosen carrier-to-interference level.

CSO and CTB

The limiting nonlinear distortions in cable systems are CSO and CTB products. The test system is capable of creating these distortions in a controlled manner. The distortions are generated using an amplifier cascade driven by either a Matrix signal generator or the CableLabs headend and then downconverted to the selected IF frequency. Figure 3 (page 122) shows how these distortions are generated.

Microreflections and delay lines

The CTS has two paths capable of creating delay distortions. The first path is an HP11749D dynamic ghost simulator. This computer-controlled instrument allows the user to combine up to six delayed versions of the various delay times and input signal amplitudes. However, this system is limited to a 6 MHz bandwidth for testing. To accommodate systems having wider bandwidths, the CTS has eight fixed delay lines built into the range of 20 to 2,000 ns. Each delay line is balanced for the IF frequency.

Upconversion block

The impaired IF signal is upcon-

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- Beveled Edge Safeguards O-Rings
- Color Coded to Cable Sizes

Jacket Strippers

- Score-Free Jacket Removal
- Color Coded to Cable Sizes
- Plastic Guide Sleeve Protects Aluminum

INFORMATION

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ShortCut

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- Eliminates Need for Knife
- Leaves Cable Ready for Jacket Removal

Drop Stripping Tools

- Consistent One-Step Cable Preparation
- Precision Cutting Edge Eliminates Nicks and Shorts

1GHz

Crimping Tools

- Ensures Full Crimp
- Field Adjustable
- Avoid Signal Leakage

Return Path

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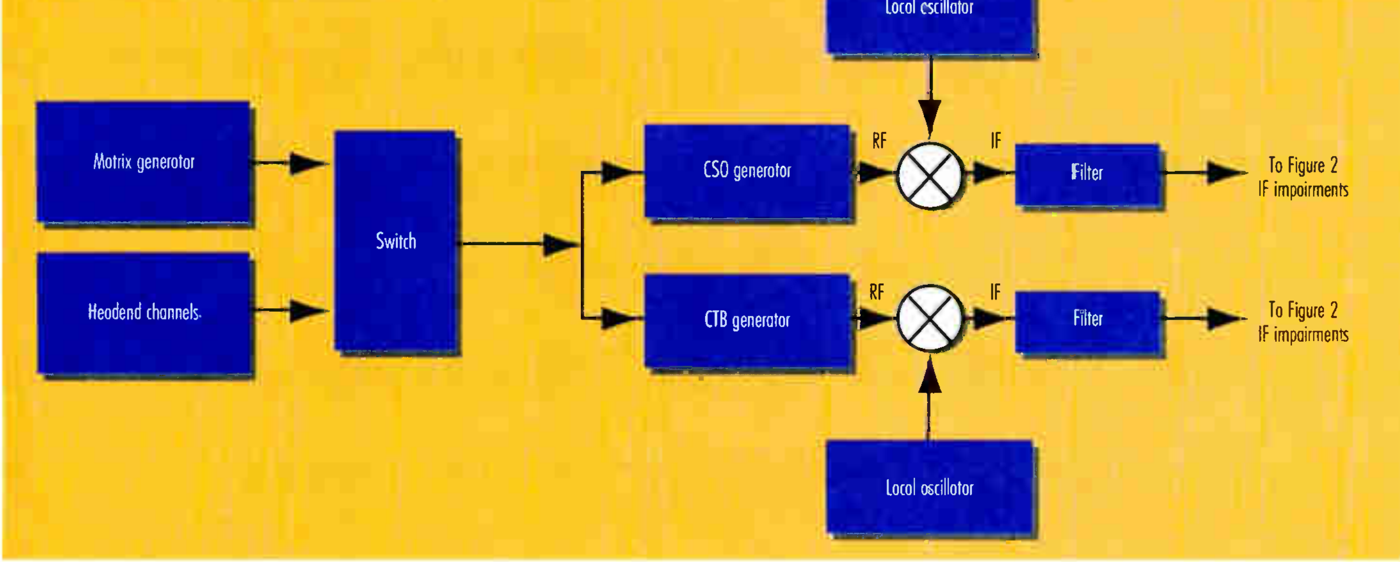
Figure 3: CSO and CTB generation



verted to a selected channel using a Gigatronics 6082A signal generator as a local oscillator with a mixer. The signal generator has very low phase noise with amplitude, frequency and phase modulation capabilities. This permits additional impairments of hum and low-frequency noise, phase noise and residual FM to be added to the system being tested.

RF impairment/distribution

The RF impairment/distribution section of the CTS (see Figure 1 on page 118) is shown in detail in Figure 4. The upconverted signal is taken from the IF impairment section, RF impairments are added and then it is sent through a distribution system. Before the signal is combined with RF impairments, it is passed through an image rejection filter. After filtering, the signal is sent through a combiner where RF impairments are added.

The CTS is capable of generating the following RF impairments: high-level sweep signal and a co-channel interference signal capable of producing a frequency agile signal at 0, ±10 kHz offset frequencies.

The option to add a Matrix generator signal or CableLabs headend signal also is available through the combiner. Four expansion ports are available for future impairments. Similar to the IF impairment section, each impairment is controlled independently. The signal passes from the combiner to the distribution section, which has the ability to simulate different cable system configurations.

