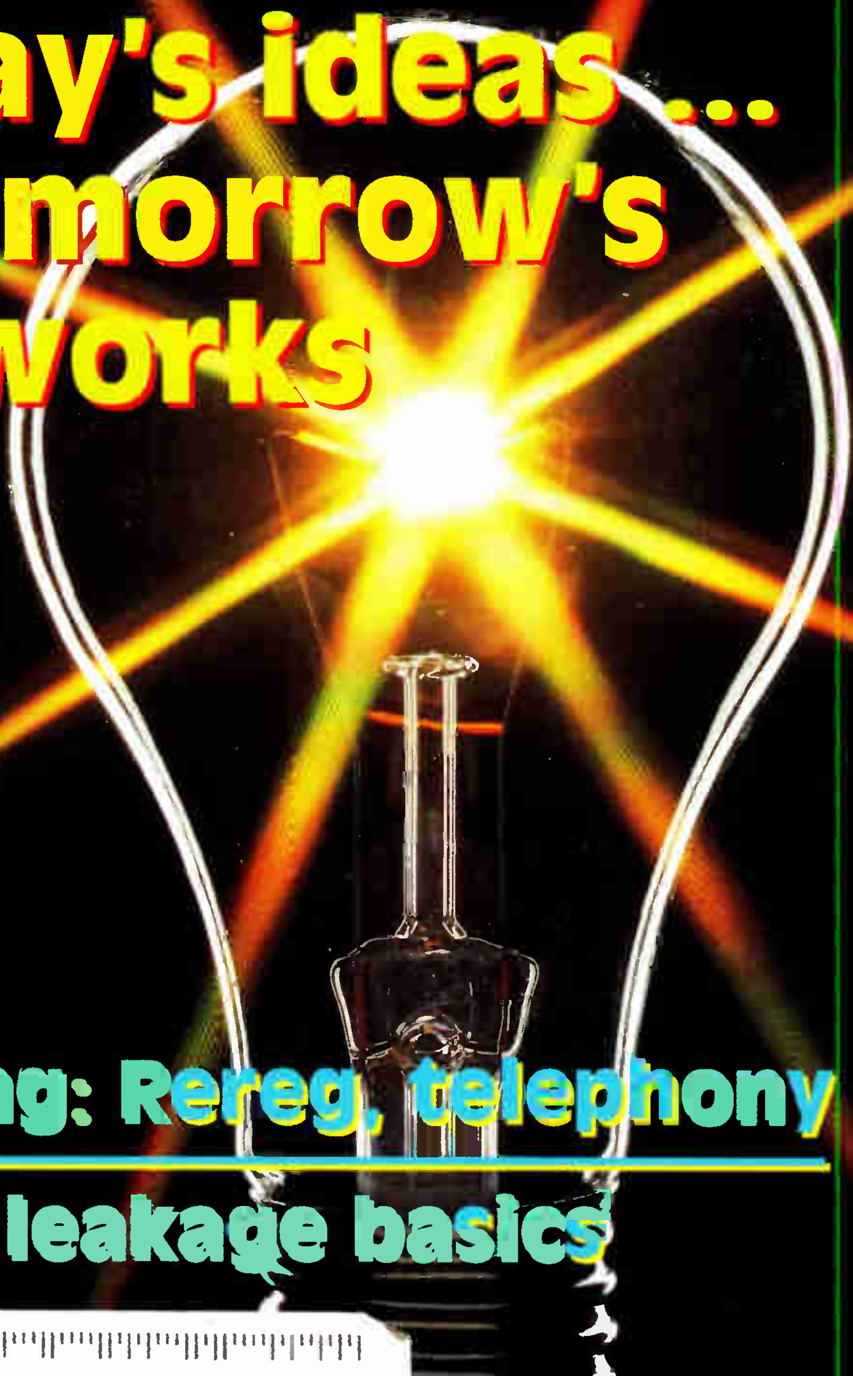
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

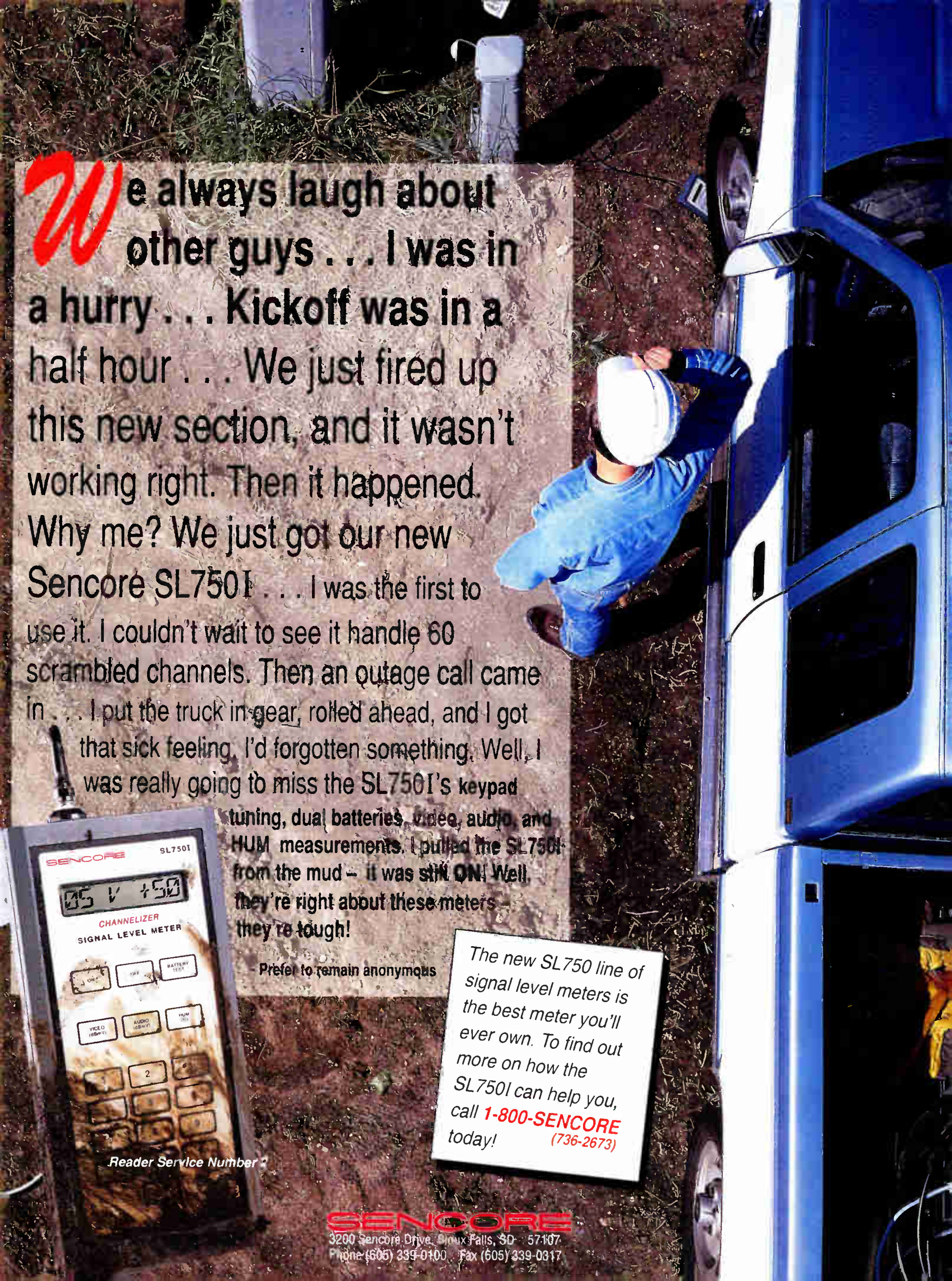
Today's ideas ... Tommorrow's networks



Training: Rereg, telephony

Signal leakage basics

January 1994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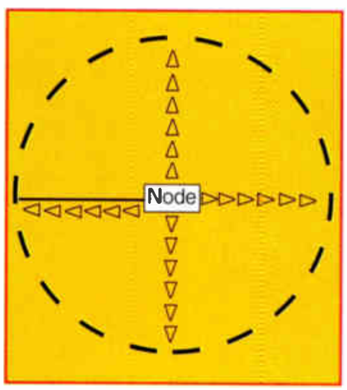
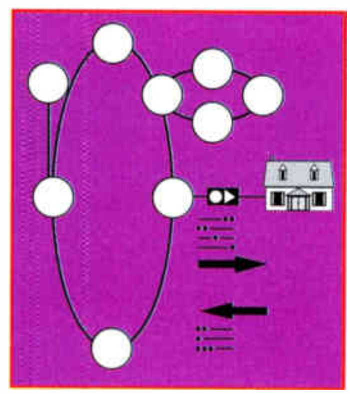
Geri Saye





Features

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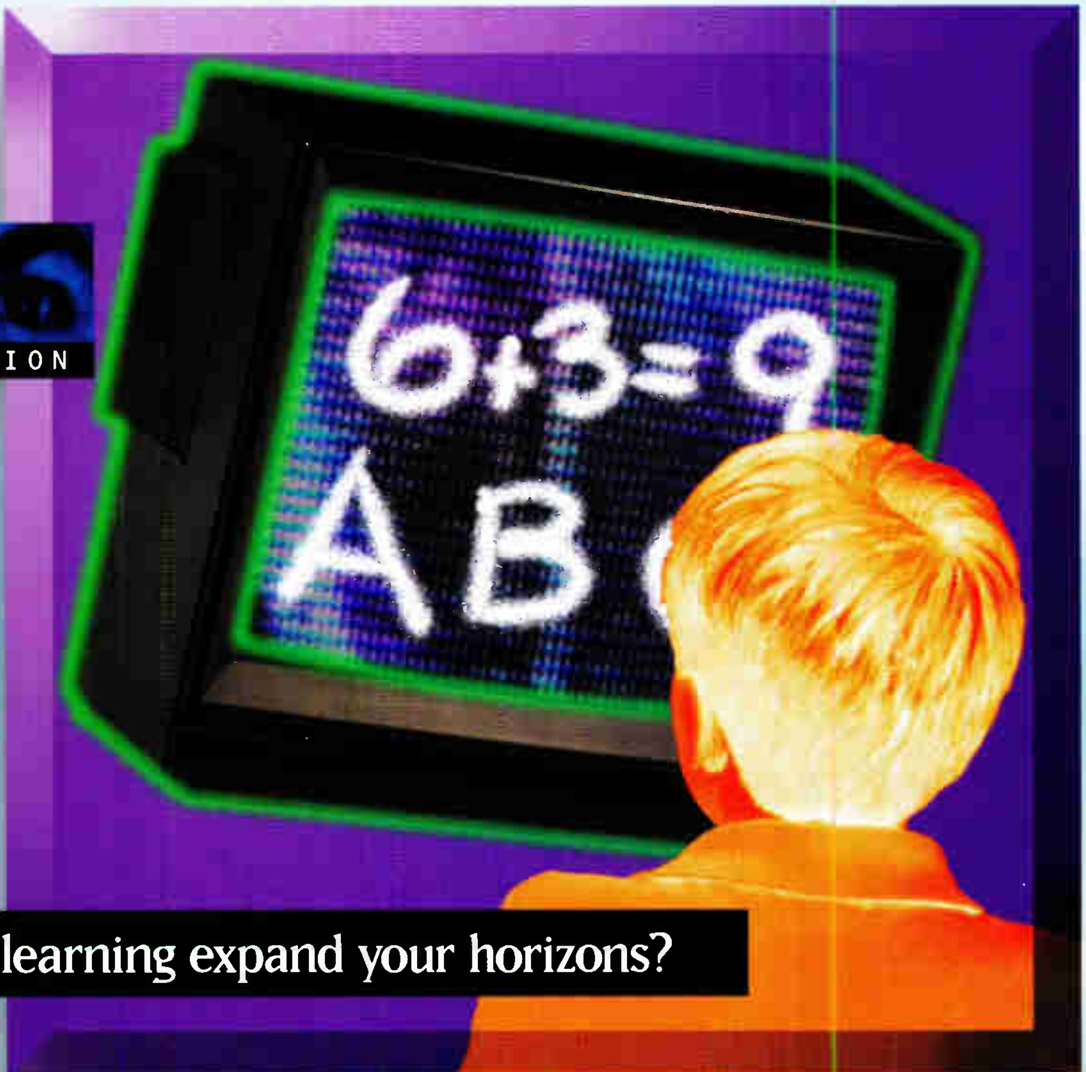

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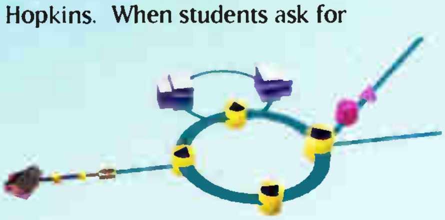

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EDITOR'S LETTER

The sleeping giant

For the past several months, we've all seen, heard or read the headlines about mergers, joint ventures and other relationships between the cable TV and telephone industries: Time Warner/US West, TCI/Bell Atlantic, Jones/Bell Canada, Cox/Southwestern Bell, etc., etc. Along with the inevitable convergence of the two industries has been varied descriptions of how all of this will play a part in the so-called information superhighway. Everything seems to indicate that North America's telecommunications future will belong to cable and/or telephone, or at least some hybrid of the two.

But will it?

There is a sleeping giant out there that for some reason has been virtually ignored by the media. It's the electrical power utilities.

Say what? The power companies?

I'm serious. For years the power companies have been quietly installing vast fiber-optic networks in their infrastructures, primarily for internal data communications, remote monitoring and telemetry, substation control, switching and so forth. In case you're wondering, many of these fiber cables are located in the center of transmission line ground wires.

Power company executives I've spoken with have indicated that they are using only 10 to 20% of the capacity of these networks. And they're looking for new and better ways to more efficiently use them. Among the ideas being considered are telecommunications services.

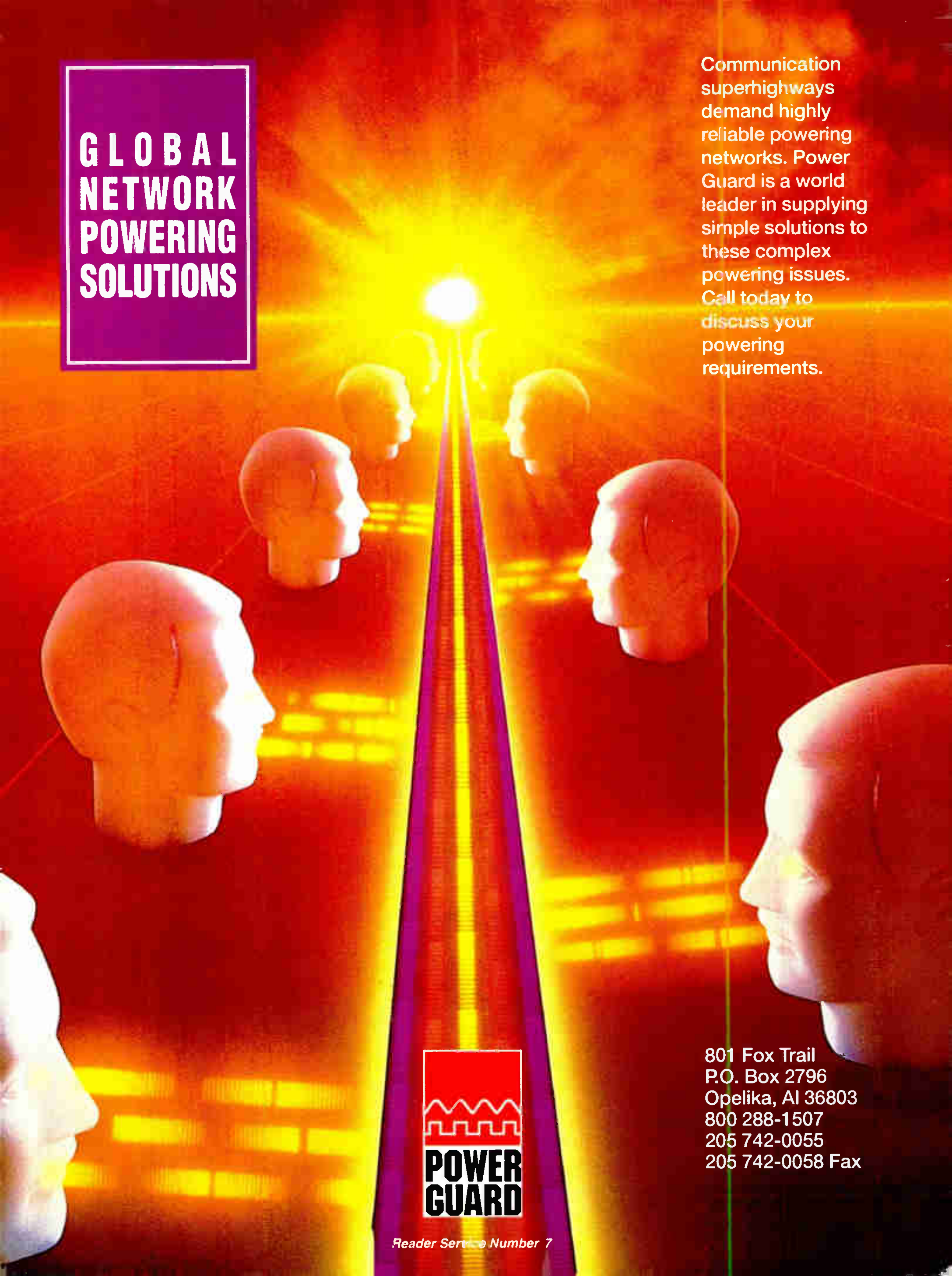
Here's another thing that may raise your eyebrows. Apparently the latest version of the National Electrical Safety Code (NESC) has a provision that would allow the power companies to construct communications networks inside of the safety clearance zone that exists between cable and/or telephone and the power services on utility poles. (Unfortunately I wasn't able to locate a copy of the latest NESC by press time to confirm the details.) These communications networks supposedly can be constructed without rearranging what's already there to maintain the original clearance, so long as the communications network is operated and maintained by "qualified personnel" (read power company staff).

If this is true, can you imagine the equivalent of a new cable system being built right above the one that's there now? One with a drop to every home? It could be interconnected with the existing power company fiber-based data network, and viola, they have the capability for instant competition to telephone and cable! And power companies have very deep pockets.

Initially I suspect such networks would be used to provide new power-related services like remote meter reading and load management, and eventually as legal hurdles are overcome, telecommunications services, then perhaps video services.

Is this necessarily bad? Maybe not. First, it could provide additional competition that the government seems so intent on ensuring. Second, there is no reason to assume that power companies wouldn't be interested in mergers or joint ventures with cable companies. In any event, it's certainly food for thought.

Ronald J. Hranac
Senior Technical Editor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Corporate Offices

Phillips Business Information Inc.
1201 Seven Locks Road, Suite 300, Potomac, MD 20854
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Fiber expert misleading?

Doug Wolfe's column comparing depressed- and matched-clad single-mode fibers ("Ask a Fiber Expert," *Communications Technology*, September 1993) contains some potentially misleading information regarding light propagation, fiber performance differences, manufacturing processes, and the relation between fiber design and manufacturing process. I would like to address each of these.

While the core of an optical fiber is often considered "the light-guiding region of the fiber," this oversimplifies light propagation in single-mode fibers. In both depressed and matched-clad commercial fibers, a significant proportion (from 16% to 27%) of fundamental mode power travels in the cladding, with the exact percentage depending on the fiber's design and operating wavelength.

As stated in Wolfe's column, the mode field diameters of depressed and matched-clad fibers differ. It is this mode field difference — not the manufacturing process — that explains much of the performance differences between the two fiber designs. So, the statement that "To appreciate the differences between these two optical fiber designs, it's necessary to understand the manufacturing processes ..." is not accurate. The advantages and disadvantages of each can be discussed independently of process.

This brings us to the subject of manufacturing processes. Major fiber manufacturing processes fall into two categories termed *inside* and *outside*. MCVD (modified chemical vapor deposition) and PCVD (plasma chemical vapor deposition) are examples of inside processes. So, MCVD is a subset of the inside process. Similarly, OVD (outside vapor deposition) and VAD (vapor axial deposition) are examples of outside processes. So, not all outside processes are OVD.