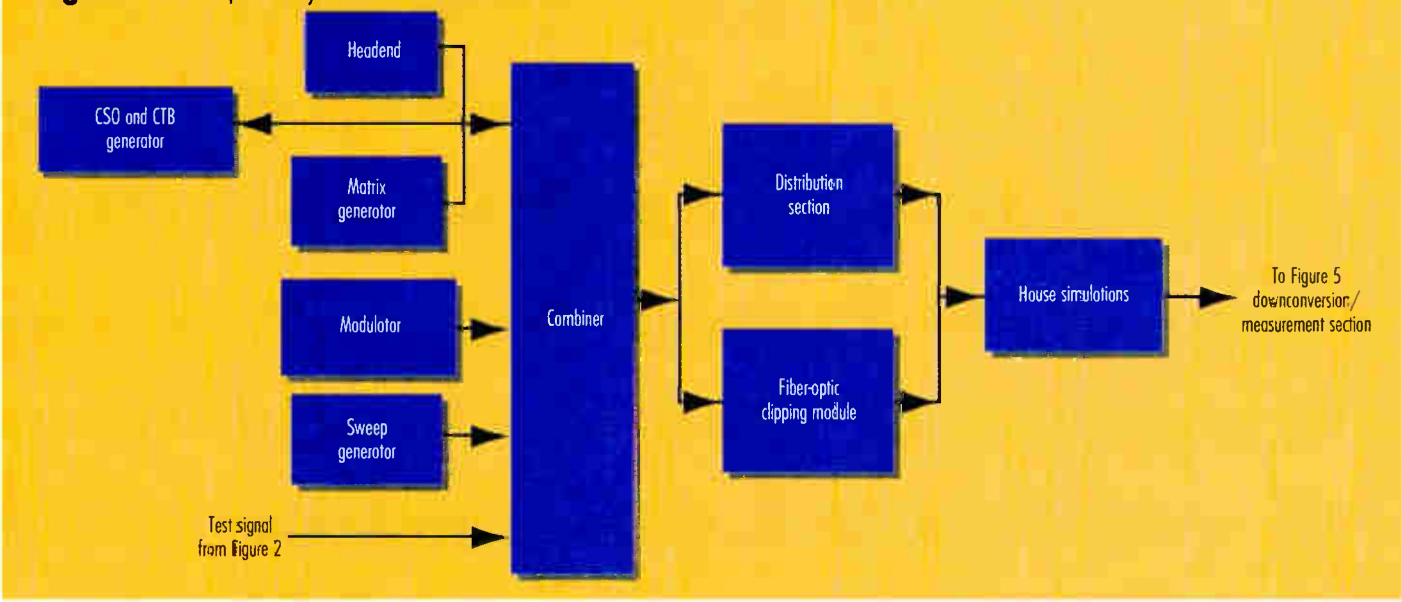
Fiber-optic clipping

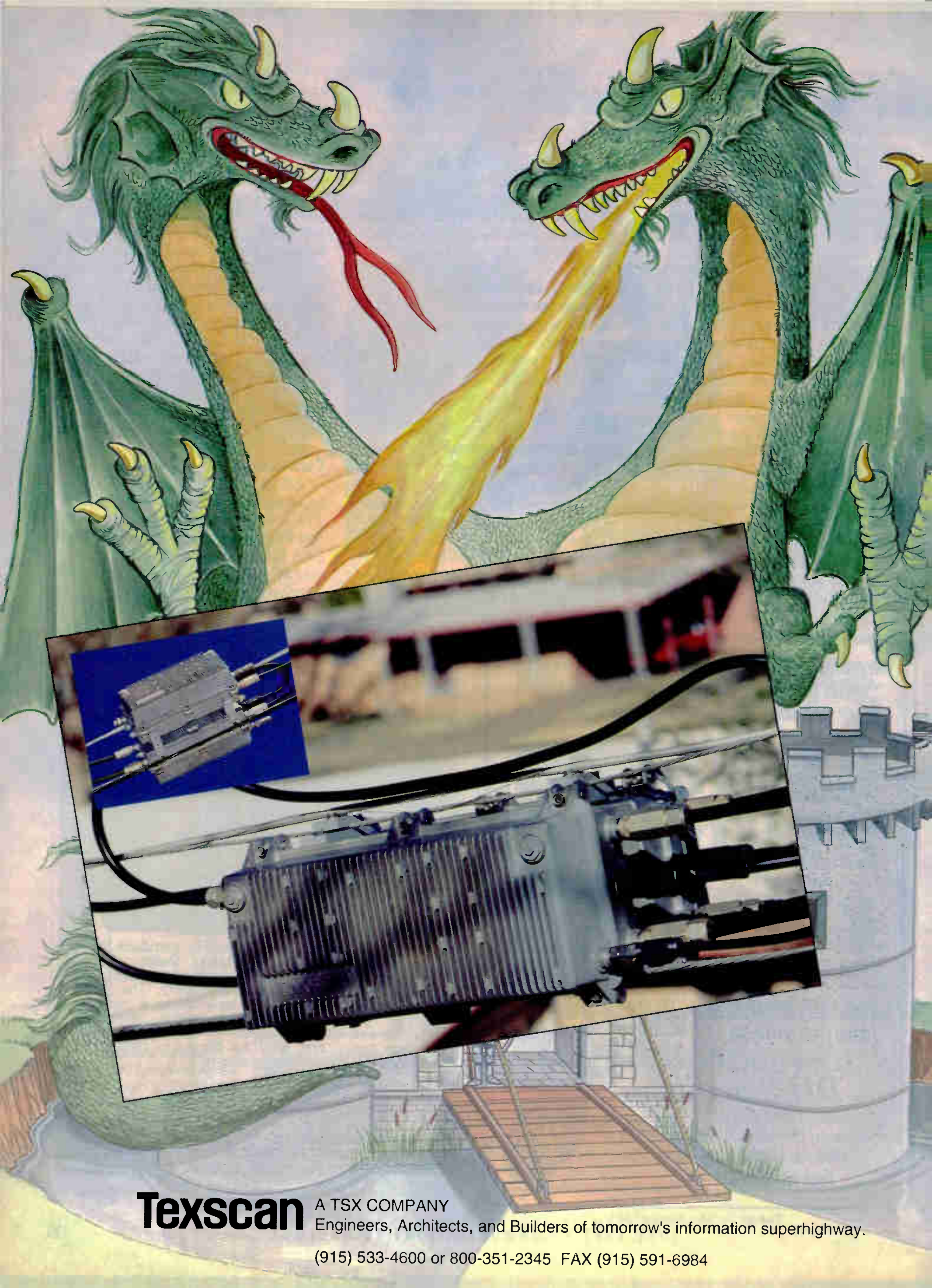
Built into the test system is a fiber-optic clipping test. Clipping is a nonlinear distortion in a fiber-optic system that limits the total number of carriers that can be transmitted. This clipping is a fundamental source of distortion in a multiple-carrier system. The fiber-optic link is capable of being overdriven by an RF signal so that the effects of the laser diode clipping on the test signal can be determined.