Manufacturing processes appropriately enter a fiber discussion when determining whether a particular fiber design lends itself to being manufactured by a particular process, and when assessing how that process affects the fiber's quality and cost. For example, to my knowledge, there are no manufacturers using an outside process (either OVD or VAD) to make depressed-clad fiber. On the other hand, several fiber manufacturers worldwide use the MCVD inside process to manufacture *both* depressed- and matched-clad fibers.

Finally, the statement about the relative loss performance of the two fiber designs is unsupported and unwarranted. Comparable quality fibers of both designs are commercially available, and have been extensively used for years.

I hope *CT*'s "Ask a Fiber Expert" column does not become a platform for partisan product advocacy, as this would undermine the credibility of the publication.

James J. Refi
Distinguished Member of Technical Staff
Fiber-Optic Applications Engineering
AT&T Network Systems

Author's response: Thanks for your opinion on the depressed-clad and matched-clad fiber question I answered in the October issue of "CT." We've received some additional feedback on that topic as well, so it's gratifying to know that the first installment of "Ask a Fiber Expert" was read.

Be assured that the column is intended as an educational platform for cable TV engineers and installers; as such, it's geared to reader interest, not commercial concerns. If other "CT" readers have fiber-optic technology queries, please drop me a line at "Ask a Fiber Expert," c/o "Communications Technology," 1900 Grant St., Suite 720, Denver, CO 80203; Fax (303) 839-1564.

Doug Wolfe
Corning Inc.

Jones and BCE Telecom expand relationship

ENGLEWOOD, CO — Jones Intercable and BCE Telecom International (BCETI) have signed a letter of intent to enter into a strategic relationship whereby BCETI would acquire an approximately 30% equity interest in Jones in the form of Class A common stock. BCETI's investment commitment totals $400 million and may increase as Jones expands its operations.

BCETI is owned by BCE Inc., the largest publicly held company in Canada, whose family of companies includes Bell Canada, Northern Telecom and Bell Northern Research. BCETI and Jones are partners in the United Kingdom, offering cable TV and telephone services to residences and business in a large portion of London.

Multimedia big at Comdex

LAS VEGAS — Over 140,000 people converged here in November to see the latest and greatest in computer technology. One of the exciting attractions was multimedia, and an entire hall was set aside for it.

Dozens of vendors were showing their video processing and editing equipment. The IBM-compatible PC can do some pretty amazing digital special effects, but at the moment the PC bus is not fast enough to work with full-motion uncompressed video in real time.

A number of vendors are coming close to creating JPEG compression systems that can compress full-motion full-screen video in close to real time for video editing. But, Sunnyvale, CA-based Videomail is the only company that claims to have succeeded so far.

Another interesting video compression technique is based on fractals. Los Angeles-based Total Multimedia was demonstrating full-screen fractal video running off of a compact disc at less than 150 kbps. From a quality standpoint, it was the best I have seen coming from a CD. Unfortunately it is time-consuming. The company is selling a complete video editing system for about $20,000, which includes a 486 computer, JPEG and fractal compression cards, and all software. The system uses a JPEG card to capture video to the hard disc. This compressed video is then converted into fractal format, one frame at a time. But it takes about two hours to compress each minute of video.

Horizon Technology Inc. (HTI), based in San Diego, was demonstrating its proprietary compression technology, which is being commercially deployed for automatic digital ad insertion. Multivail Co. in Miami has developed a system that enables cable companies to deliver a new commercial on a half-second's notice, using HTI's compression technology.

At the moment, Multivail has announced only two customers: Times Mirror/Dimension Cable in Carlsbad,

CA, and Adelphia in West Palm Beach, FL. Several ad agencies also have agreed to support the system including DBD Needham.

Pacific Bell announced at the show that it plans to produce an interactive shopping compact disc that it will give away free to customers. PacBell sees it as an opportunity to get into the interactive business, before it get its network up and running. Perhaps it is a sign that the compact disc market is poised to move away from a traditional merchandising sales channel into an advertising-supported medium like broadcast TV. — *George Lawton*

Telecon hot on video conferencing

SAN JOSE, CA — At the Telecon XIII conference, sponsored by San Ramon, CA-based Applied Business Telecommunications, video conferencing was the hottest topic. At the higher end there was considerable discussion about the video conferencing systems offered by Picturetel, Vtel and Compression Labs. This group of systems that typically have cost upwards of $25,000 each, are now beginning to fall under $20,000.

The market for these has remained relatively small, according to Dataquest, which estimates that less than 15,000 have been sold to date. Many believe that the real growth market lies in desktop video conferencing systems. All three of the previously mentioned vendors had desktop video conferencing products that operate at data rates as low as 56 kbps. But at a cost of $5,000+ each, they will probably discourage most potential buyers.

Other vendors, like San Jose-based Nuts Technologies, offered even cheaper video systems. Nuts' system, which runs on the Mac, costs from $3,000 to $4,500 depending on the setup. Unfortunately these costly systems leave something to be desired in terms of quality. Who would pay $3,000 to be able to see a tiny face on their PC?

In order to bring the cost of high-quality (30 frames per second, full-screen) video conferencing on the desktop down to reasonable levels, companies will probably rely on dedicated video networks. These will connect employees to each other, and also enable a collection of employees to share expensive video codecs and high-speed lines.

San Antonio-based Datapoint Corp. demonstrated its Minx network, which enables extremely high-quality video and data to be distributed down to PCs through a coaxial cable network, independent of another LAN. It costs $5,000 per PC to connect, plus $16,000 for the video switch. Although only one workstation can be viewed at a time, the Minx features a voice actuated switch. As soon as someone talks, the camera goes to them. This seems a natural extension to the way in which we communicate.

Universal Pair, based in Louisville, KY, demonstrated VideoLAN, a system for sending up to seven simultaneous data streams over four pairs of unshielded twisted-pair cabling. This could simplify installation, especially if a company has reserve twisted-pair already pulled throughout its facilities. The system costs about $8,000 per workstation, which includes the video server and end-user equipment.

Probably the most attractive high-speed video system from a wiring perspective was Face-2-Face from Rich Millennium Inc., based in West Los An-

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geles. Face-2-Face runs over two pairs of unshielded twisted-pair cable. It can deliver a single channel at 30 frames per second. A PC upgrade that enables it to plug into the network is only $3,995, and the switch for connecting up to 80 computers and video sources together is $4,900. The company even offers a codec server that runs the H.264 standard for $20,000.
— George Lawton

☛ Cincinnati Bell Information Systems (a subsidiary of Cincinnati Bell Inc.) will participate with six other companies (including IBM, Rochester Telephone and Lazard Frères & Co.) in a feasibility study to examine the possibility of using an optical fiber ring to link several smaller cable TV systems in Pennsylvania into a single larger network. The nonprofit corporation FiberSpan Pennsylvania commissioned the $900,000 study and is sponsored by the Pennsylvania Cable TV Association.

☛ Zenith Electronics announced the sale of $42 million of 8.5% senior subordinated convertible debentures in a private transaction to institutional investors. Proceeds from the sale are intended to be used to redeem the company's 12-1/8% notes. (The principal amount outstanding due Jan. 15, 1995, is $34.5 million.) The company expects to use the remainder of the proceeds to increase cash resources.

☛ Scientific-Atlanta Inc. has been selected to design, integrate and build the interactive digital set-top terminals for US West Communications' planned broadband trial in Omaha, NE, this year. The MPEG-compatible terminals will serve as the home communications gateway for a wide array of services. The Omaha trial is pending FCC approval.

☛ Racotek Inc. announced a strategic partnership with Advanced Telecommunications Solutions (ATS), a division of Bull HN Information Systems, to use the RacoNet wireless data and voice communication service for a new fleet management system developed by ATS. Under the strategic agreement, ATS will implement the RacoNet wireless data network services with its Field Service Management System, a fully automated dispatch system developed for cable TV installation and repair activities.

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In addition, a discussion of the F-connector specification resulted in a decision to increase the thread relief for IPS-SP-400 from one to two full threads. This is necessary to assist with the manufacturing process, which uses thread rolling. The subcommittee has set up a Document Change Order (DCO) system to provide a paper trail of any changes to specifications for future reference.

Following some discussion regarding both the F-connector and the mainline connector, it was decided that the IPS-SP-403 specification shall be applied for products to be used both indoors and outdoors. A matrix of the different test methods that are to be applied to each type of connector will be added.

Vendors Day: Feb. 16-17

The fourth annual "Northern California Vendors Day" will be held Feb. 16-17 at the Holiday Inn in Fairfield, CA.

Sponsored by the Sierra, Central California, Golden Gate and Shasta Rogue Chapters, this year's event will feature the Philips Mobile Training Center. This "classroom on wheels" provides the latest information, technologies and equipment for CATV personnel. Outfitted with a completely operational CATV system, the MTC will offer a three-day seminar, including hands-on instruction, beginning Monday, Feb. 14 and continuing through Wednesday, Feb. 16 at the site of the event. In addition, it will be open during the day for use by Vendor Day participants on Thursday, Feb. 17.

Four hundred fifty attendees filled the exhibit room last year, with over 70 vendors participating. Once again, Vendors Day will offer a full technical slate, including 25 training sessions in separate breakout rooms. These sessions provide valuable training to the industry's technical associates, while giving vendors the opportunity to demonstrate their products in a classroom environment. In addition, the sponsoring groups will conduct the Cable-Tec Games in conjunction with the event.

SCTE Region 1 Director and 1994 Vendor Show Committee member Steve Allen reports, "This year, we are looking forward to a fantastic turnout for what we consider to be the premier showcase for vendors and technical training."

Society membership analysis

Over half of the members of SCTE are employed as cable system technicians and engineers, according to new statistics recently submitted to national headquarters. This information contains a detailed analysis of SCTE membership as categorized by business, industry and job classification.

The following is a breakdown of the data: Four percent fall under the category of corporate management — which includes chairmen, owners, presidents, executive vice presidents and treasurers; 17% come under the heading of system management — that is, vice presidents, general managers, system managers and directors; 55% make up the technical/engineering component of system operations — which includes engineering vice presidents and directors, engineers and technicians; 7% work for manufacturers; and 4% are with CATV contractors.

The untold impact of cable rate regulation

By Dan Schaefer
Member of U.S. Congress
6th District, Colorado

When cable subscribers opened their monthly service bill in September, many immediately realized that the "Cable Consumer Protection and Competition Act of 1992" was not living up to its name.

After repeated congressional promises of drastic rate reductions, many consumers are left feeling burned. The reason? In a particularly perverse twist, the new law actually hiked rates on the very subscribers it was supposed to protect — the basic tier customers who rely on cable service only for better reception — while providing the largest cutbacks to lavish cable users who subscribe to more channels, extra hookups, converter boxes and remote controls.

The Federal Communications Commission has responded to media and congressional criticism of the new rate regulations by issuing a survey to the nation's largest cable companies to determine the true extent of rate cuts and increases. The preliminary results show that most subscribers did, on average, receive rate cuts. Nevertheless, the study will show that the extent of rate cuts were uneven from cable system to system, and particularly hurt the poor and rural subscribers. Congress and the FCC may be prepared to order even deeper cuts in cable rates.

Heavy blow to the bottom line

But while Washington and the media fret about who did or did not receive rate cuts in cable service, they ignore what, in the long run, is the real fallout of the 1992 Cable Act — the $1 billion hit the cable industry as a whole has taken to its bottom line as a result of the law. The financial impact of the rate regulations on the cable industry's revenues is unprecedented, representing an 18.8% reduction in annual cash flow — the measure used by financial institutions to assess the strength of cable companies.

For instance, one medium-sized cable company in Colorado reported to me that the rate reductions imposed by the Cable Act will cause an $8 million hit to its annual operating cash flow. Since bank loans and other financing is conditioned on cash flow projections, this particular company will immediately go into default on several of its loans and into technical vio-

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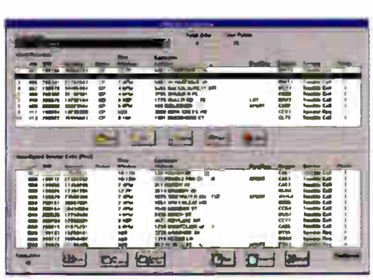

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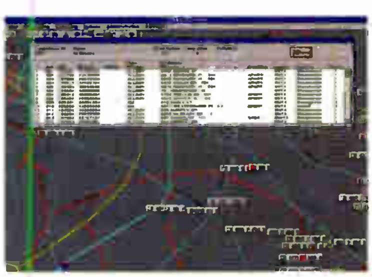

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lation on nearly all others.

The experience of this one Colorado company has been mirrored throughout the industry, according to some of the largest banks and financial institutions in the country. In a letter to the FCC, CitiBank, Morgan Guarantee and 15 other financial institutions predicted that, "since cash flow is the primary determinant of a cable system's debt capacity ... new bank financing will be inaccessible to most cable operators." While low interest rates and an improving economy are driving down the borrowing costs of most businesses, the new rate regulations have all but dried up new loans for the cable industry.

Slowing the superhighway

This effective freeze on new financing for the cable industry could not have come at a worse time. We stand today at the brink of a telecommunications revolution. Congress and the Clinton administration have killed many trees outlining their vision of this revolution — the so-called "national information superhighway." This superhighway will provide interactive data, voice and video services over a nationwide, high-tech network. By any account, the infrastructure that the cable industry has built, at the cost of billions of dollars, must serve as one of the very foundations of this superhighway.

"If Congress allows the FCC to deliver another blow to the cable industry, it will likely prove all that talk of an information superhighway to be just that — nothing but talk."

But only to the swiftest will go the spoils in the race for the telecommunications future. Without the ability to access new capital, many cable companies (particularly medium and small sized companies) will be unable to invest in infrastructure improvements. This will ultimately mean fewer new telecommunications products for their customers, such as video-on-demand, video telephone, interactive information services and the like.

As the recently announced TCI-Bell Atlantic merger demonstrates, the financial leverage of the very largest cable companies will not be significantly curtailed by anything Washington does. But limiting the future telecommunications markets to only the largest companies does not do much to advance the 1992 Cable Act's second expressed goal: competition in the cable industry.

If not everyone saw a satisfactory rate reduction, it was because a bad law forced the FCC to misallocate the savings not because the cable industry is getting off scot-free. If the FCC chooses to go back and order further rate reductions, it should reallocate the savings for all subscribers by providing real cuts for lower-tier subscribers, less dramatic cuts for the most lavish cable users and, most importantly, sparing any further damage to the cable industry's ability to compete in tomorrow's telecommunications revolution.

As it stands today, the cable industry will be hard pressed to take part in the information superhighway with their financial hands tied behind their backs. If Congress allows the FCC to deliver another blow to the cable industry, it will likely prove all that talk of an information superhighway to be just that — nothing but talk. **CT**

Evolving to digital with SONET and CISN

By Andy Paff
President
Optical Networks International
And Kathryn Lynch
Digital Product Manager
ANTEC Network Systems

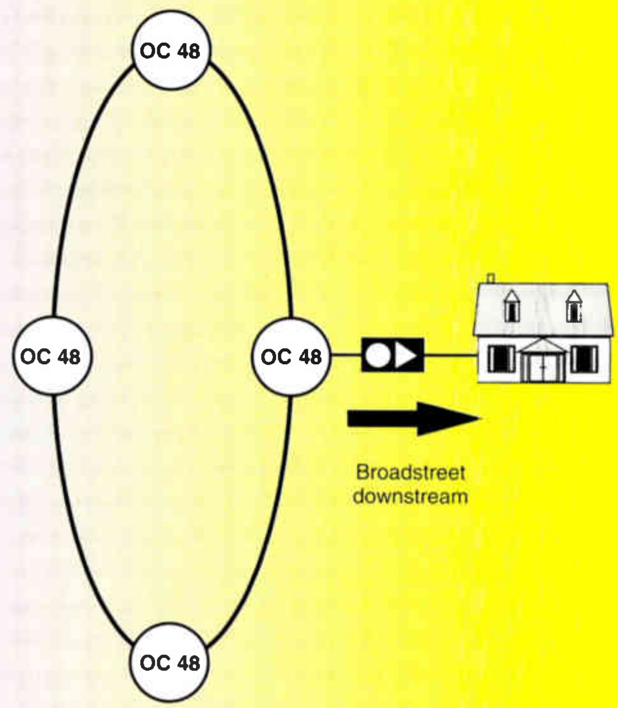
Figure 1: Phase 1

Applications/capabilities

Broadcast NVOD
- Same signals to every home
- Satellite downlink
- No server required
- Advanced, digital compression IPPV

Advertising
- Extend viewership to all systems with headend on the network

Operational economies
- Consolidate digital equipment
- 24-hour monitoring on single headend
- Program origination can be shared by all headends on ring



High-speed digital networks will be a critical factor in evolving cable TV into the premier provider of telecommunications. But many are asking how to migrate existing networks in a practical, evolutionary manner that won't make present equipment — or the network itself — obsolete in the years ahead.

Over the past two years, ANTEC's Cable Integrated Services Network (CISN) has emerged with answers. The CISN plan enables cable operators to plan and build systems that meet today's need for high-quality, reliable delivery of analog NTSC signals while allowing for the transition to digital transmission needed for the future. CISN takes an efficient, incremental approach, reserving capital for investment in a phased manner that uses today's revenues to expand the existing fiber-optic/coaxial cable network.

Nationwide, cable systems have already begun to realize the need for expanded bandwidth in the residential portion of the network. Node sizes are shrinking to approximately 500 subscriber homes and many systems have or are upgrading the coaxial cable plant (including the drop) to 1 GHz capability, offering ample capacity for maturing interactive services. Now, cable systems are beginning to focus on a number of alternatives to make the rest of the cable plant ready for coming interactive services. For example, many engineers are examining the synchronous optical network (SONET) for its ability to help save money, increase revenues and position cable systems for transition to the digital world. CISN relies on this open architecture since SONET can incrementally expand services while providing the "growth" platform for tomorrow.

SONET explained

CISN embraces SONET as the digital telecommunications platform that allows for easy migration from today's network to tomorrow's. SONET's main advantages today lie in its ability to regionally interconnect existing cable TV headends and gain seamless access to the public switched telephone network (PSTN). SONET is, in essence, a digital "superhighway," able to seamlessly pick up and drop off traffic at any node in the network. SONET's self-healing ring architectures are capable of protecting the traffic from a fiber break, equipment failure or catastrophic hub failure without any impact to telecommunication services.

SONET accepts all standard asynchronous signals such as DS-1s and DS-3s — the current products of the United States' existing telecommunication networks. SONET then adds routing information and overhead (approximately 4% of the total payload) to drive the overall transmission system and direct traffic to nodes throughout the optical network. SONET's overhead provides the capability to centralize network operational, administration, management and provisioning functions, thereby minimizing technician intervention. A gateway hub site within the SONET ring links directly to the network management systems, thereby eliminating the need for a network management interface at each hub site.