Distribution

CableLabs has developed an exten-

Figure 4: RF impairment/distribution section

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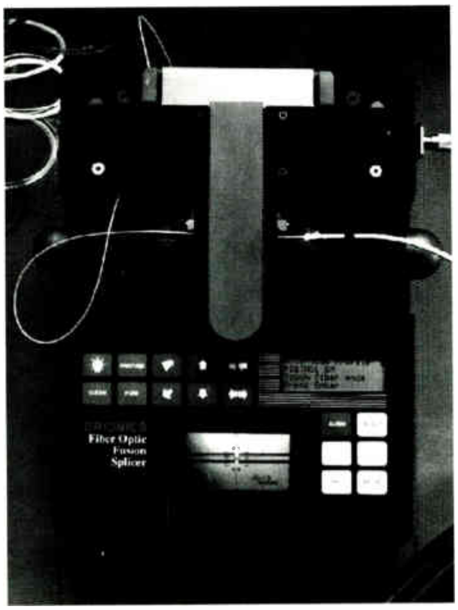
Fiber-optic fusion splicer



The new compact Fusion 2000 from Aurora Instruments Inc. is the first automatic fiber-optic fusion splicer featuring the company's advanced power alignment technology (PAT). The unit automatically aligns, gaps and fuses fibers with lower average losses and more accurate estimates than any existing splicer, according to the company, on single-mode or multimode fibers with any standard color buffer coatings, typically in 35 seconds.

Using a high-power light source, the technology guarantees core-to-core three-axis alignment and highly accurate estimates of splice loss. PAT combines the low loss and accurate loss estimation of a local injection and detection splicer with a profile alignment system splicer's ability to splice all standard colors of coatings.

Providing optimum light transmission, the unit has an average splice loss of less than 0.02 dB on single-mode fiber, a position resolution of 0.05 µm, and it estimates extrinsic splice loss within ±0.02 dB 90% of the time. The company says the unit is the smallest (9 x 6 x 10.5 inches) and lightest (16 pounds) fully automatic fusion splicer available.

The microprocessor-controlled, fully programmable system can be used on fibers with glass cladding ODs from 75 to 200 µm. It makes automatic splices after the user places the fibers in the fusing mechanism and enters the splicing requirements. An LCD provides easy menus for splicing options, fiber profiles and control. The display also automatically shows splice loss in dB after the fiber has been fused.

The user can view fibers on a 45x magnification screen with calibrated 25 µm markers and fiber alignment pointers. As new fibers are introduced, the unit easily accommodates the changes. It stores 20 fiber splicing profiles (prefuse, fuse, fiber gapping and fiber annealing) and holds the results of 100 splices for later downloading through the system's RS-232 port.

The unit also features a unique pigtail port system and PAT units that adjust for all commercially available buffer diameters. The splicing

MODULATOR 750 UHF

The Model 750UHF Modulator is especially designed for single channel full 60 dBmV (120 dBµV) output from 470 to 750 MHz no-compromise CATV professional service utilizing surface mount technology.

SPECIFICATIONS

PARAMETER	SYSTEM M/N	SYSTEM B/G	SYSTEM D/K China*	SYSTEM I
VIDEO SECTION				
Input: C3F Neg	NTSC	PAL	PAL	PAL
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% [illegible]	2% max
Differential Phase	2 degree max	2 [illegible]	[illegible]	2 degree max
Hum & Noise	-60 dB	[illegible]	[illegible]	-60 dB
AUDIO SECTION				
Input: 50 Hz-15 KHz	0 dBm (.8V)	[illegible]	[illegible]	[illegible] (.8V)
Impedance	600 ohms balanced	[illegible]	[illegible]	[illegible]
Frequency Response	±1.0 dB	[illegible]	[illegible]	[illegible]
Frequency Tolerance, ±500 Hz	4.5 MHz	5.5 [illegible]	[illegible]	[illegible]
Frequency Deviation	±25 KHz	[illegible]	[illegible]	[illegible]
Harmonic Distortion	1% max	1% max	[illegible]	[illegible]
Preemphasis	75µs	50µs	[illegible]	[illegible]
IF SECTION				
Video IF Level	+37 dBmV +97 dBµV	+37 dBmV +97 dBµV	+[illegible] dBm[illegible] +97 dBµV	+3[illegible]mV +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 adjustable	+60 dBmV max +120 dBµV			
Output Impedance	75 ohms unbalanced			
Spurious Output 470-750 MHz @+60 dBmV/+120 dBµV Output Level	<-60 dBc			
Return Loss	>14 dB			
Frequency Response	<2 dB			
MECHANICAL AND POWER				
Dimensions	Standard 19" (48.26 cm) Rack Mount, 1.75" (4.44 cm) High & 14" (35.56 cm) Deep			
Weight	8 Pounds (3.6 kg)			
Power	115/240 VAC 50/60 Hz 30 Watts			
Operating Temperature	40° F to 110° F			

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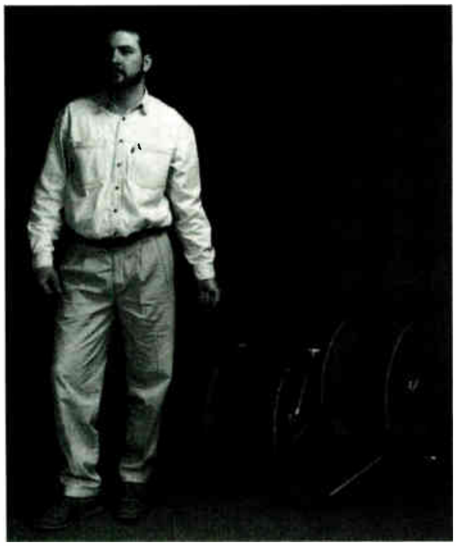
system includes data memory, RS-232 interface, built-in splice sleeve heater with auto heat and cool cycles, numerous data and diagnostic readouts, and other features.

The system is furnished in a small, formed aluminum, shock-resistant, dust and watertight case with foam interior for the splicer, cleaver, portable battery, printer, accessories and work light.

Optional accessories include an adjustable splice tray holder, high-precision cleaver, portable thermal data printer that can print out a permanent record of splice history, and a built-in tension tester available in automatic low-level or manual infinitely variable options. The tension test confirms both mechanical and optical integrity before fibers are removed from splicer PAT units.

The unit also can be used for manual splicing, using positioner keys and a built-in throughput power meter system.

Reader service #312



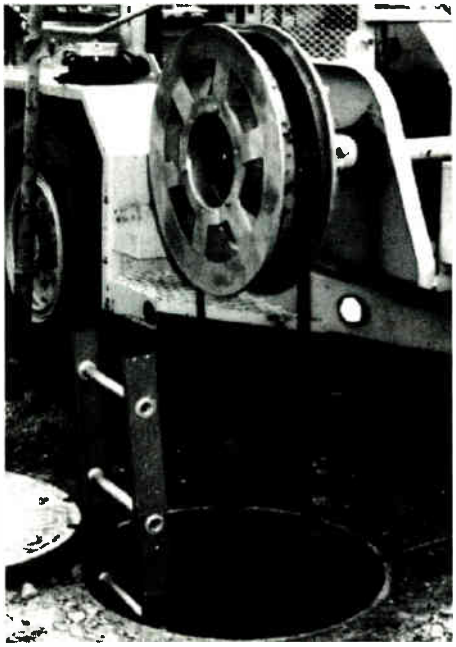
Cable reel

We Cousins Co. announced Reel Simple, a two-in-one product that ends hazardous carrying of heavy cable reels, making them easily portable while serving as a dispersing caddy.

The unit snaps into the center holes of a cable reel, which then can be pushed or pulled with minimal effort, avoiding the danger of back injury caused by lifting or carrying the reel. The unit is durable enough to roll easily over bumps, curbs, stairs and uneven surfaces. It serves as a dispensing caddy by simply flipping it and positioning it on its handle and auxiliary feet. This two-in-one feature saves valuable time otherwise spent carrying the reel and stand.

Cable reels from 12 to 15 inches wide and up to 26 inches high can be moved with little effort using the device. It is fabricated as a single unit with no moving parts for greater durability. It is 30 inches in length and is made of rustproof aluminum magnesium. A heavy neoprene rubber grip with spring action ensures a firm handle. As a dispensing caddy, the unit remains skid-free with four weather-resistant neoprene rubber guards.

Reader service #311



Fiber-optic pulling capstan

GMP introduced a fiber-optic pulling capstan for use with existing pulling equipment, winches and capstan drives in a special accessory approach. The unit can be mounted quickly on existing equipment without special modifications or new pulling gear. It is easy and safe to use, pulling the cable with synthetic rope or Muletape, or pulling the cable itself directly.

Durably constructed of aluminum alloy, the capstan has a 25-inch (635 mm) working diameter and pulls with 600 pounds (2,700 newtons) force and 600 fpm speed. The capstan can be set up easily as a mid-assist booster for use in pulling longer continuous lengths while keeping the pulling tension below the minimum threshold. It also can be easily coordinated with quadrants, sheaves and other company accessories.

Two versions of the capstan are available: with or without an integral torque limiter, which limits the pulling tension to a calibrated maximum, typically set at the factory at 600 pounds force. Either version can be mounted on a 2-7/16 inch (63 mm) diameter drive shaft with either a bayonet or cross pin type connection. **Reader service #310**

Directional boring system

The Charles Machine Works Inc. unveiled the Ditch Witch JT3510 Jet Trac directional boring system. The unit features: 35,000 pounds of pullback in the size of a 20,000-pound machine; rubber tracks that offer minimal damage to turf, asphalt and curbing; a 22-horsepower engine that allows complete setup, including anchoring, without hooking up to the external power source; two-speed spindle rotation at 164 or 327 rpm that permits faster boring and pullback in softer soil; and a 500-gallon capacity mud mixing system that delivers mud at 15 gpm at 3,000 psi, or 30 gpm at 1,500 psi.

The unit can be detached from the anchoring system and removed from the job site, allowing next-day reconnection and completion of the bore. The exclusive monitoring system automatically adjusts thrust and pullback speed when soil conditions change. No other manufacturer offers this feature, according to the company.

The pipe rack holds 31 pipes. This

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Reader Service Number 90

pipe is designed specifically for this unit and offers a combination welded and upset forged pipe for greater tool joint strength, flexibility and wear resistance. The electrical strike system is designed to alert the operator if a live electrical cable has been struck while boring. New rigid ground mats are easier to use and advanced microprocessor electronics provide more information about possible strikes.

The system also features built-in storage for downhole tools and electronic equipment. The trailer's ramp can be easily lifted and lowered by one person.
Reader service #309

Distribution frame

Fiber Optic Network Solutions Corp. unveiled the Light Express 3000 main distribution frame, designed for total management of backbone fiber. It supports, organizes and simplifies hundreds or thousands of fibers terminated in a central location. The modular shelf design accommodates over 1,000 connections utilizing modular connector panels or optical splitter cassettes. The unit can be direct terminated, stubbed or prewired. The modular design supports both terminating and splicing in various configurations.