SONET offers economical add/drop capabilities and the ability to upgrade the network through modular components

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Figure 2: Phase 2

Applications/capabilities

Competitive access
- Voice, data and video service to commercial users
- Connection to long lines (IXC)

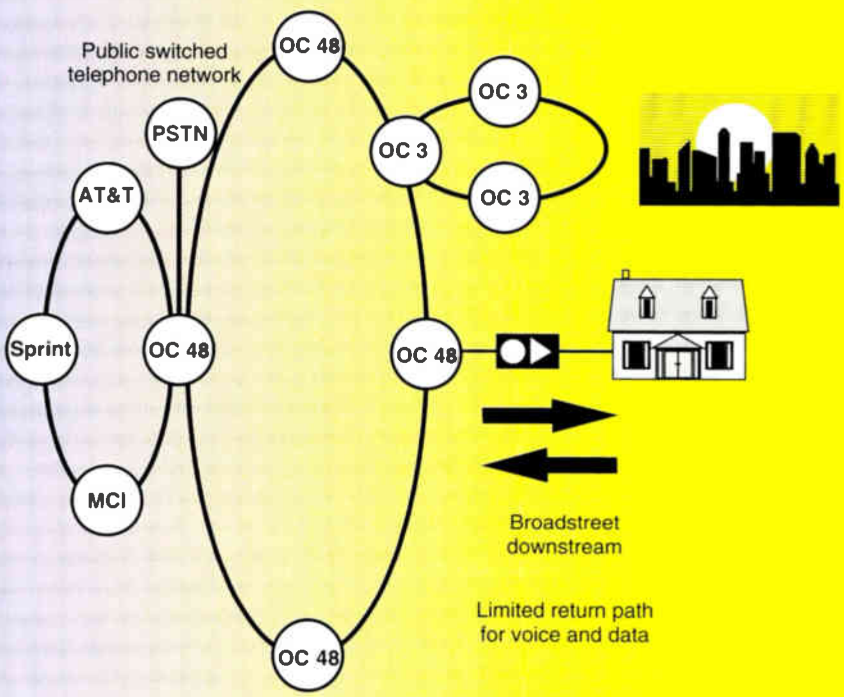
SONET platform
- Compatability with global networks

Interactive multimedia
- Limited return path

Residential voice
- Voice over coax
- PCN

Operating support system
- Bidirectional rings for path redundancy
- Network monitoring

Interactive distance learning /telemedicine



rather than installing completely new equipment when each new application arises. SONET's standardized platform will ultimately allow one vendor's equipment to directly interface with another's at an optical interface point, providing maximum network flexibility and efficient, long-term equipment utilization. In addition, SONET's use of primary and protection fibers provides the network with the ability to switch traffic from service to protection fibers should a hub or fiber failure or degradation arise. Once the problem is corrected, traffic is switched back to service fibers.

Performance monitoring is another key component of SONET networks. At each hub site, SONET equipment monitors signal integrity. If degradations reach a certain threshold, the equipment sends messages to the operations system at the central location and the technician terminal at the actual hub site to locate the faulty signals and clear the problem before it can impact services.

What this all means is that SONET is an unparalleled digital transmission mechanism that offers reduced costs of operation and improved network reliability. Further, SONET accommodates any of the digital video, voice and data demands of the future (e.g., interactive multimedia, telephony, distance learning, medical imaging, telecommuting, local area and wide area network interconnects, and video-on-demand — VOD). Since each of these applications can "talk" the standardized SONET language, cable systems that install a SONET platform will be able to efficiently deliver these as well as other types of digital services.

Network evolution

The CISN plan consists of three phases to evolve today's hybrid fiber/coaxial cable TV plant into an efficient, fully protected digital network that can ultimately become as ubiquitous as today's telephone system. Evolving the cable plant in this manner will allow the industry to compete in an increasingly sophisticated environment for the subscriber's current — and future — entertainment dollars while generating entirely new revenues from any number of information services.

Phase 1

Phase 1 of the CISN plan relies on SONET to regionally interconnect area headends. (See Figure on page 26) This is accomplished by implementing fully redundant SONET fiber-optic rings. Each existing headend is linked to a "master" site where broadcast entertainment and advertising are originated and transported to the hub sites without any degradation to the video signals.

Regional interconnections mean operational and labor costs can be cut by consolidating equipment and manpower from remote locations. Advertising can be routed to specific nodes or throughout the entire service area, opening up new opportunities for increased advertising segmentation and offering the ability to generate more advertising revenues. Small businesses can advertise only in their local areas; larger businesses can advertise in a portion of the regional network; and national advertisers can saturate the entire area with a regionally distributed spot. Programming will be delivered via the master headend to nodes throughout the network, thereby offering the potential for programming to be negotiated in bulk.

However, to transmit broadcast entertainment and advertising through the SONET network, current analog signals will chew into capacity. Approximately three DS-3s or 140 Mb/s (the equivalent of over 2,000 individual voice circuits) are required to transmit a single video channel. Compression devices can help to utilize the network's capacity more efficiently.

The main benefit to regionally interconnecting headends lies in achieving improved economies of scale. Network costs are reduced and advertising dollars can be increased. Those revenues (and savings) drive the move to CISN's first phase in the migration to the digital network.

Figure 3: Phase 3

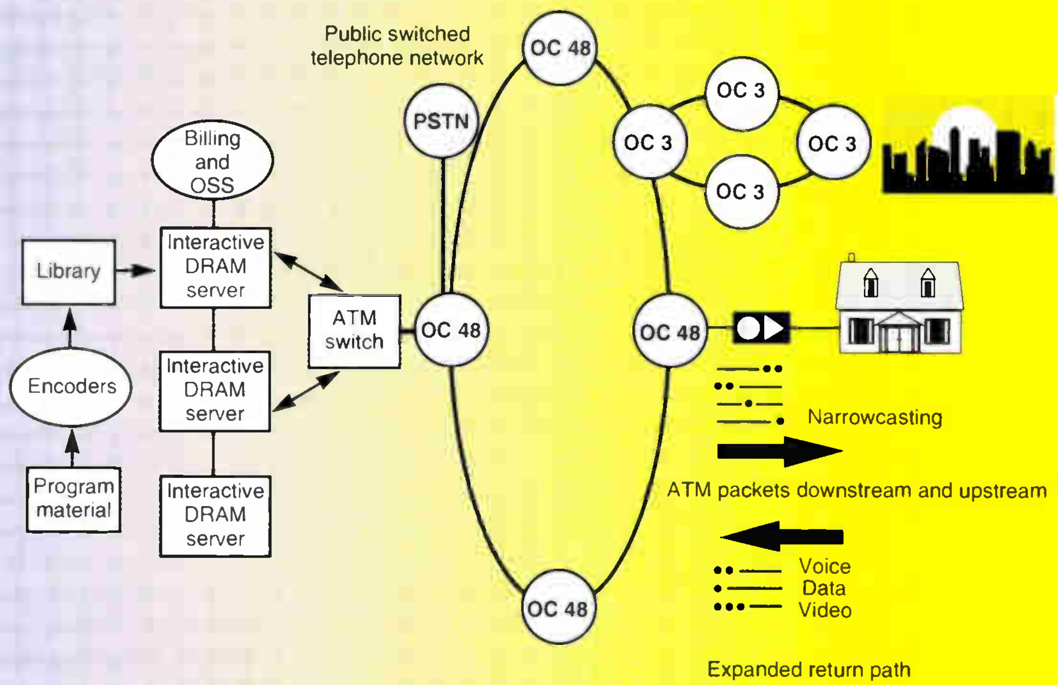
Applications/capabilities

VOD: Real-time
- Any video source from library
- Immediate availability to subscribers
- Pause, rewind, other functions

Interactive multimedia
- Send and receive broadband video from other subs
- Interactive games with other subs
- Video fax through PSTN
- Expanded return path

ATM/SONET
- Interface with any other regional interconnect through PSTN

OSS (operating support system)
- Billing by time and/or channel usage
- Total network management
- Self-healing network
- 99.997% network reliability



Phase 2

Phase 2 (Figure on page 28) of the CISN plan continues the progress made in Phase 1 by connecting the regional network to the PSTN. Ties to interexchange carriers (IXCs — AT&T, Sprint and MCI) and the establishment of metropolitan SONET rings mean alternate access (AA) services are possible. In the residential network, this phase means telephone and data services can be provided. SONET's add/drop features allow for the integration and segregation of smaller groups of circuits into the overall SONET payload. Thus, traffic can be sent only where it needs to go on the loop.

To illustrate, an alternative access provider has several customers at different locations. Several AA customers have one or two DS-1s that need to go to one IXC. Other customers want their traffic to go to another carrier. In the asynchronous world, the network provider would have to bring the circuits via dedicated fibers to a central location, demultiplex them, patch the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proper circuits into another multiplexer, then transport them to their respective carriers via another dedicated fiber route. Using SONET, the traffic can be routed within network rings to each carrier and, using the add/drop function, can drop the signals at their respective destinations without requiring any demultiplexing/remultiplexing. This results in lower costs because of reduced equipment needs.

SONET allows additional nodes to be installed in-service without impacting existing traffic as the AA customer base expands. Orderwire interfaces (64 kb/s voice channels) allow technicians to communicate between nodes independent of the traffic, a particularly valuable function during turn-up and maintenance. Software-driven automatic turn-up capabilities mean equipment and cabling can be tested upon installation, eliminating the need for external test equipment.

Intelligent analog and digital switching capabilities can be shared between all systems on the regional network, allowing efficient channel grooming for advertising insertion. For applications such as interactive distance learning, telemedicine or teleconferencing, video codecs can be installed at business user premises while switches ensure that participants can access the video signals of multiple locations.

In the residential network, SONET has made telephony and data services available to traditional cable TV subscribers. In addition, ad-hoc pay-per-view events can be efficiently offered whether those services are provided through the PSTN or by the regional network itself. Return bandwidth capabilities make other multimedia services, such as distance learning to the home, possible as well. To manage these activities, a scalable operational support system evolves to monitor the network and effectively itemize transactions.

Phase 3

Phase 3 (Figure 3 on page 30) represents the evolution of cable TV to the fully interactive network, made viable when new interactive services (like VOD and expanded multimedia offerings) prove in. During this phase, sophisticated switches and a digital video server are installed at the headend, allowing subscribers access to a vast array of digital services and to have those services routed directly to them.

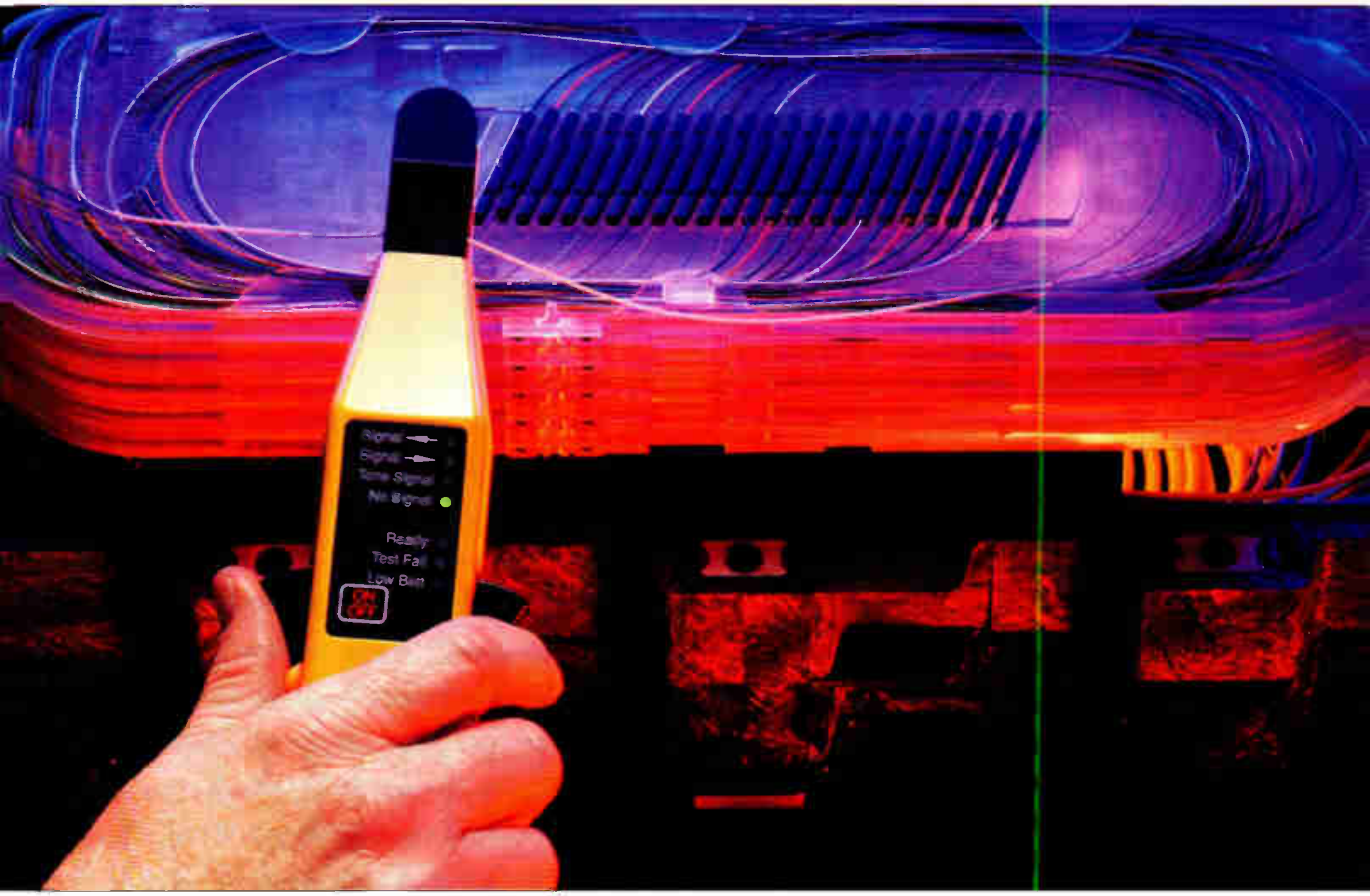
Asynchronous transfer mode (ATM) is a promising new technology that can help to evolve the cable network into this fully switched network. ATM switches efficiently route digital information to (and from) the user, using SONET as the transmission method. ATM "cell packets" consist of a 5 byte header that contains the address and a fixed length 48 byte information payload. This makes it easy to integrate signals into the formats associated with traditional telecommunication signals such as DS-1s and DS-3s the asynchronous rates used today to transport voice and data throughout the PSTN. ATM works with both SONET and RF carriers. Either can offer the transmission mechanism required to deliver an ATM packet to its destination. For transactional billing, the operational support system expands again, tying the ATM switch to the billing system.

Digital video servers also are emerging as a means to store digital services to make true VOD possible. Servers can store movies, games, home shopping catalogues, etc. Centrally locating these scalable units at the master headend allows the subscriber to effectively access digital services and use such VCR-like qualities as pause, fast-forward, and rewind. In addition, video servers can hold a number of digital business information services, such as data libraries, corporate training tapes, medical images, etc., allowing any number of business customers immediate access to critical information. What will drive the implementation of ATM switches, digital video servers and enhanced automated systems will rest in how the public buys — and becomes hooked on — these new interactive services.

Heading to the future

Cable TV is now on the threshold of an exciting new era fueled in part by SONET high-speed digital transmission systems. Systems strategically laying fiber today can effectively expand their networks to achieve the benefits SONET can provide. SONET offers the ability to reduce network costs and improve advertising revenues today while providing the survivability of ring architectures needed to deliver increasingly reliable service tomorrow. As new applications come into play, the CISN plan positions cable systems to exploit revenue-generating opportunities in such areas as alternate access, residential telephony and multimedia. Over the long-term, cable systems that implement the CISN plan will not make their present equipment or the network itself obsolete. Nor will those systems be forced to change out or install completely new equipment as new service offerings emerge. **CT**

Identify fiber lines without interrupting or cutting service.



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in the telecommunications environment

By Pam Nobles
Senior Staff Engineer/Technical Training
Jones Intercable Inc.

Cable TV companies are fast becoming "full service" providers, and delivering more than just "plain old cable service" to our customers. (Perhaps we can jump into the alphabet soup of acronyms and call this "POCS.") There are a myriad of video and data options on the horizon, from interactive shopping channels to financial services. High-speed digital switches will allow the customer to select the movies services, or the communications mode desired. New technologies allow a merging of cable TV, telephone and other industries to form a new industry within the broadband telecommunications spectrum. This convergence of the cable, telephone and computing industries has created a new environment that isn't cable and isn't telephone, and in which new rules are being invented.

We need to prepare our personnel, through providing training and educational opportunities, for this new and changing environment. As I began my research for this endeavor, it quickly became apparent that the availability and choices of training materials in telephony and related fields are seemingly endless. What I found lacking, however, is a plan of action to answer these questions: Who needs to be educated and to what level?

So, let's begin at the beginning. This article will first establish a starting point by reviewing how technical training is presently accomplished in the cable industry. Second, we'll assess a plan for charting the way. And finally, we'll take a look at what is presently being done in the cable industry to address this growing telecommunications training need.

Jack-of-all-trades

Many cable veterans take great pride in their seat-of-the-pants learning style. In charting their course, these entrepreneurs set the stage for the primary training method presently used in the cable industry — on-the-job training (OJT). A person learns a great deal when allowed to focus on areas he or she is most interested in. However, this leads to haphazard, inconsistent and sometimes even erroneous learning if the instructor did not learn the "right way." Often, learning basic but critical skills are missed. Our cable engineers, for example, have been called a "jack-of-all-trades, master of none." They are responsible for a wide variety of tasks and the development of each separate task varies widely. However, their experience and thus, proficiency, at each of their tasks varies greatly. Although this bootstrap learning worked well in the infancy of the cable industry, as we move deeper into telecommunications, this method of training just ain't gonna work! Since there is an established track record, customers already have high expectations.

Present CATV training

There are some training institutions rooted in the cable industry. The National Cable Television Institute is the largest supplier of technical training to our industry. Approximately 67,000 students have taken NCTI's correspondence courses over the last 25 years. Mind Extension Institute has cable-specific training (on interactive laserdisc and videotape formats) available for both customer service reps and technical associates. The Time Warner National Training Center and Continental Cablevision's regional training centers concentrate on CATV training, and may allow employees from other companies to attend. Vendors also offer training; some, only if you buy their equipment. Others, such as Siecor and the Philips Mobile Training Center, are open to everyone, for a fee. Associations such as the Society of Cable Television Engineers conduct national and local seminars. SCTE also conducts the Broadband Communications Technician/Engineer (BCT/E) Certification Program.

Most companies have some kind of formal in-house training. Employees also can learn on their own through attending college as part of their own development. Overall, however, we find that a large part of the technical work force within the industry is not being adequately trained. Often, training is supplemental, not a company requirement, and not consistent.

So what does this mean? There are some fine training sources available. But since the technicians and engineers we will be preparing for our telecommunications future may have started their career track with hit or miss training, we will initially have a large learning curve.

Survey offers insight

It will come as no surprise that the results of a 1992 survey conducted for a training seminar indicated that lack of resources (money as well as personnel) is the number one concern among cable industry trainers. Part of the problem is attributed to the limited perception of the value of training by managers, which prevents resources being

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allocated. This attitude needs to be resolved so managers can better support the training. And, perhaps trainers need to devise ways to help managers see its value.

Starting point formula

Our starting point could resemble the following equation:

Hit or miss training +
Limited resources +
Low perception of the value of training

Companies are struggling to keep up and to provide necessary support to their employees so they can provide support to customers, both technically and in service. These problem areas need to be resolved as we progress toward our new environment. In other words, we have quite a challenge here.

Next, we'll examine our company vision. The gap between where we are now and where we want to be is the deficiency we need to fill.

Follow your company's vision

There are many telecommunications ventures to consider. Do you know which one your company is taking? What is your core business? What impact does the size of your business have on training? What new businesses might you be expanding to? Say, for example, the business plan calls for plain old telephone service (POTS) over the existing coaxial network. Although designs of most of our networks are planned to be reverse-capable, most of our systems have never activated or swept the reverse system. Although it is the same coax network, it is important to consider the additional attention needed for sweeping and maintaining the plant.

If you don't know your company's vision, find out! Armed with this vision for your company's direction, explore your options.

Call to action

So far, you know where you are and have some idea of where you want to be. How are you going to get there?

Those in human resource development are familiar with training needs assessments. The typical steps of a training needs assessments are as follows:

- *Assess or analyze* the challenge requiring training.
- *Design* the goals and objectives of the training.
- *Develop* actual training strategies, based upon the goals and objectives.
- *Implement* or launch the final training program.
- *Evaluate* after a period of time to see if the objectives are met.
- *Revise* your program as necessary.

At the analysis or assessment stage (where we are now) ask these simple questions:

- Who will our students be?
- Why do we want them to know this?
- What will they do with this information?
- What do they already know?
- What do they want to know?
- What should they learn first?
- How should we decide?

Suppose we're reviewing a course of study in basic telecommunications. Using these questions as a model, let's assign a specific training group — corporate cable engineers — and see how the answers may look.

Who will our students be? Corporate engineers.

Why do we want them to know this? To have an overall understanding of our core businesses and to be able to answer detailed questions our field staff may have.

What will they do with this information? The depth of the information should be similar to the depth they presently understand coaxial architectures and RF technologies.

What do they already know? What do they want to know? What should they learn first? Prerequisites may be needed. Interview perspective students to determine the existing level of expertise and what level they'd like to be at.

How should we decide? Through small development teams, made up of both engineering experts, prospective students and human resource development managers.

After these questions are answered, move onto the design step, where the goals and objectives of the training are determined, as well as the actual training strategies — videotape, training manual, college course, etc. And, before you develop your own training, check out what's available.

The Time Warner plan

Ron Wolfe, the director of the National Training Center, Time Warner Cable, shared that they are well along in the development stage of their telecommunications training program.

Time Warner Cable has an additional affiliation to the telephone industry through its partnership with US West, forming Time Warner Communications. This group plans to have its own traveling trainer, who will work closely with the National Training Center. This trainer will cover such topics as DS1 and DS3 circuits, and multiplexing.

The National Training Center itself is developing a basic telephony course. This course will eventually be open to the industry for attendance after the Time Warner employees have had their opportunity to attend. Topics include alternate access, personal communication networks (PCNs) and personal communication systems (PCSs) as related to full service provider. Also, SONET, ATM, basic telephone, as well as multimedia and video-on-demand (VOD). They also are conducting courses on basic CATV architectures, for our telephones counterparts.

Wolfe stresses, "Prepare now!" →

Telephony training for cable engineers

There are three main "tiers" for which we need to prepare: engineers, technicians and installers. At this point, we will just deal with the training of the engineers. About two years ago, Paul Schauer (strategic development, telecommunications network, Jones Intercable) began this research at Jones primarily to train himself. His research uncovered five main sources of telecommunications training for the engineer that could be accomplished simultaneously:

1) *Bellcore*. Bellcore (Bell Communications Research) is the training branch to the seven regional Bell operating companies (RBOCs). Training they can provide includes formal schools, publications, videos and distance learning/computer learning tools. To receive more information on the training available, call 1-800-TEACH ME.

2) *Local colleges and universities*. The inquisitive learner can seek out his or her way through a degreed program, or just by taking a few classes. The University of Denver, for example, offers a master's degree in telecommunications.

3) *Conferences*. Private conferences are offered to individuals or groups, but are typically very costly. Groups such as the Association for Local Telecommunication Services (which serves the competitive access providers the same way SCTE serves the cable industry) can provide telecommunications-specific training. Training also is available through associations such as the IEEE.

4) *Read, read and read*. Trade journals specific to telecommunications can furnish the inside scoop. It's easy to feel that there is just too much data to keep up with, so reading all you can is a critical step. A good trade journal to start with is *Telecommunications*. To subscribe to this free journal call (617) 356-4595.

5) *Telco reps*. Meet with telco industry representatives — either local exchange carriers, interexchange carriers, as well as vendors — to glean more of the information you need.

Schauer notes that it became apparent during his research that there is no one, clear path that the entire cable community needs to know or follow. Using a combination of these resources could provide the student with lifetime learning.

Schauer says, "The cable TV industry must prove that its networks, when used in the telecommunications local loop, will meet the reliability and availability standards mandated in the telecommunications industry today."

He is a member of the Telecommunications Subcommittee at CableLabs and is working on a program called "Network Integrity Testing." The final report from this working group will contain criteria and recommendations on reliability and architectural issues. The results of this report may help to shape the way we conduct our telecommunications training as we move forward.

Start small, but start

Recognizing your first step may not be clear at this moment so start with a small step. Learn about the basic workings of the telephone through the SCTE videotape #T-1136, "The Basics of Telephone." It is available by calling SCTE at (610) 363-6888.

Also at Jones

Jones is continuing with its career path development. A course structure will be introduced that will allow our associates to develop their skills in this changing environment. These skills can easily be transferred among the telecommunications industries. A self-directed career guide is under development to aid our associates in charting their own path. This format will allow our associates to take charge of their own future. Important elements include communicating benefits to the employees as well as management and providing the employee a goal to work toward. A career day will be used to launch the career path format.

Embrace change

We need to embrace change and, at the same time, address the technical training needs of an industry that has had "hit or miss" training. This means we must continue to concentrate on the basics and make it a priority to refine what we have. We need to move from supplemental to required training. Transferable skills, not job positions, need to be further explored. I may not have given you specific answers the questions of who needs to be educated, and to what level but I hope I've provided you with enough information to start your journey. Just remember this: The type of business the cable industry is headed for cannot survive without a well-trained work force. **CT**

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Technical training following reregulation

By Bill Riker
President
And Ralph Haimowitz
Director of Training
Society of Cable Television Engineers

The 1992 Cable Act has created an entirely new focus on the need for technical training within the cable industry. Today, it is not as much a choice of whether to train technicians as it is a mandate by federal law to meet the criteria and standards set forth by Congress and the Federal Communications Commission. Let's examine the facts as they are, since reregulation has been imposed upon our industry.

The new technical standards established by the FCC will require some additional technical skills as well as new test equipment to perform the tests and measurements as specified under Part 76.605 of the FCC Rules. The rules are very specific about what is to be measured, what the acceptable measurements are, where the tests are to be made and when the tests are to be made.

Who needs it?

It becomes very important for technicians to be thoroughly familiar with these requirements so that the resulting documentation is accurate and to ensure that the systems meet these minimum performance standards. It is equally important to ensure that the ability and knowledge to properly perform these tests and measurements is not relegated to just one individual, but that a number of maintenance technicians are trained and capable of doing the job. In larger systems, for example, the chief tech or engineer, at least one headend technician, and several system technicians should have the required training and skills to perform the tests.

Training more of the system technicians in this area is an added plus, as they then have the ability to see and understand signal problems when the measurements fall below FCC technical standards, and can then correct those problems before they result in customer complaints.

There also are potential difficulties that may occur if franchise authorities impose additional technical standards on their cable companies to ensure better system performance for the subscriber. This becomes as much a political issue as it is a technical requirement, and cable systems will have to address maintaining customer satisfaction as well as the technical standards.

"We must stop thinking of and calling ourselves the cable TV industry. We need to become the telecommunications industry."

The competition factor

Another area that is sure to create problems for the industry is the anticipated increase in competition from alternative delivery systems. Among these very real and potentially devastating competitors are wireless cable, direct broadcast satellite (DBS) and telcos. Wireless cable broadcasts TV signals and services that cable systems provide over coaxial and fiber-optic cables directly to the consumer, through an antenna and receiver/decoder system installed at the house. DBS will provide the same signals that cable systems receive via satellite, to a small roof-mount antenna system with a receiver/decoder that the consumer buys for a reasonable fee and can be installed by a franchise area business such as a backyard dish dealer. Telcos have recently become involved with cable TV system ownership and the fiber-optic delivery of telecommunications signals (including the same satellite signals carried by cable systems.)

In addition, telcos are currently developing technical specifications for coaxial cable, materials and equipment, and construction/operation of coaxial fiber-optic telecommunications systems. If we allow ourselves as an industry to fall behind in the quality of operation and service that others will provide (often at a lower price) then cable TV systems as we know them are certain to go the way of the dinosaur.

Everything that has been said up to this point comes down to one basic fact — giving consumers what they want and what they are willing to pay for. Every single item, from new competitors to reregulation has been the result of customer dissatisfaction with our rates, services and attitudes. It is no secret that this industry must make some radical changes.

First, we must stop thinking of and calling ourselves the cable TV industry. We need to become the telecommunications industry. Second, we must be sure that we can provide all the services that the consumer demands, at a competitive price, and do it better than anyone else. In other words, we need to be masters of customer satisfaction. To accomplish this, we need to ensure that our personnel are highly skilled and are qualified to do their jobs in a manner that is efficient, cost-effective and reliable. All three of these factors will prove to be an absolute must for this industry, and all of them can only be achieved through appropriate training.

In addition, other training programs will have to be addressed because of reregulation. One area concerns the consumer who wants to prewire/postwire or add outlets to his home through a local contractor or on a do-it-yourself basis. This will be a bitter pill for this industry to swallow, but it is inevitable and we need to prepare for it now. It is important that we provide the consumer and/or contractor with the training in proper equipment/materials selection and installation of the interior portion of the house drop. Consumer education has always been and will always be a key issue.

The Society of Cable Television Engineers sees a growing need to provide more and more education and training to meet the needs that have been created by reregulation, increased competition and new technologies. We hope that those who sit in control of our industry will be proactive to ensure that this industry continues to make the right choices for its survival. This is essential if we are to be a leader in the telecommunications market. **CT**

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Preparing for the future: How much bandwidth and fiber is enough?

By Alex Best
Senior Vice President of Engineering
Cox Cable Communications

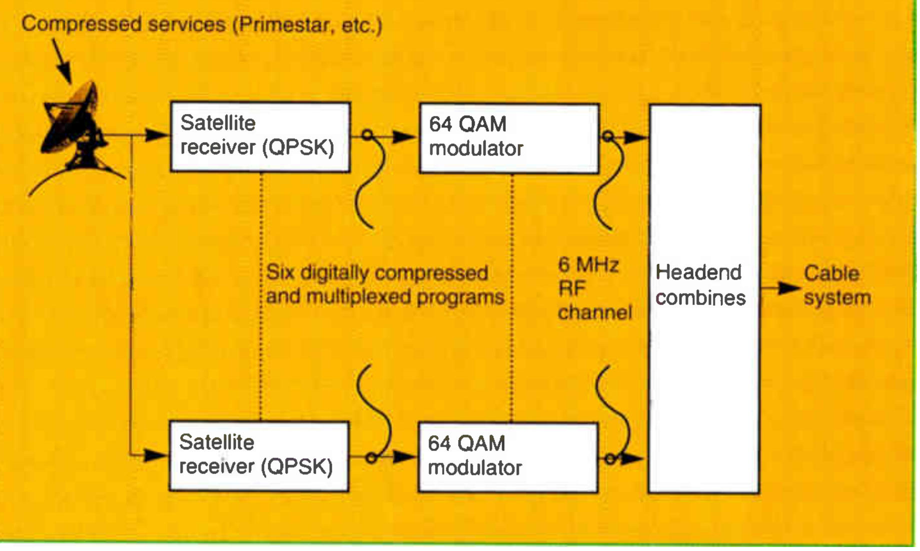
Let us assume that you are the general manager of a 300 or 400 MHz cable system, built around 1975 or 1980, respectively, and you lean back in your chair one day to reflect on your past successes. Quickly you realize those days are gone forever and any future possibility of success depends on how you respond to the following issues:

- Revenue growth in a regulated environment
- Competition in '94 from DirecTv
- Delivery of multimedia services

You quickly realize you have no time to waste since you used every available spare channel prior to Sept. 1, 1993, to reduce the impact of rereg by increasing the number of channels allocated to CPS (cable programming services). In spite of this, however, your total '94 revenues are projected to be down by 5% compared to '93. You really become depressed when you mentally review your current market conditions. Due to the economy, the growth of homes in your area is practically zero. In addition, your present customer penetration is 76%, offering little opportunity to gain new customers in your existing homes passed market. Finally, you lost 2,000 pay customers last quarter, a trend that has continued for the past two years.

After several additional moments of thought, one fact becomes clear: Without additional channel capacity, your options are limited. You call your chief engineer, Bob, and ask him to come to your office. You explain the situation. Bob has been anticipating this discussion and he lays out the following choices.

Figure 1: Digital compression — pass-through mode



Compression/decompression

Bob explains to you that advances in digital compression now offer the capability of placing four to eight channels in the spectrum space where one channel now resides. Bob goes on to explain that there are many issues that must be addressed, however.

First of all, it is not economically practical to compress signals locally. As an example, assume you decide to move aggressively into PPV. You want to offer 10 movie titles a night with 30-minute start times. Assuming two-hour movies, this requires 40 channels, or eight 6 MHz channels using 5-to-1 compression/decompression. Regardless of how you obtain the programming (analog satellite transmission, local tape or disc), you will need 40 compressors. Bob explains they cost somewhere between $50,000 and $100,000 each. This places the total cost of the compressors between $2 million and $4 million. Additional cost will be involved in receiving the satellite channels and/or local origination. In addition, you will need to expand the headend building to locate the 20 racks of equipment necessary to hold all the electronics. The total cost is somewhere around $3 million to $5 million. You lose interest.

Bob goes on to explain that programmers are slowly converting to digital compression, but it will be a number of years before they all agree on compression standards; a necessary step before you can deploy decompression boxes in your customers' homes.

Finally Bob explains your best bet is to receive and pass through digitally compressed signals that will come from services such as Viewers Choice, Your Choice TV or Primestar. An example of how this would be accomplished in the headend is shown in Figure 1. You are told this can be accomplished for a few thousand dollars a channel (assuming five services per 6 MHz).

Set-top boxes

Bob continues. Unfortunately, decompression boxes won't become available until the first quarter of 1995. In addition, they will cost somewhere around $300 each, depending on options. As far as service level authorizations are concerned, your choices are two: You can either contract with the satellite programmer to provide this service for you (this signal will go over the satellite and pass through your headend) or you can accomplish local control by buying the necessary equipment to insert authorization signals. The cost to achieve this has not been determined but could run between 20K to 50K depending on your present capability for addressable box control.

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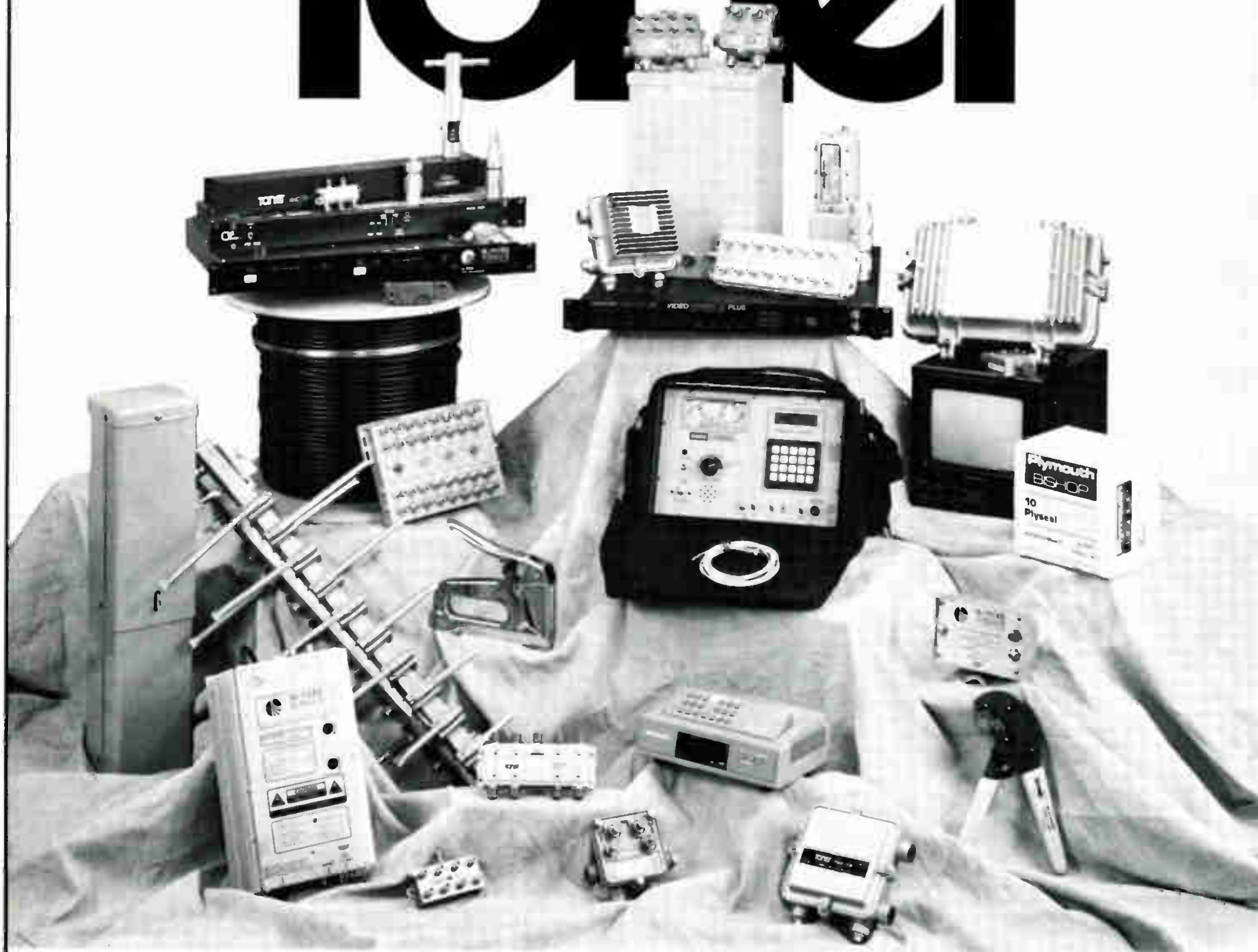

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forward with this program. Your analysis indicates that with reasonable assumptions on PPV buy rates plus the FCC-allowed 10.25% return on converter capitals (if you decide the market can bear it), the payback is attractive. Bob explains to you what your system will look like in '95 (Figure 2).

He goes on to list the advantages and disadvantages.

Advantages
- Requires no network rebuild or upgrade
- Set-top capitals can be deployed incrementally

Disadvantages
- Must wait until '95
- Must remove analog channels
- Does not support the full service network (multimedia interactive services)

Figure 2: 400 MHz and compression

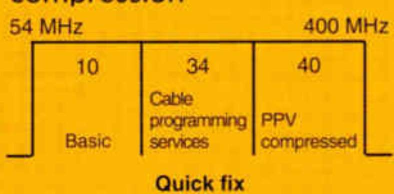
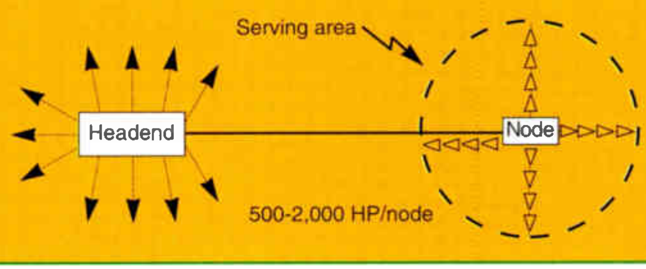


Figure 3: Segementing the system



Delivering multimedia services

Now that you have decided on an action plan for the next few years, you decide to focus on a longer horizon, say five to 10 years out. It is obvious from the spectrum allocation drawing that Bob just illustrated, you are not prepared to "play" in the much touted "interactive multimedia world of the future."

You ask Bob what must be done to your existing coaxial-based tree-and-branch system to make it capable of providing services such as video-on-demand, educational programs, PCS, cable-phone and data. Bob explains, in order to provide services in an "on-demand" scenario, you must "break-up" your system into relatively small serving areas. It becomes easier to understand when you are shown Figures 3 and 4.

The explanation goes like this. The broadcast channels are available to everyone, just as they are today. When someone requests a movie-on-demand, however, a switch in the headend directs that program only to the fiber feeding the node that contains the home of the customer requesting that movie. This movie, in digital form, is assigned a "slot" in the shared channel spectrum. Only the requesting customer will see the program because only his/her

Figure 4: Spectrum allocations

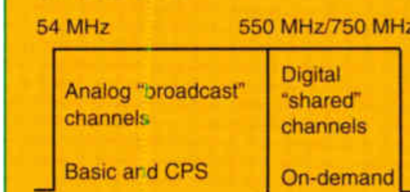


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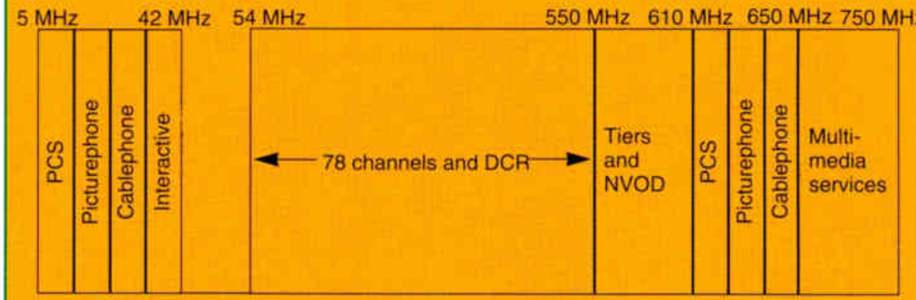
Figure 5: "The future" 2000



750 MHz, 500 HP/node: The answer — *compression* and *two-way*

digital terminal has been authorized to decode the signal. This concept of segmenting the system such that viewers in different serving areas can each watch a different program using the same spectrum allocation is identical to the method used in cellular phone systems. It is called frequency reuse. Your boss is a quick study and he then asks the $64,000 question: How much bandwidth is enough and how deep in the system do you have to take fiber?