The company developed the series in anticipation of the explosive demand for fiber-to-the-desktop as well as the growing demand for increased fiber management in CATV headends.

The series provides: fiber management radius guides on every shelf, floor and ceiling cable access; optional jumper management rings on the frame for each shelf location; and many other features that optimize fiber management.
Reader service #306

Multivendor support system

Objective Systems Integrators announced loopMASTER, the company's multivendor broadband cable/telephony/video operational support system. It is the first of a family of modules for support of multiple cable/phone technologies, providing comprehensive fault, performance and configuration

management for hybrid fiber/coax (HFC) cable networks. Additional technologies such as fiber-to-the-curb and fiber-in-the-loop are planned to complement the module.

The application provides monitoring, configuration and control of HFC telephony and video equipment and status monitoring systems. The system combines network events from multiple vendors and types of equipment utilized within the HFC infrastructure. The initial release of this rules-based application works with equipment from such manufacturers as ADC Communications, AM Communications and Superior Electronics (Cheetah).

The OSWorx NetExpert element manager is designed to manage ADC's Homeworx HFC system and will allow ADC to provide customers with an integrated, fully functional element management solution to support Homeworx, according to the company.

The system enables seamless flow-through provisioning of TR08 telephony services from the switch to specific vendor host digital terminals and network interface unit combinations. The company says this significantly reduces the cost of operating the network and enables the customer (cable/telephony systems) to deploy new services rapidly.

The system performs root cause correlation of problems detected in the network from any element in the HFC network. Correlated alarms are presented to network operations personnel through either a graphic display of the network or an alphanumeric alert window in the Motif graphical user interface display. Alternatively, alarms can be forwarded into the high level NMS console or directly routed to a workforce management application to automate dispatching of craft personnel to proactively manage the problem resolution process. The system has been integrated with Arrowsmith Technologies' Fleetcon workforce management application.

The system is a prebuilt, rules-based application implemented using the company's NetExpert technology framework, an object-oriented, expert analysis environment that enables rapid deployment of network management and new operations support systems. Through a series of 4GL "programmerless" editors, network experts develop rules that define the behavior of an operations support system.
Reader service #308

Test data software

EXFO introduced the Fiber Test Manager (FTM) and DocuNet software packages in order to address the increasing need for efficient, timely management of fiber test data. The company says this offers a unique approach to network test documentation and that it is now providing fiber networks with a computerized data base system for test data.

These software packages form a complete and user-friendly system to organize OTDR traces and test data acquired in the field. FTM creates a central data base of fiber network test data and can act as a control center with instant test results from the field.

DocuNet is used in a test unit and is comparable to a roving reporter, collecting test data to be transferred centrally to FTM. It also can be used as a stand-alone unit and offers the FTM's same intuitive archiving of network test data.
Reader service #307

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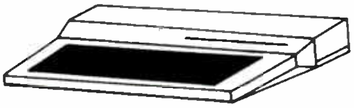

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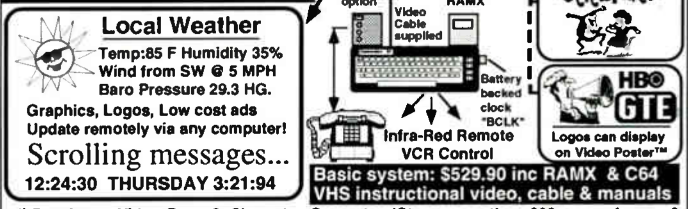

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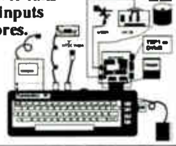

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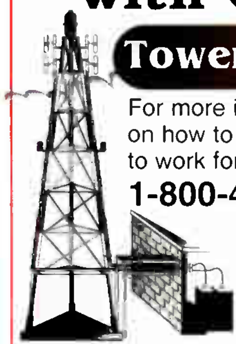

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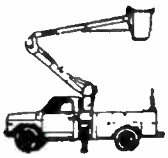

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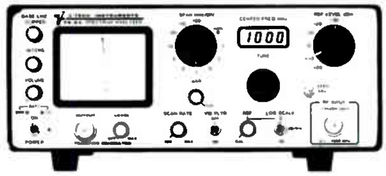

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PRODUCT MARKETING MANAGER

This challenging position is responsible for worldwide strategic and tactical marketing in our CATV product line. Candidates will be responsible for customer research, product definition, cost and price analysis, competitive analysis, and product promotion. Additional responsibilities include developing strategic partnerships with customers and suppliers in the CATV and Telecommunications arena, ensuring future products closely match the requirements of the pending information superhighway.

The ideal candidate will have a BSEE with at least 3 years experience in a marketing management role with a company that serves either the CATV or Telecommunications industry. An MBA/Marketing degree would be a definite asset. Must have excellent analytic and communications skills, knowledge of strategic planning, structured new product development background (I.E., QFD, conjoint analysis, or other formal training) and a proven track record in marketing.

FIELD SALES SUPPORT SPECIALIST

In this position you will be responsible for field training, technical support and sales support of our CATV product line. Located in Northern California, you will travel across the Western U.S., supporting our sales force efforts by providing product demonstrations, technical training, field troubleshooting and trade show support.

The ideal candidate will have a minimum of an AS EET (BSEE preferred) with at least 5 years experience in CATV. Previous sales and/or technical support experience preferred. Must have excellent verbal, written, and presentation skills, and be comfortable making presentations to large audiences.

This position's compensation package includes a commission component and a car allowance.