Fiber and bandwidth decisions

You explain that the answer to this question depends upon three factors: 1) the services you intend to offer, 2) the spectrum requirement for each of these services, and 3) the "take rates" for each of these services. You both know that nobody can answer these questions today but some early studies indicate 750 MHz and 500 homes passed (HP)/node offers a reasonable traffic model, assuming a comprehensive list of video, voice and data base services. The spectrum allocation drawing in Figure 5 shows how the system might look at that time.

Upgrade cost per mile

Bob has prepared two "decision tree" diagrams that are shown in Figures 6 (this page) and 7 (page 56). He explains that the cost per mile numbers are averages and include labor and materials for the fiber and coax portions of the upgrades. He also points out that this is an upgrade, not a rebuild (i.e., reuse all of the hardware and 95% of the coax). Finally he states that these numbers do not include activation of the reverse plant, which will cost an additional $1,000/mile.

From a starting point of 400 MHz (Figure 6) , you have three choices: Upgrade to 550 MHz for $5,000/mile (assumes some limited respacing in the feeder only), space the actives for 750 MHz and activate to 550 MHz for $10,000/mile (popular in '93 before availability of 750 MHz electronics), or space and activate to 750 MHz for $11,000/mile.

As far as fiber is concerned, there is a lot of flexibility in terms of HP/node. The number is generally determined by the density of homes in the area, the picture quality you desire at the end of amplifier cascades, and the spacing of amps

Figure 6: 400 MHz (52-channel) system upgrade bandwidth choices

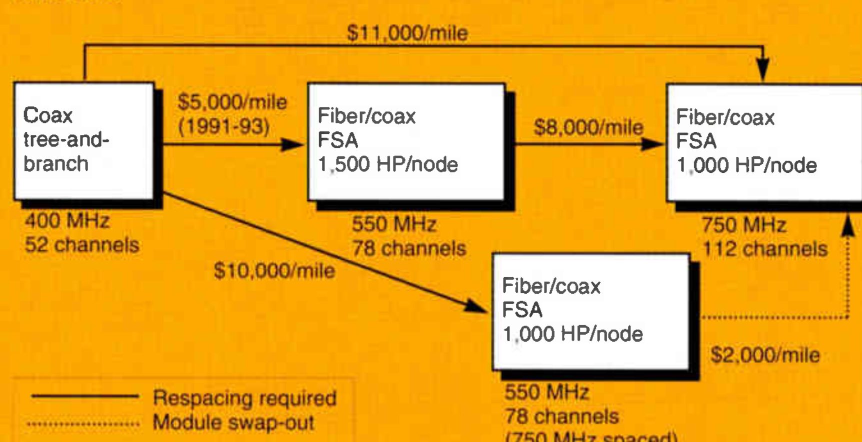


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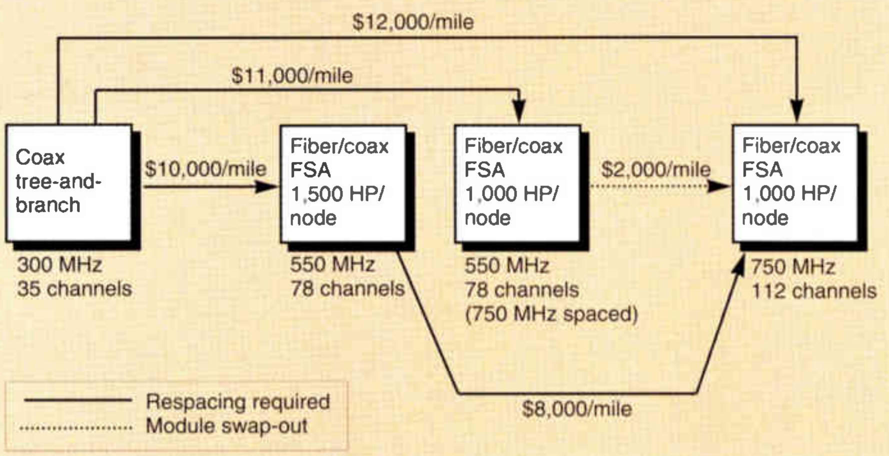
Figure 7: 300 MHz (35-channel) system upgrade bandwidth choices



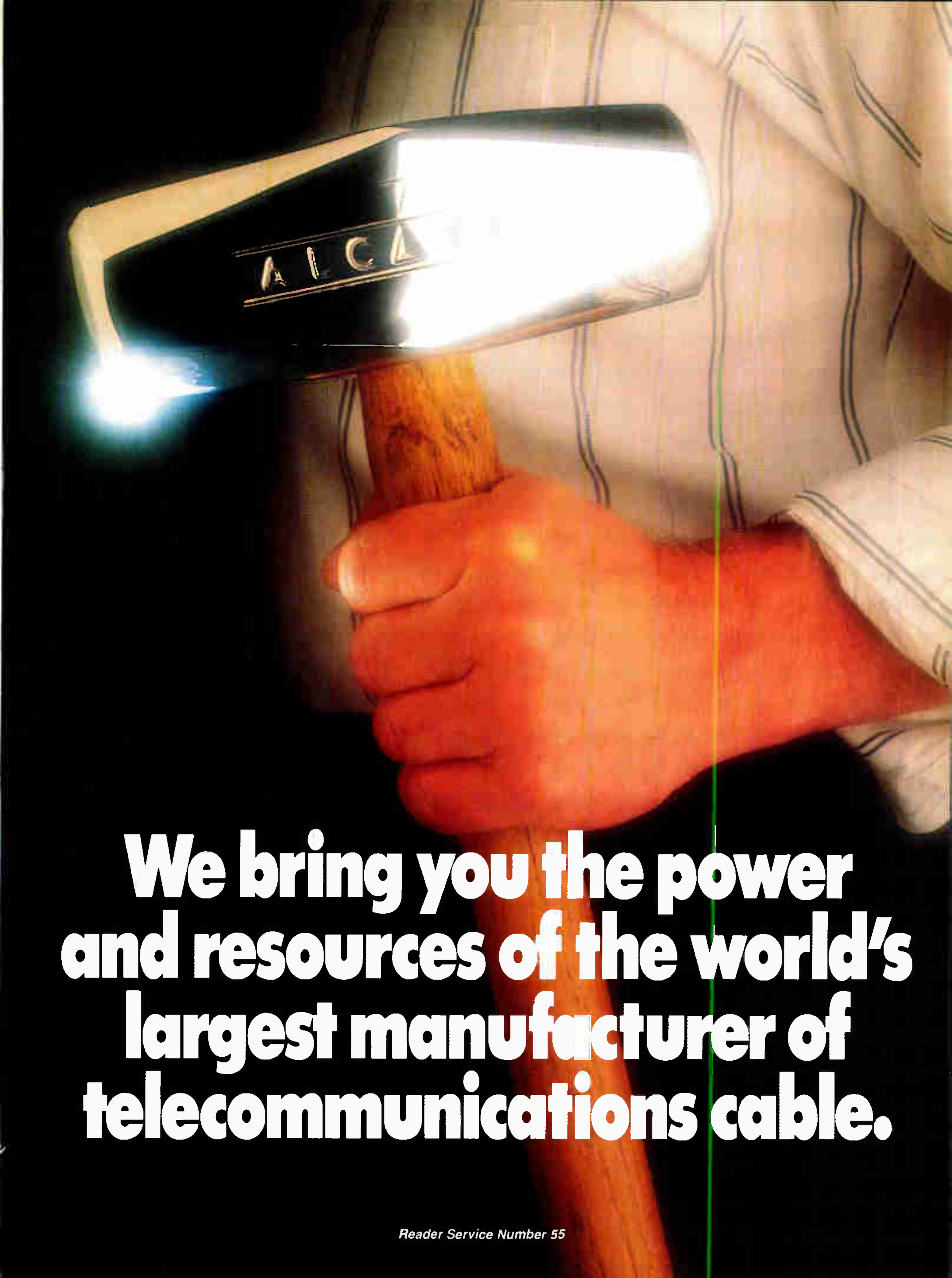
(bandwidth). Bob strongly recommends that you limit amplifier cascades to achieve a 49 dB C/N worse case (noise-free NTSC picture). Based on your average density of 80 homes/mile, this results in 1,500 HP/node at 550 MHz spacing and 1,000 HP/node at 750 MHz spacing. Although this is not where you project you will need to be some day (500 HP/node), you convince Bob that by allocating six fibers to each node, you can get there when you need to by deploying more lasers and receivers at a later date (subdividing the node), while saving money on the initial upgrade.

After studying the three choices, you decide to focus on the 550 MHz ($5,000/mile) upgrade and the 750 MHz ($11,000/mile) upgrade. You realize that the correct choice between these two is almost solely dependent on when you offer services in an on-demand scenario (full service network). You really struggle with this one. You know you can't forecast a full service network's revenue stream with a degree of accuracy that gives you a reasonable IRR on the 750 MHz upgrade, yet you are convinced the 550 MHz upgrade will quickly (<3 years) run out of channels.

It is Friday and you tell Bob you need the weekend to think this one over. On Saturday morning you read in the business section of the paper that Pactel will spend $15 billion over the next several years to replace its network with a 750 MHz/500 HP/node fiber/coax network. All of a sudden your decision seems clear.

Conclusion

On Monday morning you call Bob into your office. You tell him to place an order for 30,000 digital decompression set-tops (30% of your subscriber base) and start the process to upgrade the network to 750 MHz. You realize that operating income will be negatively affected as you deploy the capital and incur the depreciation, and cash flow will be affected as you pay down the debt on the borrowed money, but you are confident you made the right decisions. Once again you are excited about the future. **CT**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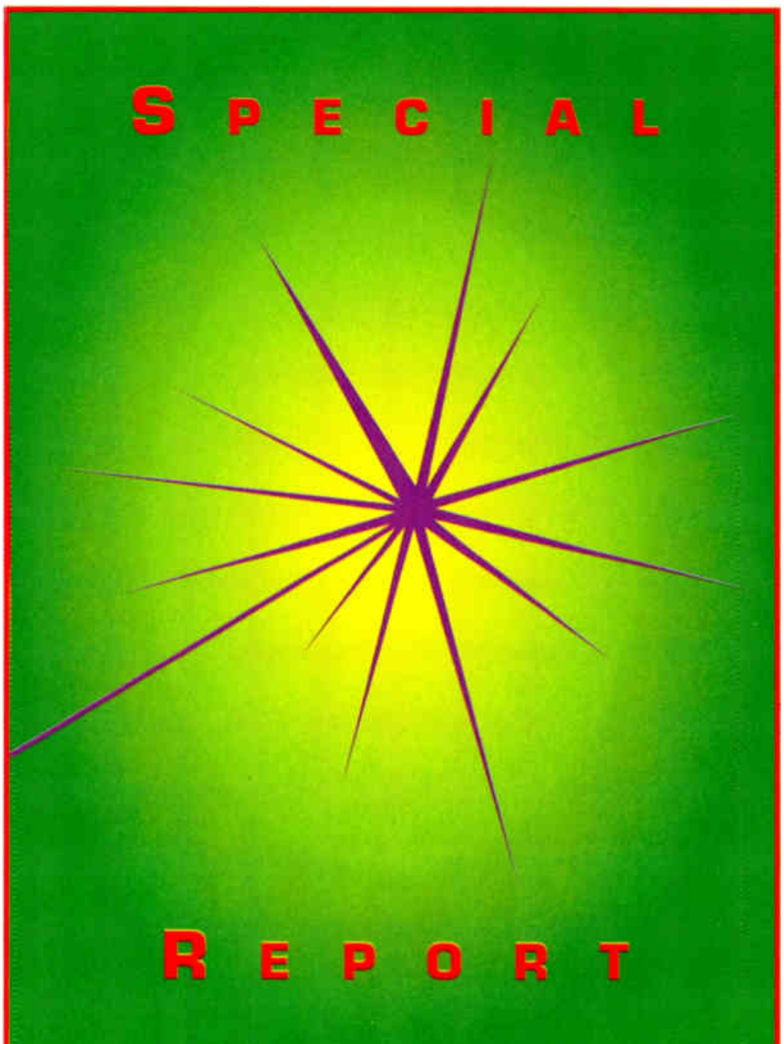
Remote fiber testing

This is the fourth in a series of special reports by CT's West Coast correspondent on the deployment of fiber optics.

By George Lawton



The concept of network monitoring for communications has been around for quite some time, particularly in the telephone industry. Eventually that idea made it to the cable industry as status monitoring, when long cascades of amplifiers were common. As the communications industry moves to fiber, a new class of network monitoring tools are emerging.

Remote fiber-optic test systems are installed in cable headends, or telephone central offices, and enable engineers to instantaneously monitor the status of any fiber leaving that office. All of the systems on the market today can act as sophisticated optical time domain reflectometers (OTDRs), instantly notifying a manager as soon as a line is cut and the exact location of the cut. They can reduce the number of people required to test and install new fiber. They can keep a history on all of the fiber in your network over time, and tell you when a connector or splice is beginning to go bad, before it happens.

The basic components of a remote fiber test system include a test unit, a host and a field terminal. The test unit is capable of scanning multiple fibers with a single OTDR, through a switch. The host collects and stores data from all of the test units installed by a company. A field terminal enables a technician, or anyone in the company, to get up-to-date information on all the fibers in the field.

The whole concept of remote fiber testing was proposed three years ago by Maryam Aghamirzadeh, a researcher at Photon Kinetics. Photon Kinetics took the lead in developing FiberCheck 5000 based on Aghamirzadeh's idea, and brought the first complete system to the market.

Since then several others have introduced remote fiber test products, and many more are planned. Laser Precision has introduced ROTS 1000. Teradyne has 4Sight System 2000 and ADC is planning on releasing its own remote fiber test system, sometime in the near future.

Why bother?

As the cable industry moves into new services, like telephony and competitive access services, it is discovering that service cuts can cost. Particularly in industries like banking, in which a few hours of down time can cost the banks millions. As Gene White, president of Photon Kinetics, explained, "In a lot of places where a company is hooked up to a network, it has guarantees in the contract with penalties for outages. There are some cases where losses are over $100,000 per minute, and as the data rates go higher, the numbers get bigger."

By centralizing the testing function, and enabling technicians to access the test data remotely, then those techs don't have to travel as far to find a problem. Aghamirzadeh points out, "Chances are, the technician with OTDR expertise is half way across the state. When a break occurs, they have to travel several miles to get to the end of the cable so they can use an OTDR, and then travel to the access point to check the fiber. Right there, you have spent an hour on travel time alone."

Take the case of Southwestern Bell in St. Louis, MO. George Ballard, district manager of installation and repair, said, "We have an objective in St. Louis of restoring service within two hours of a downed fiber."

For the most part, the FiberCheck 5000, from Photon Kinetics enables him to surpass his goal. When a major cable was washed away by the floods last summer, the test system enabled them to find the break quickly. Ballard maintains it would have taken considerably longer to find the break without the test system, because the location of the break seemed so durable. "Because of our high degree of belief in the abilities of the FiberCheck 5000, we were able to find the fault quickly."

Aghamirzadeh argues that cost savings can come not only from reduced outages, but also from maintaining the system with a smaller number of tech-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nicians. "I am sure you have heard how much per hour a cable tech is worth. If he is just driving around for an hour and a half before he can start fixing, that is money they are wasting. It is the same scenario with a lot of our international customers. It comes down to a lot of their engineers out in the field who are not productive. This will allow them to have a smaller number of trained technicians support a larger network.

Many see remote fiber testing as one component in a whole system designed to manage a communications network. By integrating it with maps and other types of test equipment in the field, companies can reduce the amount of time required to deploy, manage and provide service on a fiber-optic network.

Laser Precision has a complete set of maps to the United States. Its system enables technicians to correlate a physical landmark to a distance down the fiber. Using a global positioning system (GPS) receiver, a technician can press a button and get his latitude and longitude. He then enters these into the remote fiber testing system. When a problem emerges, the computer determines how far it is from two fiber events, like connectors. It determines what physical location corresponds to the connectors, and based on this, determines the physical location of the problem.

Complete testing systems may find applications in other areas besides just testing, such as enabling competitive access providers to provide quotes for new installations in real time. Laser Precision had one customer who was trying to find a way to beat the telephone company's time to market with a quote for a new connection, by an order of several days.

While it used to take a month to install a new T-1 line for a customer, that time has dropped. By integrating a remote fiber test system to a map, a customer support person could find the closest splicing cabinet to a potential customer. Based on that data, they could determine the cost to install a new link to that customers premises, while they are talking on the telephone.

Differentiators between systems

Photon Kinetics definitely has the lead in developing and bringing remote testing systems to market. Most of the test systems now deployed in the field came from them. In order to penetrate the market, other vendors have been trying to develop systems that can differentiate themselves by providing even greater integration with companies' operations.

"As the cable industry moves into new services, like telephony and competitive access services, it is discovering that service cuts can cost."

Both Teradyne and ADC are basing their product on UNIX, a multitasking operating system. This enables the company to build a single data base for all of the fiber in the network, which multiple users can log into simultaneously. The problem with PC-based systems is that only one user can log into them at a time.

UNIX is often at the heart of many corporate information systems because of its ability to reliably handle large volumes of information. Even if the network spans several states, all of the data can be kept in one place for easy access by all who need it. Jeffery Korkowski, ADC's product manager for remote fiber testing, said that the only limitation on the number of optical test heads in a network, is based on how you leverage the system controller.

These UNIX systems enable a company to store all of the OTDR traces in a central place, for future analysis. It would even be possible to correlate fiber maintenance performance with a particular technician. You also could integrate this system with a trouble ticket system. As soon as a problem emerges, a trouble ticket could automatically be issued, and a tech assigned to it.

Another differentiator lies in compliance to open systems. Bellcore has defined a set of technical specification for communications networks called TA-TL1. At the moment, only ADC is embracing this quasi-standard. (Can you really call it a standard if only one vendor adheres to it?) TA-TL1 describes the communications protocol that test equipment can use to share information between each other.

When the market matures and multiple vendors support this standard, you will be able to mix and match components from vendors in order to build the lowest cost, highest functionality test system. By adhering to the standards, ADC is betting that you will not be able to find better components than what they have when you decide to expand your network. Korkowski points out, "This is important, because if someone comes out with a better optical test access unit, they can use it instead of ours. One reason we created these open interfaces, is that if you are willing to give the customer something better, then you are willing to take a risk."

The optical test access unit (OTAU) is the switch used to connect the OTDR unit to multiple fibers, and is the single most expensive component in the network, as much as 80-90% of the cost of the system, according to Korkowski.

Today all of the remote fiber test vendors are using OTAUs from either DiCon or JDS Fitel. Korkowski said that ADC is working on a low-cost switch for the OTAU "that will be cost-effective by a large factor."

Korkowski claims ADC's experience with physically managing fiber gives it another edge in making the system easier to work with. ADC now commands 30-45% of the market for fiber distribution frames in the United States. "Bringing in hundreds of fibers to the OTAU can be a real mess if you don't know how to wire it up correctly."

Teradyne decided to integrate a whole suite of testing tools with its remote fiber test system, called 4Sight System 2000. These include a power meter, a stabilized light source as well as a fiber-optic tone generator.

The active laser is used as a source. A power detector is connected to the fiber in a second office through a tap. While it can take an OTDR up to 15 seconds to detect a break, a power meter can detect changes in a fraction of a second. Probably more significantly, the power meter can determine the performance of the laser over time. Lasers tend to lose power before dying completely. By constantly measuring power over time, you can replace the laser before it dies, while keeping it running its entire life time.

This same system also can be used for acceptance testing, a process that requires two people today. The installer in the field can test the fiber by sending a fixed level of power down the line, and the test system can tell him the power level at the headend, thereby eliminating the second technician.

Teradyne also is integrating a stabilized light source into 4Sight. It is used during construction acceptance testing for extremely long links, and also to determine optical return loss. Randy Flinn, 4Sight product manager at Teradyne, said, "In higher bit rate systems, a certain amount of light gets reflected back at the laser. At faster bit rates, if those reflections are too severe, then the bit rate is degraded. As companies go to 2.4 Gb/s, they have to be careful about total reflectance."

In order measure return loss accurately, you need to be able to hold the power level of the laser to within 0.1 dB. Flinn said that a standard laser can vary by up to 1 dB.

"An emerging generation of systems support UNIX and go beyond OTDR testing to speed up different kinds of operation."

The fiber tone generator is used during installation for finding a specific fiber. From the field, a technician commands the test system to put a modulated signal on a specific fiber. He can verify he has the right fiber before he makes corrections to a splice.

One of the most interesting directions being pursued by Teradyne is toward creating a complete physical network test system that monitors fiber, twisted-pair wiring and coax. Teradyne plans to have a demo running by February. Flinn said, "The exciting thing is the way our customers' maintenance operations work — they want a single operator with a single interface to work on the problem. With 4Sight, if part is copper and part fiber, they will be able to work on the whole system simultaneously."

Conclusion

Remote fiber testing systems are a reality today. They can be used for building, testing and managing a fiber-optic network. They can even be linked with maps, enabling salespeople to provide real time quotes for new telecommunications service. An emerging generation of systems support UNIX and go beyond OTDR testing to speed up different kinds of operation.

The trend is that these systems will integrate every aspect of network management from the fiber connecting the headends, to the coax running to customers' homes. But keep in mind, remote fiber testing is not cheap. Most of its proponents are advocating its use for high-capacity links like long distance telephone lines or headend superhub networks. Systems today can cost on the order of $500 per fiber to test. **CT**

Contacts

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January 1994

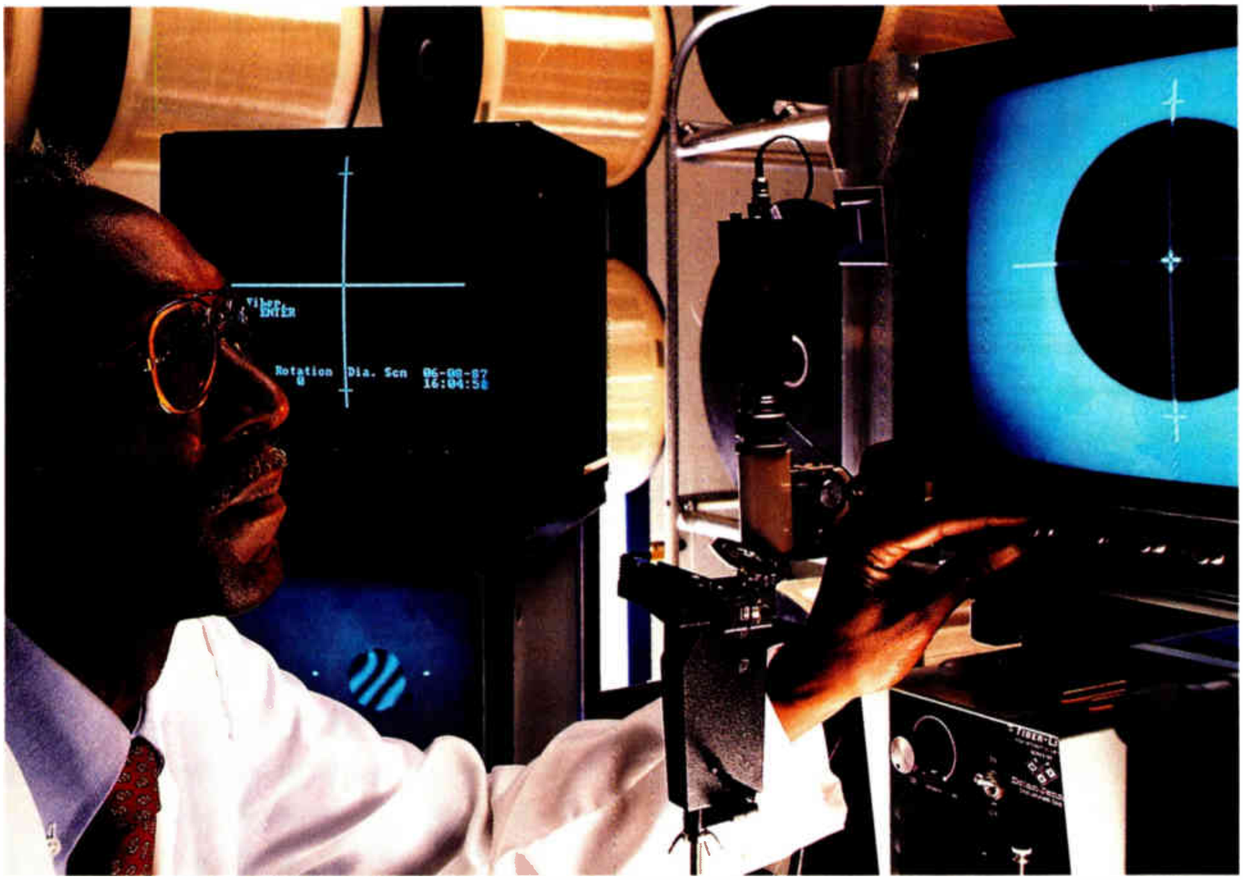
BACK TO BASICS

Spotlight on signal leakage

The training and educational supplement to Communications Technology magazine.

Geri Saye

Table of Contents



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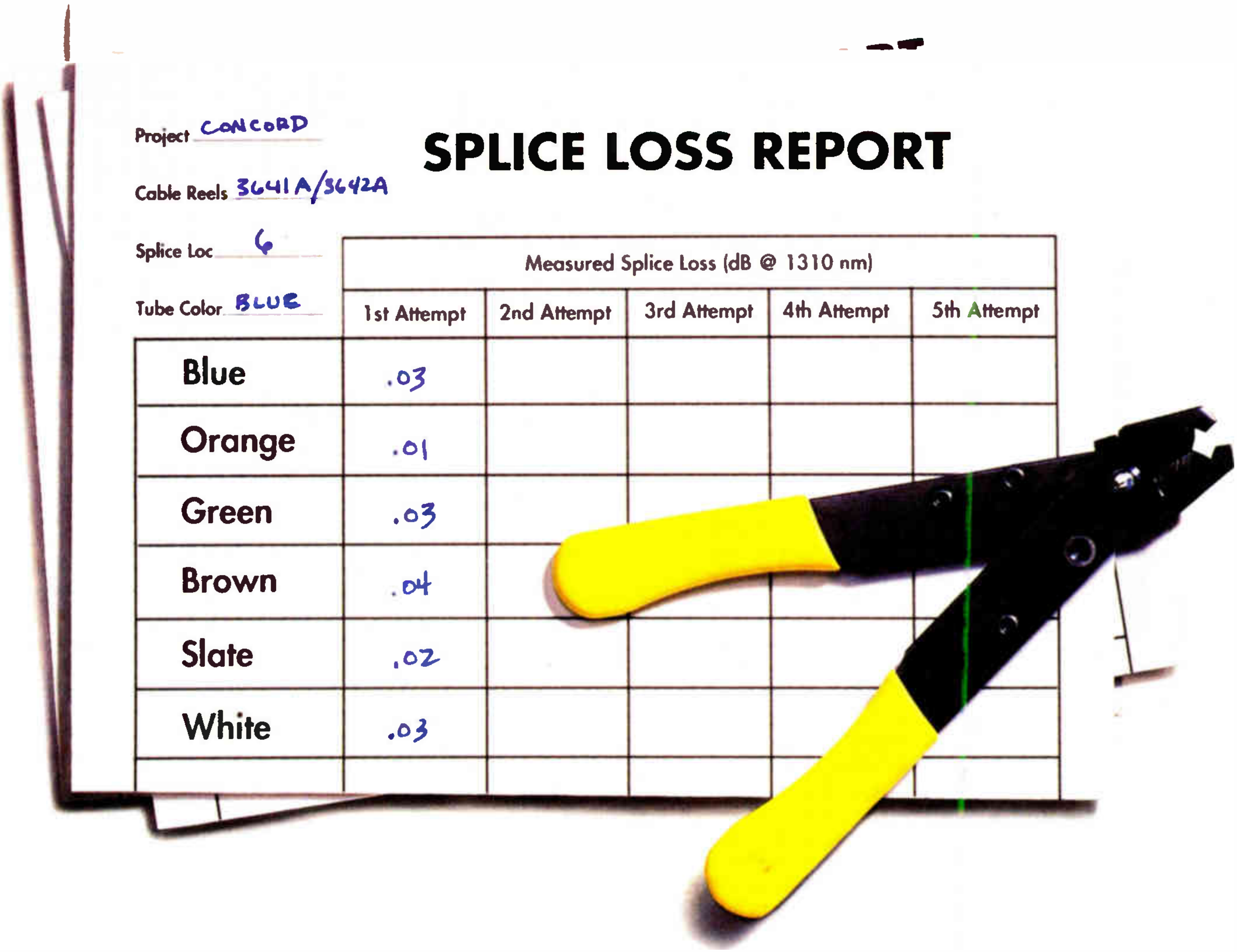

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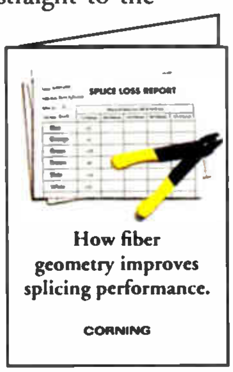
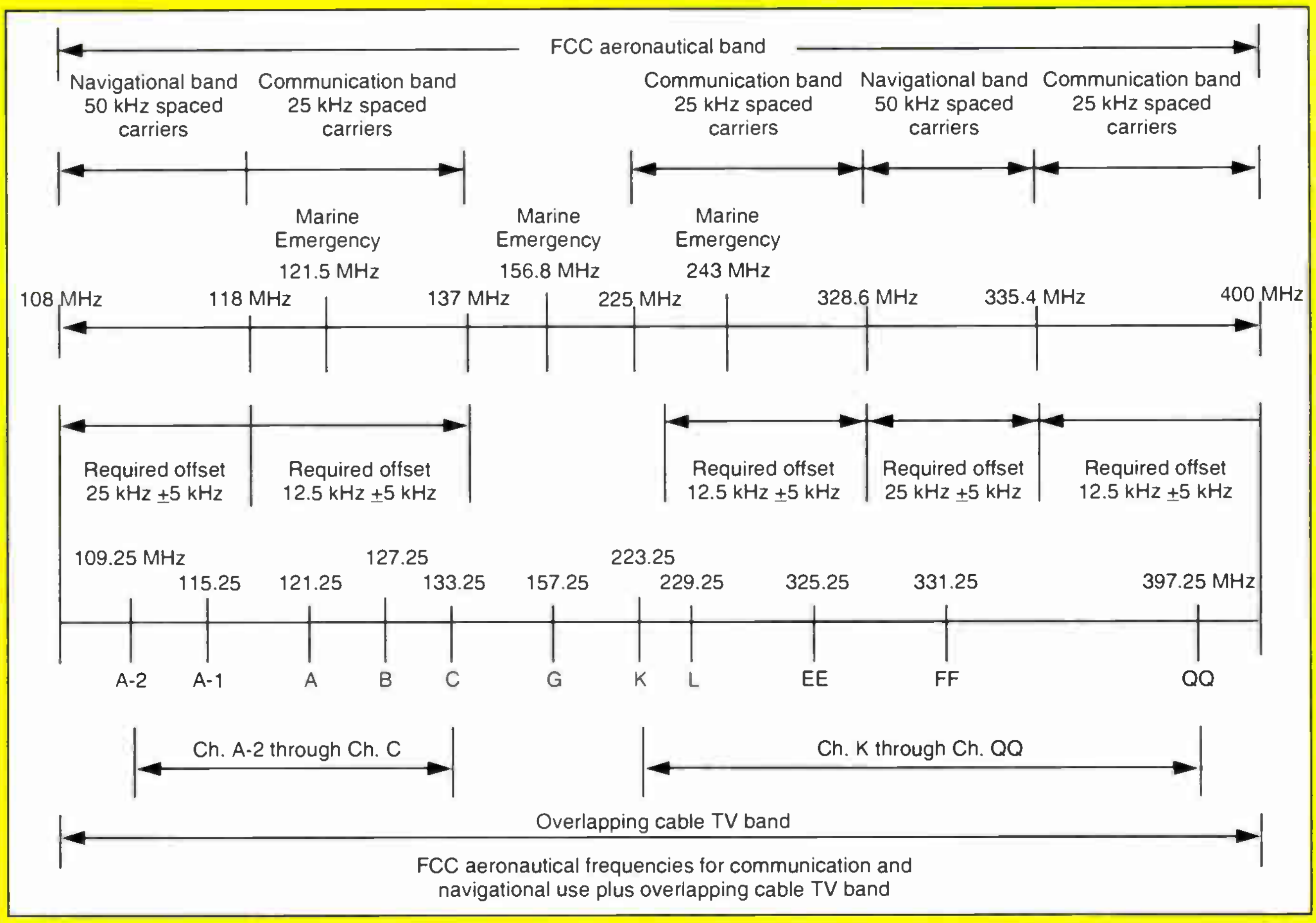


Reader Service Number 92

CORNING

Figure 3: Cable over-the-air frequency band overlap



What causes signal leakage?

There are numerous causes of leakage from the cable plant. The most common is the loss of shielding in the cable, connectors or equipment. Other causes are in the drop system and the customer's TV set. A not too infrequent cause of leakage is a customer's own wiring job using poor cable and connections or illegal connection to the neighbor or adjacent apartment. Apartment wiring also is notorious for leakage problems.

Aluminum cable related causes of leakage (Figure 5) include:

1) Poor fitting installation
2) Loose connectors
3) Corrosion

Figure 4: Ingress potential for cable drops

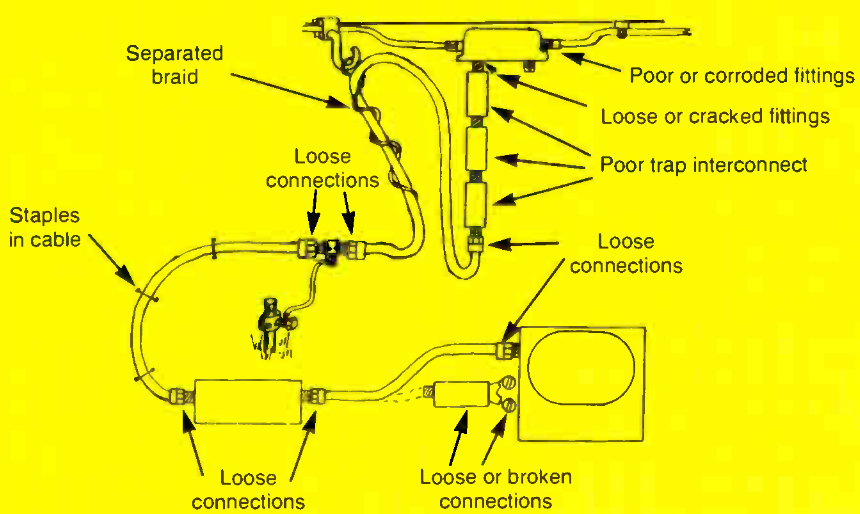
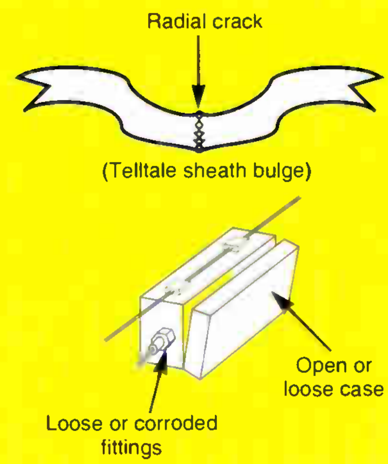


Figure 5: Typical line problems



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Structuring The Creative Team
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Licensing Agreements
Designing Interactive Broadcasting

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Hollywood - 2001
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\> 3DO, SGI, GI, Scientific Atlanta, Laptops, MMCD
Making Money:
\> Title Developer, In-house Training, Educational Titles
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"If the leakage is severe enough, we can in fact blank out radio receivers, interfere with aircraft navigation systems and even interfere with over-the-air TV reception."

4) Radial cracks (aluminum)
5) Case integrity (loose or open housing covers)

Drop causes of leakage (Figure 6 on page 72) include:
1) Braid separation (drop cable)
2) Poor connector installation
3) Loose connections
4) Staples in cable
5) Poor interior wiring

Customer causes of leakage (Figure 7 on page 74) include:
1) Poor tuner shielding (cable-compatible TV sets/VCRs)
2) FM tuner connection
3) Do-it-yourself wiring
4) Illegal connections

How do you find and fix it?

Finding leakage is either accomplished by looking for it or by having a maintenance problem such as interference to another radio service or ingress that interferes with the cable. (Remember, what gets out, gets in!). In either case, instruments are usually used to identify the leaking component, then corrective action can be taken. If a connector is loose, it can be tightened. If corroded, it can be cleaned and tightened (or replaced). A radial crack can be recut or spliced, and staples can be removed from the line. A TV tuner that is radiating is a more difficult problem because we cannot work on the tuner. However, the simplest solution is to install a converter (at least leakage will be only at one channel) and any over-the-air TV direct pickup will be eliminated.

Looking for leakage is done with instruments that can be as simple as a portable FM radio or as complex as some of the precise leakage measuring equipment. Taking the simple way first, it is possible to determine if leakage is present (but not the amount of leakage) by using a portable FM radio

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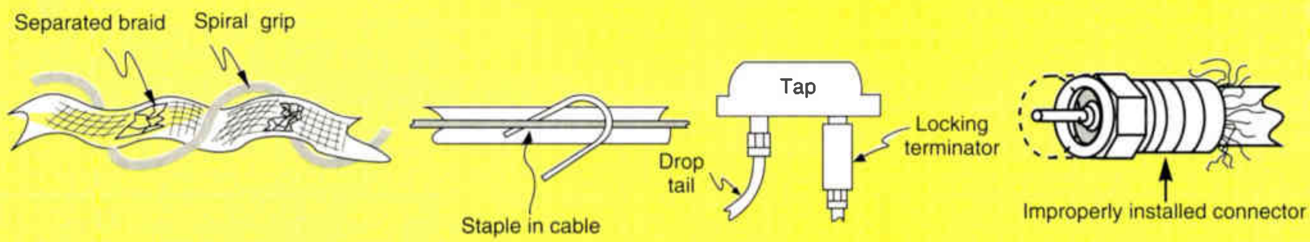
Figure 6: Typical drop problems

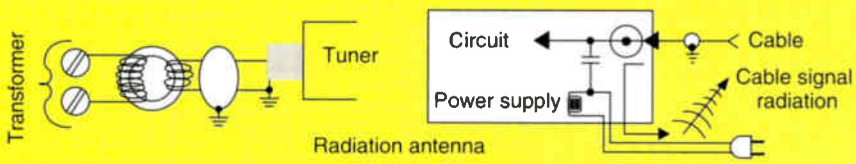


to listen for cable-only FM signals, or for a special test carrier in the FM band. The radio is held close to the cable and passed over it and the connectors. If the carrier is heard, or the intensity changes as the radio passes a connection, staple or splice, leakage is present. This method is effective, although in areas where a lot of strong FM stations are present you might not be able to use it. Some companies such as ComSonics and Wavetek make instruments that are tuned to one or more of the picture carriers and work the same way.