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The ideal candidate will have a BS/BA or equivalent sales experience. Minimum 5 years sales experience and three years CATV sales. Must have demonstrated technical knowledge of the CATV industry, and have excellent verbal, written, and presentation skills.

This position's compensation package includes a commission component and a car allowance.

Qualified candidates may send a resume and salary history to: **Wavetek, 5808 Churchman Bypass, Indianapolis, IN 46203 or FAX (317) 788-5999, Attn: HR.**

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☛ *Category III Review Course: Transportation Systems* — Dr. Tom Straus provides a technical look at transportation systems, including the benefits and trade-offs of different methods. This program begins with a basic discussion of the decibel and then goes on to cover baseband video and its waveform, distortion, harmonics, ingress and satellite transmission. It also deals with microwave transmission and refraction, including AM and FM transmitters and receivers. (1 hr.) Order #T-1063, $35. **(Reference for BCT/E Category III)**

☛ *Developing a Technical Training Program* — Roger Keith discusses the design and development of a system level CATV technical training program. (1 hr.) Order #T-1065, $35.

☛ *High Definition Television* — Walt Ciciora, Ph.D., Wayne Luplow and Norman Hurst briefly review the basics of HDTV, going on to discuss intermediate technologies such as advanced TV (ATV) and ACTV. Delivery of these signals by cable, as well as competitive technologies, also are discussed. This program provides an understanding of how HDTV can affect your systems in the years to come. (1-1/2 hrs.) Order #T-1066, $45.

Note: The videotapes 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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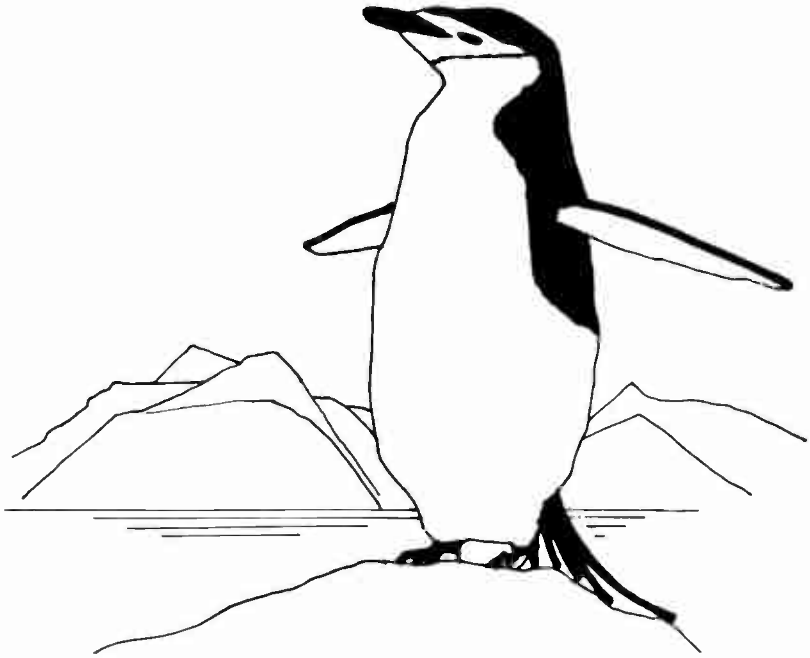
July 24-27: New England Cable Show, Newport, RI. Contact (617) 843-3418.
Aug. 13-15: Great Lakes Cable Expo, Indianapolis. Contact (317) 845-8100.
Oct. 31-Nov. 2: Private Cable & Wireless Show, Miami Beach, FL. Contact (713) 342-9826.
Dec. 6-8: The Western Show, Anaheim, CA. Contact (510) 428-2225.

June

5-8: Antec Fiberworks training course, fiber-optic systems, Denver. Contact (800) 342-3763.
5-8: Siecor training course, fiber-optic installation and splicing, maintenance and restoration, Hickory, TX. Contact (800) 743-2671.
6: SCTE Chattahoochee Chapter seminar, FCC video testing, FCC public file inspection, CLI flyover vs. ground-based testing and BCT/E tutorial, Galleria Convention Center, Atlanta. Contact Greg Worthman, (404) 874-8000, ext. 250.
6: SCTE New York City Chapter seminar, alternative powering options, BCT/E exams to be administered, Time Warner Cable office, Flushing, NY. Contact Rich Fevola, (516) 467-5080.
6: SCTE Southeast Texas Chapter testing session, BCT/E exams to be administered, Walden, TX. Contact Richard Grahn, (713) 579-6319.
6: SCTE Southeast Texas Chapter testing session, BCT/E exams to be administered, Houston. Contact Richard Grahn, (713) 579-6319.
6: Scientific-Atlanta broadband training course, fundamentals of the hybrid fiber/coax network, Philadelphia. Contact Bill Brobst, (404) 903-6306.
6-9: Mississippi Cable Television Association annual meeting, Grand Casino Hotel, Biloxi, MS. Contact Leeann Hayes, (601) 352-8766.
7: SCTE Bluegrass Chapter seminar, basic telephony, Holiday Inn, Elizabethtown, KY. Contact Max Henry, (502) 753-6521.
7-8: Scientific-Atlanta broadband training course, hybrid fiber/coax design, Philadelphia. Contact Bill Brobst, (404) 903-6306.
8: Society of Cable Television Engineers Tele-Seminar Program, *Convergence (Part II)* and *Advances in System Architectures (Part I)*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.
8: SCTE Lincoln Land Chapter seminar, construction practices and technology for coax and fiber, Best Western Suites-Eastland, Bloomington, IL. Contact Richard Rohm, (309) 467-5107.
8: SCTE Magnolia Chapter testing session, BCT/E and Installer exams to be administered, Grand Casino Hotel, Biloxi, MS. Contact Robert Marsh, (601) 939-6240.
8: SCTE Music City Chapter testing session, BCT/E exams to be administered, Nashville, TN. Contact Kenny Long, (615) 244-7462, ext. 392.
9: SCTE New England Chapter testing session, BCT/E exams to be administered, Lincoln, RI. Contact Tom Garcia, (508) 562-1675.
11: SCTE Northern New England Chapter testing session, Installer exams to be administered, Brunswick, ME. Contact Bill DesRochers, (207) 646-4576.
11-14: Cable Television Association of Maryland, Delaware and the District of Columbia spring meeting, Sheraton Fontainebleau Hotel, Ocean City, MD. Contact Wayne O'Dell, (410) 266-9111.
12: SCTE Northern New England Chapter testing session, BCT/E exams to be administered, TCI office, Wells, ME. Contact Bill DesRochers, (207) 646-4576.
13: SCTE Desert Chapter testing session, BCT/E and Installer exams to be administered, Inland Valley Cablevision office, Hemet, CA. Contact Bruce Wedeking, (909) 677-2147.
13-15: C-COR training seminar, cable TV technology, Indianapolis. Contact (800) 233-2267.
13-15: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.
14: SCTE Mid-South Chapter testing session, Installer exams to be administered, Time Warner office, Memphis, TN. Contact Kathy Andrews, (901) 365-1770, ext. 4110.
14-17: Society of Cable Television Engineers Cable-Tec Expo, Las Vegas Convention Center, Las Vegas, NV. Contact SCTE national headquarters, (610) 363-6888.