The more precise instruments (available from several manufacturers) not only identify leakage but also measure the level accurately. This is necessary to meet FCC regulations, which are detailed in the next section of this article. These units are for the most part vehicle-mounted and use precision antennas to measure the signal. The readouts are in microvolts per meter (μV/m) or dB above or below a set value (normally 20 μV/m at 10 feet), and must be corrected for distance from the leak.

The installation team can be one of the most important links in leakage control. Because the greatest amount of leakage is found in the drop system, more progress can be made there than anywhere else in the cable plant. Beginning with the tap, all fittings on every tap should be tightened and inspected for poor connections every time the pole is climbed or the pedestal is opened. The line into the home should be checked with a radio or a test device from the pole or pedestal to the ground block, paying special attention to the staples. Connections at the ground block should be clean and tight, the ground should be properly made, all outdoor connections weather-proofed, and all internal fittings should be properly made

Figure 7: Typical TV set problems



and tightened. If your system uses snubber grips to hold the drop at the tap and house, you're just building a problem into the plant. These spiral grips, over a period of months, have a tendency to work the braid of the cable apart and split the foil, causing a leak. Standard installation procedures in this day and age call for use of self-supporting (messengered) drop cable from pole to house.

Another source of leakage (in systems that use them) are the old Vitek type of coaxial traps. The fittings on these can leak severely. Be careful with coaxial traps, particularly if they are connected together. They need to be tight. They also are subject to crack the tap fittings if several are connected together and happen to be bumped.

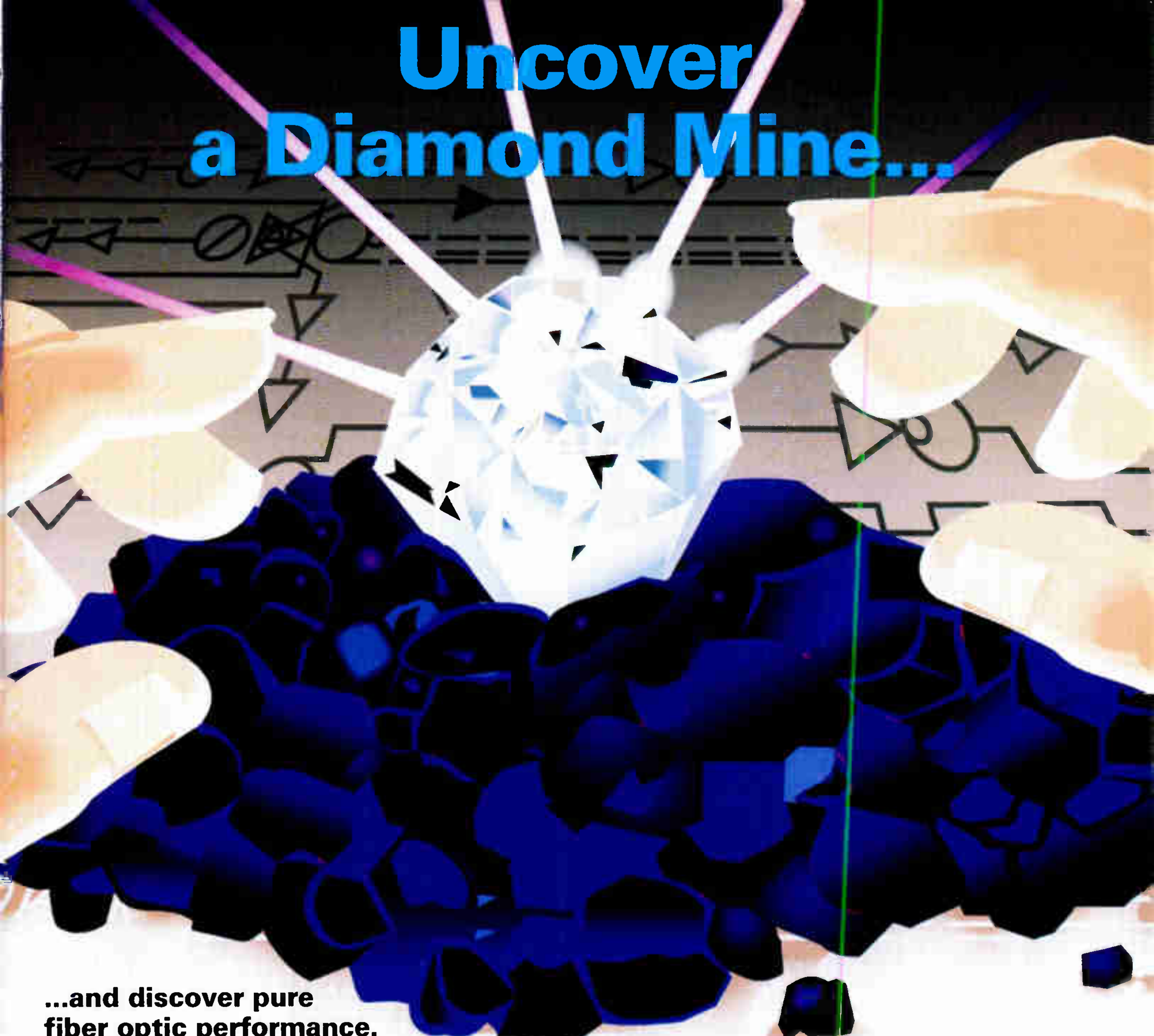
For disconnects, never cut the drop and leave a tail hanging off the tap. This becomes nothing more than an antenna, with resulting potential leakage. The same is true for drops that are left hooked up in an addressable system. Leaving taps unterminated is not a problem for higher values, but don't allow it for 11 dB or less values. Locking terminators can be more of a leakage problem than a protection for the system (use locking terminators that do not have an internal resistor).

When at the tap, check the jacketed aluminum for telltale bulging under the jacket, particularly at the bottom of loops. This is where most radial cracks occur. If bulging is present, cut back the jacket to check. Be particularly suspicious of housing-to-housing fittings between taps. They are frequent culprits in leakage if they become loose, and should be tightened if necessary. Also, an FM radio can be passed across the junction and it will be pretty apparent if the fitting is leaking.

In the customer's house, if the TV or VCR tuner is radiating, the only solution is to use a converter. For the FM tuner, you should never split the signal with a cable splitter. Instead, use an FM splitter and this will give some isolation to the TV signals.

The FCC and signal leakage

In all cable systems, the FCC requires a signal leakage control pro-



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gram to be in effect. This is comprised of two parts:

1) Routine monitoring
2) CLI (cumulative leakage index)

Routine monitoring includes:

• The system must have "a program of regular monitoring for signal leakage by substantially covering the plant every three months."
• All leaks over 20 µV/m at 10 feet from the cable must be logged and repaired "within a reasonable period of time." (Large leaks should be fixed immediately.)

CLI requirements include:

• Once per year at least 75% of the system must be monitored and all leaks over 50 µV/m logged.
• A calculation using the logged leak levels is performed and a figure of merit number arrived at. This number must be below the allowable standard.
• If the standard is exceeded, the leaks must be fixed until the system passes.
• The proper Form 320 must be completed and sent to the FCC.

As can be seen, the CLI part of the program is a proof on the routine monitoring that should be in progress all year. Leakage generally is present all the time in low background levels and no system will be completely quiet when monitored. As said before, there is a threshold of allowable leakage based on the FCC requirements for maximum leakage levels, which is 20 µV/m at 10 feet.

Exceeding this level, particularly in excessive numbers such as 500 or 1,000 µV/m at 10 feet, can result in substantial FCC fines or even an order to vacate certain channels. Particularly sensitive and subject to special rules are those channels that overlay frequencies in the aeronautical communications and navigational bands.

Even if the system is not leaking excessively, fines can and will be imposed if the proper logs aren't being kept and if a leakage program doesn't exist or isn't being followed. The installation team can help in a very significant way to ensure the system is kept "leak-free" and in compliance, by simply following a few basic rules and procedures. After all, someday it may be you who is the tech responsible for leakage control. **BTB**

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Reader Service Number 68

Wavetracking the leakage basics

By Ken Eckenroth
Vice President Engineering
Cable Leakage Technologies

After five years in the signal leakage business, something has become very obvious: the need for a routine. This is especially true now during this explosion of new converging technology. However, routine must be tempered or open ended to respond to the influx of new ideas into this pot of accumulated knowledge. The purpose of this article is to define a routine placing emphasis on default values. I also will discuss some of the advanced logic that can be used to optimize performance.

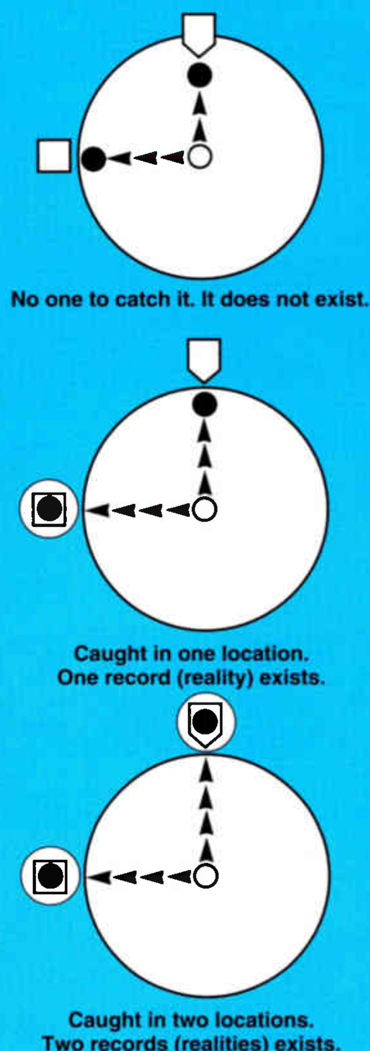
Coherent spectral analysis

Before we go any further, let's take a look at the concept of signal leakage. The process in its raw form is in a state of incoherence. (See Figure 1.) Picture for a moment two baseballs being pitched simultaneously toward home plate and first base. It's not until the ball is caught at one of these places that it becomes reality. This creates a record of the interaction. Without a record, it's the same thing as closing your eyes and pretending it's not there. If the ball is caught at both places, a second record is created, reinforcing the first record. The major variable here is the time between the two measurements. The less time, the better mathematical description with lower various possibilities.

A shotgun or random approach to leakage is similar to balancing every other amplifier. The odds will sooner or later catch up to you. Remember, "Big Daddy" (150 µV/m and higher) is lurking. A street-by-street methodical ride-out is the very foundation of coherent spectral analysis (CSA). The goal of CSA is to minimize all variables. CSA is possible through math and computer logic. Math and computer logic may be dry and boring, but what it can do is anything but. More discussion of CSA will follow in another article. For now we will concentrate on the CSA aspects of the following:

1) Blind spots (contouring)
2) Standing waves (with longer search times)
3) Time between measurements
4) Atmospheric conditions
5) Proximity thresholds
6) Spike values (duration or dwell time)

Figure 1: Leakage detection's state of incoherence



List of variables to minimize
1) Time between measurements
2) Environmental differences
3) Blind spots (contouring)
4) Standing waves (with longer search times)
5) Proximity thresholds
6) Spike values (duration or dwell time)

Routine

With the previous ideas in mind, let's take a look at the life of a fictional technician. His name is Stevie Vaughn and he works for R&B Cablevision in Dallas. Stevie has become a legend at R&B even though in the beginning he was overshadowed by his brother Jimmy. Hard work, perseverance and eagerness to learn were his trademarks making up for less seniority in the company.

Stevie remembers when he wanted to learn how to sweep. Jimmy wouldn't teach him. Stevie picked up a manual and taught himself. Somehow, it just wasn't as hard as Jimmy made it sound.

Stevie remembers the day he first read Cable Leakage Technologies' Wavetracker manual. He had just torn some ligaments in his knee. He couldn't climb, but he could drive a vehicle. Full pay is a lot better than reduced Workman's Comp pay. Plus R&B Cablevision likes having all their workforce available. So Stevie took the manual home. It wasn't so bad giving up one night of guitar practice to read this manual. The next day Stevie was ready to establish a routine knowing the next quarter he would have a routine.

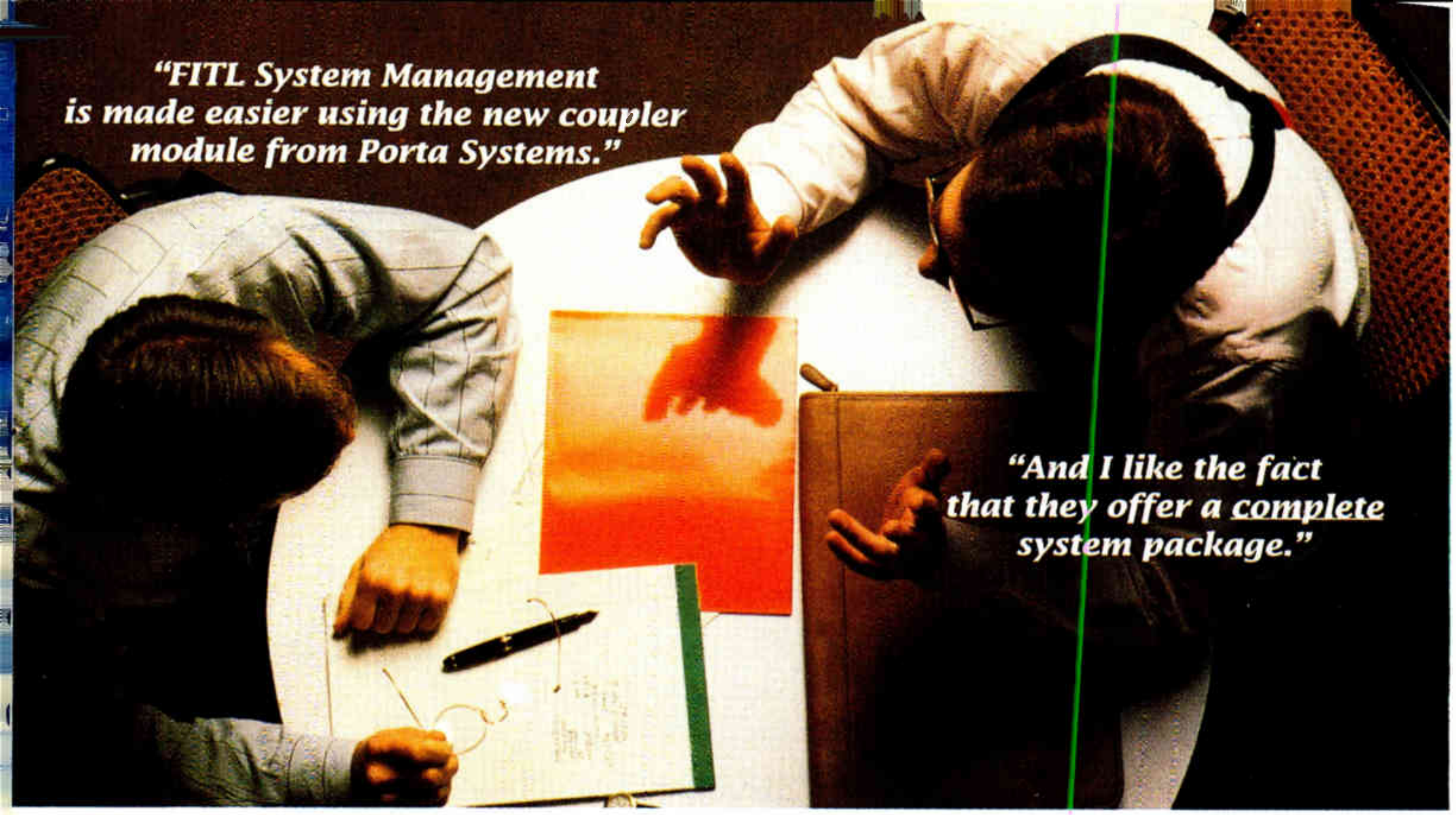
First he looked at the "tracker.cfg" file. The UTC time correction was set at 6, which is correct for daylight savings time in Dallas (Central Time zone). The default values for the distance keys (20, 40, 80 and 160 feet) work well for R&B Cablevision's plant because it's a mixture of backyard easement and streetside cable. The threshold and spike values work pretty good too.

However, he makes these values higher and places them on a separate disk. He saves this disk for when he rides-out that neighborhood that has 20-year-old cable and leaks like a sieve.

Stevie also likes the idea of rotating frequencies (midband to superband) during alternate quarters. Everything looks good on the tracker.cfg file. The next thing to do is start the Deltawave GPS base station recording differential corrections. Stevie enjoys the increased 10 to 25 meter accuracy. That puts the line tech on the right street when he fixes the leak. Losing time on that is no different than losing time on tracking down a standing wave to its source.

In the field

Stevie checks his vehicle for low air pressure, worn fan belts and good Wavetracker connections much like a pilot would do his careful preflight check. (See Figure 2 on page 82) Stevie powers on the Wavetracker to begin



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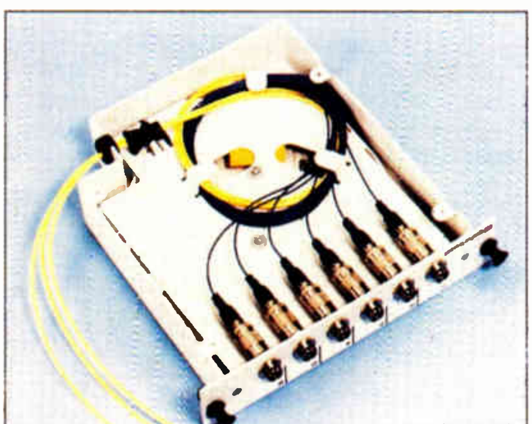
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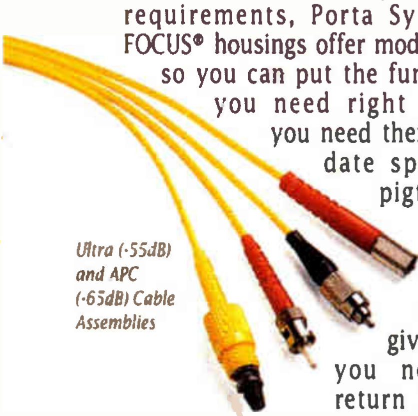
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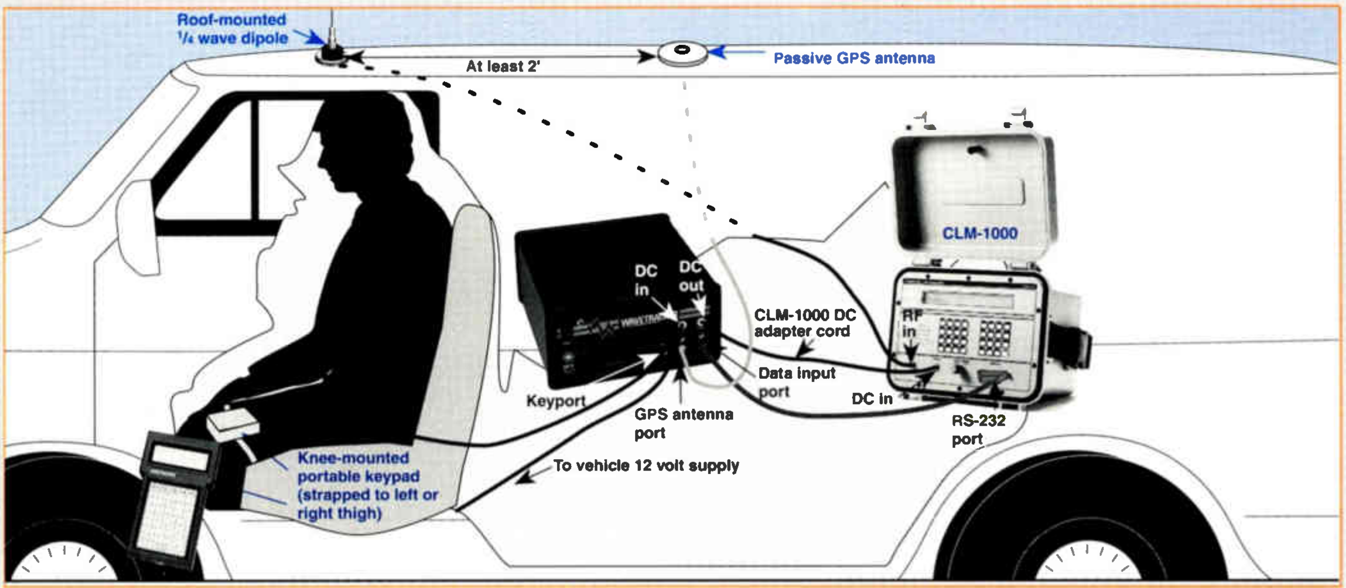
Figure 2: Connecting the Wavetracker CLM-1000



Courtesy National Cable Television Institute © NCTI Inc.

the GPS lock-in period. The two- to four-minute lock in (cold start) became part of the drive to the neighborhood to ride-out. Stevie has learned that once a GPS locks in on a given day, the GPS has a full almanac of that days constellation and locking-in after lunch takes 30 seconds or less.