Reader Service Number 1



Reader Service Number 191

By Don C. Vassel, Senior Market Development Engineer, Corning Inc.

Ins and outs of fiber deployment

This month our fiber expert answers your questions about fiber deployment in the cable TV market.

☛ Is it true that the cable TV industry could surpass the telco industry in fiber deployment in the near future?

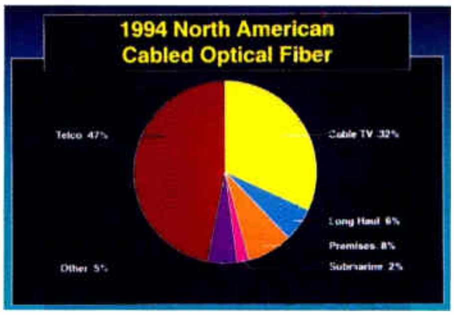
Yes. Cable TV is catching up fast with the telco segment. Corning's projections for fiber deployment, released at Corning's annual OFC Media Briefing, point to 1995 as the year when cable TV may pass telco as the largest North American market segment.

For the past several years, cable TV has been the fastest growing fiber market segment in North America. Growth for this segment has exceeded 100% three years running. Aggressive fiber deployment continued in 1994 (see accompanying figure), bolstering cable TV's market share to 32%.

But despite its current growth spurt, fiber deployment in the cable TV industry will slow a bit in '95, with anticipated fiber consumption growth of about 43%.

☛ How will cable TV's anticipated entry into the telephone market affect fiber deployment?

In order to carry telephone traffic, cable TV providers are deploying fiber and establishing SONET ring technologies, which will help to ensure uninterrupted service in the event of fiber cuts. These steps will help designers build more reliable networks to meet the exacting telco network downtime requirements of



53 minutes of network downtime per year, which translates to 99.98% network reliability.

Increased fiber deployment isn't the only change we'll see this year. "Clustering" also will become more common as larger cable TV companies form agreements allowing them to establish neighboring networks for transferring telephone traffic. **CT**

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

Signs of SCTE growth

As I write this, the Society's national staff is making final preparations for Cable-Tec Expo '95, which promises to be the most spectacular yet. This year, we will host more than 310 exhibitors, up from 250 last year. I look forward to seeing you in Las Vegas and sharing information on the latest developments in technology and the constantly evolving telecommunications industry.

Many exciting events will occur during Expo '95, including the recently elected directors taking their positions on the Society's national board. At the meeting set for June 13, prior to the start of Expo, the board also will elect the Society's national officers for 1995-96.

This meeting also will mark the official change of SCTE's name to the Society of Cable Telecommunications Engineers, a transition approved by the membership in a referendum vote held in conjunction with this year's board election.

I feel that the new name more accurately represents the Society's diverse members. Our industry is undergoing a transition from cable TV to the broader area of cable telecommunications, and the name of the organization will now accommodate this evolution.

This year, the Expo technical program begins for the first time with a series of preconference tutorials to be held June 13. Among these will be a special presentation on the industrywide public relations program, "The Future Is On Cable."

This tutorial, to be presented by Rob Flynn of the National Cable Television Association Public Affairs Department, will show how "The Future Is On Cable" can improve the cable industry's public image by offering on-time guarantees and is designed for the cable installers and technicians who will ultimately be responsible for carrying out its customer service guarantees.

Attendees will be updated on how the program is progressing and Flynn will review research conducted by the NCTA dealing with public perceptions of the cable industry as a technological leader. He also hopes to hear feedback from attendees to learn about their experiences in the field implementing these customer service guarantees. We are very pleased to be making this preconference tutorial available to attendees, as it will provide a broad overview of a program that should benefit the entire industry.

Another special highlight of this year's Expo is sure to be the keynote address to be given by Federal Communications Commission Chairman Reed Hundt during the Society's 1995 Annual Engineering Conference. This prerecorded address will be presented just prior to our 1995 Annual Awards Luncheon. The Society is honored to have such a prominent official address Expo '95 attendees, and considering all of the current interest in FCC legislation and regulations, I am certain that his presentation will be a high point of the conference.

Booming membership

Besides our preparations for Expo '95, there also is a great deal of activity in the Society's Membership Services Department due to the ongoing growth of our membership. By the time Expo '95 begins, SCTE's membership should exceed 14,000!