On the way to the neighborhood, Stevie stops at an area he knows is RF quiet. He sets the distance on the Wavetracker to 10 feet. Ambient noise should be 3 μV/m or less. Anything above this indicates a noisy RF problem somewhere from the vehicle and should be corrected before the ride-out begins.

After finishing the morning ride-out session, Stevie stops for lunch. He eats outside enjoying the nice weather. He remembers when the company made the decision not to do ride-outs in the rain. Several factors were weighed in this decision:

1) Safer and faster driving conditions.

2) The 90-day quarter allowed the time.

3) Removing the rain factor in the RF measurement.

Stevie can remember fixing an outage in the rain because he had to. He never saw a need to measure a leak in the rain. Doing the drive-out in dry weather made the atmospheric conditions of the ride-out more closely resemble the conditions of the measurement. Stevie thinks about how rain definitely affects the measurement. (It seems to dampen or quiet the leak.) But because of its refractive nature, it's unpredictable. It is very similar to the in-phase/out-of-phase, additive/subtractive qualities of multi-

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Figure 3: Tabular list of leaks

AREA CODE:	mm3	DATE REPAIRED:
LEAK IN uV/m:	140>	MEASURED LEAK:
ADDRESS: 4409 SARAZEN DR		EXACT LOCATION:
		CAUSE:
DATE:	09/02/93	ACTION TAKEN:

AREA CODE:	mm3	DATE REPAIRED:
LEAK IN uV/m:	329>	MEASURED LEAK:
ADDRESS: 2800 ROSEWOOD DR		EXACT LOCATION:
		CAUSE:
DATE:	09/02/93	ACTION TAKEN:

AREA CODE:	mm3	DATE REPAIRED:
LEAK IN uV/m:	77>	MEASURED LEAK:
ADDRESS: 4511 ASTOR RD		EXACT LOCATION:
		CAUSE:
DATE:	09/02/93	ACTION TAKEN:

AREA CODE:	mm3	DATE REPAIRED:
LEAK IN uV/m:	98>	MEASURED LEAK:
ADDRESS: 4216 OLEANDER TRL		EXACT LOCATION:
		CAUSE:
DATE:	09/02/93	ACTION TAKEN:

path. Some are a little higher, some a little lower. Even though they might average out, it's always a good idea to minimize the variables if possible.

Stevie starts his afternoon ride-out session. He navigates the three-lane primary streets with ease hitting the 20 feet distance key for the first lane next to the streetside cable. He switches to 40 feet as he moves to the third lane. Stevie hits the "L" flag key to mark some broken lashing wire possibly preventing an outage waiting to happen.

Stevie pulls into an older neighborhood with some chewed up alleys that have produced many a flat tire. Stevie likes the company policy of only riding these alleys once out of the four quarters in a year. The 160 feet distance key effectively finds all the high level leaks and most of the low level leaks. Stevie gets a kick out of finding the low-level leaks at a great distance. He remembers when he used to use a TV set to track low-level ingress problems.

Post ride-out

As the ride-out nears completion, it's almost anticlimatic, so Stevie decides to use the flag keys to spell out a subliminal message for his boss. He finds a street heading east and spells "company truck." At the end of the neighborhood ride out Stevie presses "E" to end the Wavetracker program.

Stevie arrives at the shop. This makes him think again about getting full pay because the usual data entry person is letting him process the data because of his injury. Stevie stops the Deltawave record process and inserts his ride-out disk. He converts (corrects) his data. He then exits the Deltawave program and enters the "Mapinfo" program. Stevie chooses the "RFLEVELS" file from the start-up file menu, knowing that this creates a digital blank page. He then chooses "Cableleak" from the applications menu, which initiates the Wavetracker software. Stevie whizzes through the menus happy that the DOS commands are batched and condensed into descriptive menus. Stevie chooses "import" and lets the PC color-code and frame that day's ride-out.

Then he chooses "mapfiles" and adds the street layer by selecting the "TXDALLAS" county map. Stevie immediately spots the new subdivision that construction was finished on last month. He chooses "mapfiles," then "edit" and adds those six streets along with their names and address ranges. He also spots four streets that are geographically incorrect. The GPS corrected data provides him with a fixed repeatable constant that gives Stevie a template so he can confidently and permanently correct his data. Stevie laughs because he knows five minutes a day editing is gradually creating a position correct map that is rare and costly on the open market. Plus he can customize it in a way only he could because he lives and works there everyday.

Stevie then starts the "Leak Center" to pick the center of each cluster of leaks. Experience at this shows him that Big Daddy leaks (large red squares) splash out on neighboring streets. He also sees two low-level leaks (small yellow squares) out by themselves separated by quiet areas (small green squares) and knows to treat (Leak Center) these as separate leaks.

After tagging each cluster, Stevie hits escape and lets the PC take over. The results are refreshed on the screen. Stevie chooses output and prints three work orders. One work order is a list of the flags and their addresses that go to the construction department to get that cable relashed. The next two are for Jimmy the line tech. One is a tabular list of the leaks with amplitude, distance symbol and address. (See Figure 3.) The second is a map output to staple to the first

Figure 4: Locating the leak

Figure 5: CLI printed report

```
TOTAL PLANT MILES:         8.0000
TOTAL MILES DRIVEN:        7.5607
I3000 = -8.3582       ** SYSTEM PASSED **


                                                                DIST TO CENT
 READING  AREA     ADDRESS                                        in miles
 -------  ----     -------                                      ------------
     69<  mm1   2717 OATES DR                                        0.184
    192>  mm2   2428 LETA WY                                         0.174
     95>  mm2   LBJ W                                                0.464
    329>  mm3   2800 ROSEWOOD DR                                     0.329
    140>  mm3   4409 SARAZEN DR                                      0.202
     98>  mm3   4216 OLEANDER TRL                                    0.381
     77>  mm3   4511 ASTOR RD                                        0.297
    305>  mm4   4355 CHESTNUT DR                                     0.286
    252>  mm4   4293 ASHWOOD DR                                      0.176
```

work order and assist in cross-reference for locating the leak. (See Figure 4.) Stevie thinks "Boy, Jimmy is lucky to have a brother like me printing both these maps for him."

Stevie remembers talking to a tech from a different system at a Society of Cable Television Engineers meeting. The tech said because he worked for a larger system with several line techs, the system used the "Assign Area" to give each leak an area code or map page number. When the work orders are printed, they are presorted to give to the various line techs in their assigned areas. This tech also told Stevie how the system exports its leak data to the cumulative leakage index (CLI) program "LES." Stevie acknowledged the tech's way of working his options but was happy with his stand-alone Wavetracker software.

Archiving

Stevie knows that as soon as he's finished with the raw data, he can dispose of it. He initiates the "Rename Files" command and chooses to rename only the two files that matter to him. He renames "RFLEVELS" to "3QTR93." Everyday he can add to this growing list of processed data. He also renames the "SCRATCH" file, which represents the drive path he acquired that day, and appends it to a highlight file he names "ZZ3QTR93." This is his permanent record of what has been done that quarter and can be copied to floppy disk for permanent storage. He now can dispose of that day's ride-out by choosing the "Reset Data" command.

CLI

Once a year, the CLI certification must be performed. Stevie has this down pat. He renames the two files back to their original names. "3QTR93" is renamed "RFLEVELS" and "ZZ3QTR93" is renamed "SCRATCH." Stevie then performs the "Distance" command to obtain the accumulated total miles of each day's ride-out. Then with the returned work orders from the line tech, he has the corrected measured data to achieve his CLI numbers per the letter of the law.

He enters the "Post Ops" menu that gives him the following three options:

1)"Post Edit," which allows him to correct the amplitude of any of the leaks.

2)"Post Add," which allows him to add a leak if there were more out there.

3)"Post Delete," which allows him to get rid of standing wave byproducts that were produced by one leak.

Once this is done, Stevie enters the "I3000" menu and sees the total miles that were driven. On the next screen, he enters his systems total strand miles of plant. He then chooses the geographic center of the city and the software calculates the CLI and asks Stevie if he wants to print a report. (See Figure 5.) Since Stevie figures the FCC probably wouldn't take his word for it, he enters yes and prints supporting documentation to attach to his Form 320.

Stevie looks at the clock and sees it's 4:45 p.m. There's time enough to print a map showing directions to his home. He wants to give it to the new dispatcher so she can come over and hear the new guitar licks he's been working on.

I think we can all see that Stevie Vaughn was someone that vowed he wouldn't be swallowed by the cracks. God bless Stevie and the work ethic he represented. He inspires a lot of us to take it to the next level. **BTB**

During the Annual Membership Meeting held at Cable-Tec Expo '92 in San Antonio, the national board and staff learned the importance of the development of new training programs to the membership. As a result, SCTE enlisted the services of William Grant, author of the widely recognized textbook, "Cable Television," to conduct a series of seminars to be professionally produced as video programs and made available on videotape to the members. These programs follow the textbook, and build upon it. Together with the textbook, the videotapes provide a comprehensive treatment of the basics of CATV design and operation. The tapes are available by mail order through the SCTE. The price listed is for SCTE members only. Nonmembers must add 20% when ordering.

☛ *Modified System Designs, Two-Way System Designs* — Chapters 16, 17 and 19 are covered in this seminar. Topics include supertrunk, institutional cable, plant extension and LAN systems. Also discussed is two-way technology, including noise contribution, performance calculations and noise reduction techniques. Like most of the tapes in this series, T-1129 is applicable to Category IV; however, it also applies to Category III because it covers supertrunk and single/multichannel/low power/high power microwave systems. Fiber optics is briefly discussed also. (80 min.) Order #T-1129, $45. **B-III, B-IV**

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Listings of other publications and videotapes available from the SCTE are included in the March and October 1993 issues of the Society newsletter, "Interval."

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E. What is your annual cable equipment expenditures?
51. ___ up to $50,000
52. ___ $50,001 to $100,000
53. ___ $100,001 to $250,000
54. ___ over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?
55. ___ Fiber-Optic Amplifiers
56. ___ Fiber-Optic Connectors
57. ___ Fiber-Optic Couplers/Splitters
58. ___ Fiber-Optic Splicers
59. ___ Fiber-Optic Transmitter/Receiver
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angles a cleaved fiber between 0° and 10° in reference to an optical flat. This allows the maximum fringe definition to occur when the fiber end face and reference flat are in close contact with one another, and may provide greater detail of surface topography than any other interferometric system.

The motorized tilt operates by activating a push rod on the stage that increases or decreases the angle of the tilt on the fiber. A tilt controller switch controls the direction, and a digital readout measures the cleave angle to 1/100th of a degree. An "express" feature allows the fiber mount to be raised or lowered in single steps or in larger increments.

Contained in the system are a 4 x 5.2 x 1.65-inch fiber interferometer, 9-inch video monitor, solid-state CCTV camera, stepper motor and control panel. All the cables and adapters needed for connection are included.

Reader service #201

OTDR plug-ins

Tektronix Inc. announced plug-in acquisition modules for its FiberMaster optical time domain reflectometer (OTDR). The FL Series long range plug-ins allow telecommunications carriers and suppliers to test extended fiber cable lengths with greater accuracy and more sophisticated analysis, according to the company.

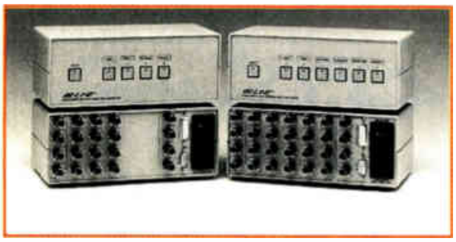
The units are designed for 1,310 and 1,550 nm single-mode operation and provide greater dynamic range (greater than 37.5 dB at 1,310 nm and greater than 37 dB at 1,550 nm) for testing long fiber links. This dynamic range can be increased with extended averaging. In addition, the new modules offer reduced noise, improved linearity and increased resolution.

Three configurations are available: the FL1300, which tests 1,310 nm fiber; the FL1500 for 1,550 nm fiber; and the FL1315 for testing both 1,310 and 1,550 nm in a single module.
Reader service #199

Downconverter

Conifer Corp. announced the T-3409 integrated downconverter, which is built into the antenna feed assembly and features 30 dB gain, a 1.5 dB noise figure and 31-channel capacity. Interchangeable with the company's 12, 18 or 24 antenna, the integrated unit provides system gain of 42, 48 and 54 dB respectively with each antenna.

According to the company, the design yields excellent performance and reliability through reduction in the number of components and the elimination of mechanical connections.
Reader service #208



Switcher/ distribution amp

Inline Inc. introduced the IN3710/20 high resolution RGBS switcher/distribution amplifier. The unit comes in five-port and seven-port versions. One button turns the unit from a switcher into a distribution amplifier. The unit can switch and distribute video signals at the same time.

Used with three source and three display devices, the unit can switch between the video sources while displaying the signal on all three display devices. The company says the same setup normally would require several pieces of equipment. The unit requires only a half-rack wide and 2U high space.
Reader service #200

Fusion splice protection sleeve

The new F1-1002 fusion splice protection sleeve from Fiber Instrument Sales offers compatibility with other leading brand splice sleeves and trays, including Sumitomo. The unit contains an inner tube made from EVA that melts then hardens to prevent moisture penetration of the fusion splice.

The sleeves may be installed using either a standard heat shrink oven or with a heat gun. After installation, sleeve diameters are equivalent to those of Sumitomo fusion splice protection sleeve, and can be used in any splice tray where Sumitomo sleeves are used.

Measuring 2.25 inches in length, each sleeve contains high strength stainless steel to prevent weakening or degradation of the splice when inserted into a splice tray.
Reader service #196

Cable cutter

The new UP-B41 cable cutter from Benner-Nawman Inc. is designed to cut 100-pair communication cable with minimum effort. This compact hand tool is 8 inches long and is made of heat-treated high carbon tool steel with an off-set bite that eliminates compression and frayed cable ends. While the tool is for use on 25, 50 and 100 pair cable, it also can be used on control cable, welding cable or 2/0 aluminum and #2 copper electrical wiring.
Reader service #198

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Board approves Society budget for 1994

By Bill Riker
President, Society of Cable Television Engineers

On Oct. 15, 1993, the national headquarters staff submitted its proposed 1994 budget to members of the Finance Committee. The committee then met by conference call to review the proposal. A final draft of the 1994 budget was presented to the board of directors and was approved at its Nov. 30 meeting during the Western Show.

It is the consensus of the chairman, Planning Committee and the board in general that 1994 should be the year to address improvements in several Society programs that will be crucial to the continued growth of the organization. As a proactive, progressive organization, we cannot be satisfied with maintaining the status quo. Being a service-oriented Society, SCTE will continue its efforts to be on the cutting edge of the newest developments in the industry. Therefore, greater attention will be paid to the areas of publication and videotape development, BCT/E and Installer Certification Programs and chapter development. The following items also have been approved:

- The consensus of the Planning Committee is that annual membership dues remain at the current rate of $40 for next year. There also will be no changes in 1994 for the Emerging Technologies conference, BCT/E exam fees, Technology for Technicians course fees and publication/videotape purchases.
- Several new publications are scheduled for release in 1994. They include an *OSHA/HAZCOM Manual*, an updated *Installer Manual*, a Spanish-language version of the *Installer Manual*, and study guides for several BCT/E categories. Videotapes covering BCT/E Categories I and II also are slated for 1994 production to complement the tapes for Categories IV and VII presently available. In addition, seven videotapes will be produced in 1994 to replace topics covered in T-1001 through T-1020. This means that all 20 of the original SCTE videotapes produced in 1981 will have been replaced by the end of next year.
- Conversion of a portion of the national headquarters basement into office space was included in the 1993 budget and was completed last year. As a result, we will soon be hiring a manager of chapter development to assist Marvin Nelson with this key grass roots program. This addition will allow Marvin to concentrate on upgrading the Society's certification programs while taking on additional administrative duties at national headquarters. This will then free up the president to work on establishing alliances with other organizations and to take a more active role in planning for the future of the Society.
- The PR/marketing firm hired in 1993 has issued a report containing 27 proposals for increasing awareness of SCTE benefits among system managers (and other organizations such as the telcos). The national headquarters staff has selected 11 of these ideas for implementation in 1994. The ideas chosen will focus on influencing individuals who make the decisions as to their company's support of Society activities. We feel this is especially important at this time. With phone and cable companies merging and new technologies evolving at a rapid rate, we believe the Society has an obligation to bring this knowledge to workers who may not otherwise be exposed to the training they will need to do their jobs well and safely.
- In addition to upgrading study materials for the BCT/E Program, we also will be upgrading the procedures in which exams are created, graded and their results processed. This will require the investment in additional computer hardware and software in 1994 to speed up the turnaround time for notifying candidates of their exam results and provide them greater guidance in areas requiring further study.
- The board created five standing committees in 1991 that are now taking an increasingly active role in guiding the Society. Along with SCTE's 22 subcommittees, they are meeting more often and requiring more support in terms of meeting room and A/V equipment rentals, catering, conference call phone charges, document printing and mailing costs. National headquarters plans to assist the work of these groups even more effectively next year by providing additional staff support. This increased activity also will create new income in 1994 for fees charged to distribute technical standards documents developed by our engineering subcommittees.

"In 1994, the Society is committed to taking an aggressive, proactive approach to addressing new programs and services."

The 1994 budget has been formulated and approved to meet the challenges we feel the Society will be facing throughout the next year. These include not only meeting the needs of our present members, but attracting and informing those in the converging telecommunications field who will need the additional training and direction that our organization offers. This year, we are celebrating 25 years of service to the cable industry. In 1994, the Society is committed to taking an aggressive, proactive approach to addressing new programs and services. We are convinced it will be our most productive effort to date. **CT**

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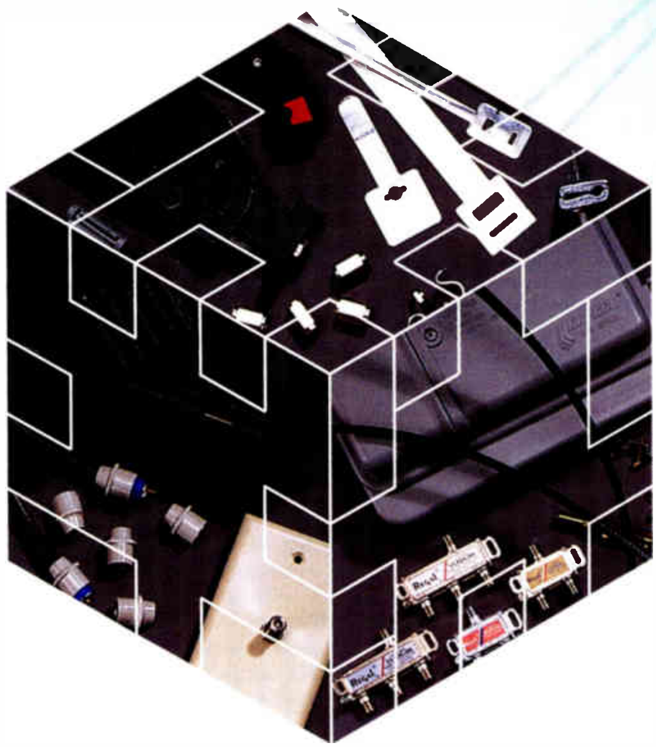

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