This figure should encourage our industry, because it shows a definite increase in its recognition of the importance of technical training, professional certification and industry standards. In order to compete and survive in the increasingly competitive telecommunications business, more and more people are turning to SCTE as an invaluable training resource. The Society will continue to strive to meet the changing needs of its membership, and we look forward to serving an even larger portion of the industry in the coming year as our membership continues to grow.

Subcommittee update

Besides all of the excitement generated by Cable-Tec Expo '95 and our attainment of 14,000 members, the Society's engineering subcommittees also have been making news of late, with the Inventory/Material Management Subcommittee's recent announcement that it has issued an Interim Material Management Practice.

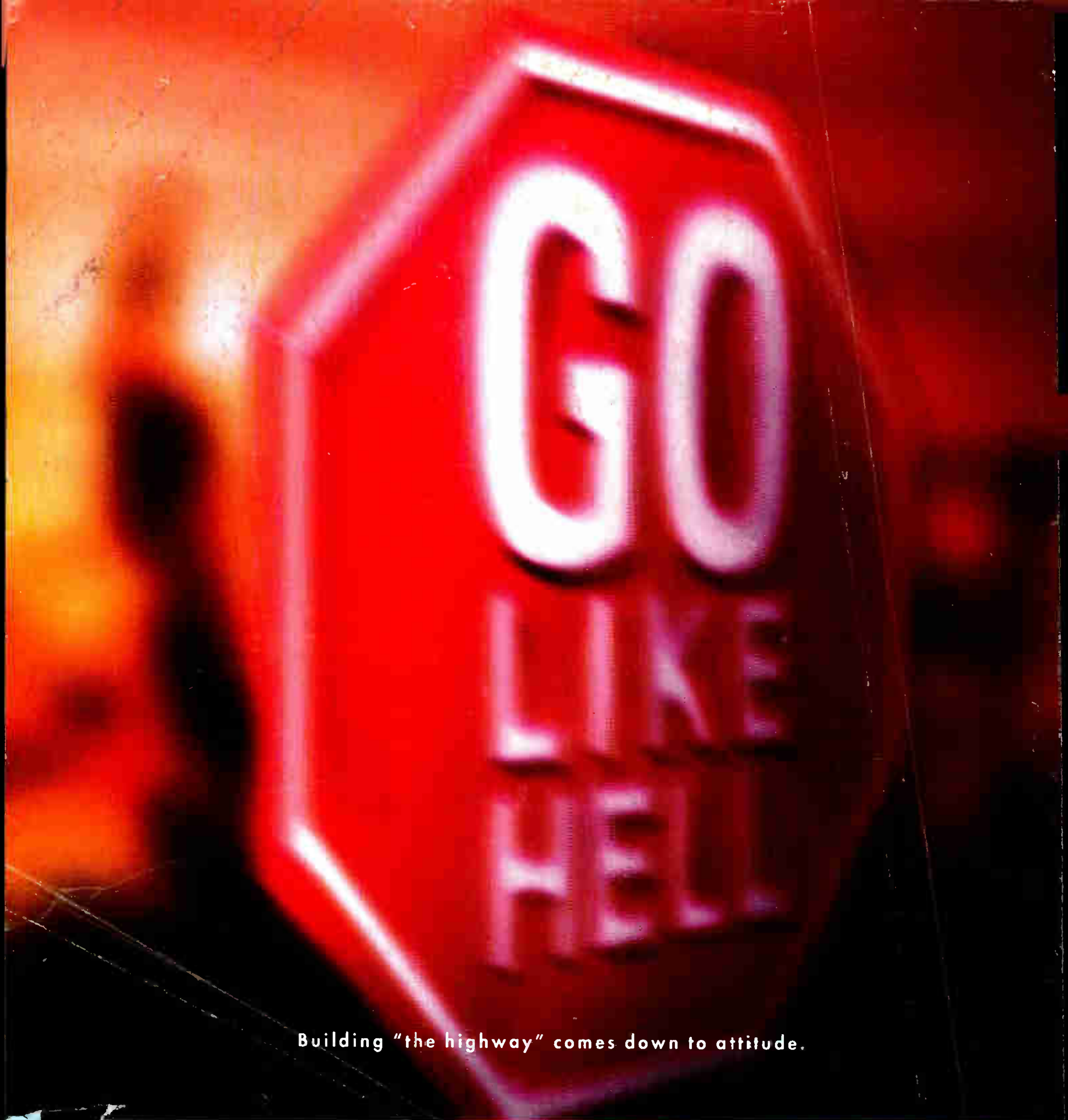
This practice recommends that the universal product code (UPC) should be used as the bar code standard for the cable telecommunications industry. When a wider-ranging material management practice has been defined by the subcommittee, it will replace this interim measure. Once an overall electronic data interchange (EDI) has been put into place, it will allow trading partners in the industry to use computer systems to the fullest extent in controlling inventory. With the adoption of this standard, material management will be much more efficient and less time-consuming. The cable industry will then be able to use electronic systems to maintain all aspects of company materials from placing orders to settling account balances. (See "SCTE News" on page 12 for more details.)

New headquarters

I am happy to let you know that planning for the Society's new national headquarters building is moving along as we prepare to break ground soon. The building was first proposed by the Finance Committee as part of the 1995 budget, which was approved by the board in December 1994. Since then, the staff has been working diligently on details such as design, development and township approvals. The building, which will be located in an attractive, wooded lot in an upscale industrial park, will be represented in a display at Cable-Tec Expo '95, showing members the current status of the project.

With our growing staff and membership, the new building has become a necessity. We are currently planning to move our operations to the new location in December of this year. As more details become available, I will update you on the progress of this exciting enhancement to our organization.

At a time when there is so much activity in the industry, there also is a great deal of activity within the Society. I will continue to use this forum to address the measures that we are taking to provide better services for the membership. I hope to hear your ideas for additional ways that the Society can become even more beneficial to you. **CT**



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