COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

Construction considerations:

- Planning fiber routes
- Crisis-easing restorations
- Upgrading system bandwidth
- Microwave antenna prealignment

Battling theft-of-service

CableLabs on outages — Part 4

March 1993

INTRODUCING

The first Signal Level Meter designed to pinpoint RF/video problems and performance test any RF distribution system more accurately than any other Signal Level Meter.

Sencore's New SL750A Channelizers are designed with your needs in mind. The SL750A features:

- Direct keypad entry of either the channel or frequency in VHF/UHF or FM from 5-810 MHz.
- Super sensitivity to measure down to -40dBmV.
- Simultaneous monitoring of both the video and audio carriers, plus an exclusive pilot test that will make system balancing a snap!
- Testing of C/N and Hum on active channels. No need to tune off-channel or remove modulation to make these tests.
- Easy-to-use, automatic data collection.The stored information can either be downloaded to a computer or printer, giving you a full spectral print-out. Great for doing system analysis, 24-hour testing, or FCC documentation.
- Provides you with a quick test for analyzing ghosting, off-air pick-ups, and interference with a color LCD display.
- Best of all, it's field and weather ready. The SL750A features a rugged, light-weight case with "a water run-in resistant" front panel.

Plus, these other exclusive features:

- External DVM inputs (with *true*-RMS)
- Automatic fine tuning
- .5 dB accuracy - the best in the industry!

If you would like to know more, or are interested in seeing the SL750A work in your system, call 1-800-SENCORE (736-2673) ext. 735 for details.

SENCORE

3200 Sencore Drive, Sioux Falls, SD 57107

Reader Service Number 2

The Perfect Marriage of LIGHT and AIR.

MC².650

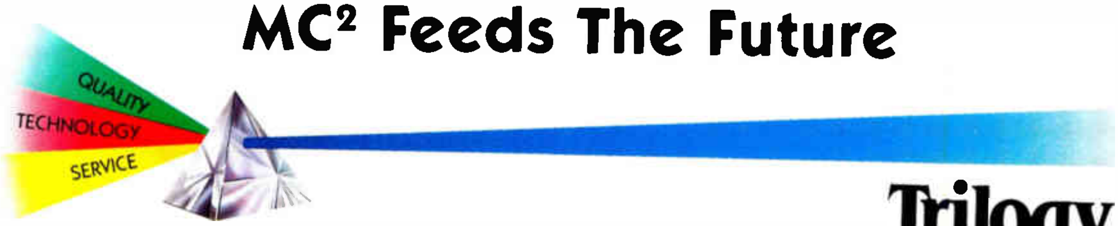
UNEQUALLED FOR FIBER-TO-FEEDER TRANSMISSION

- **TIME PROVEN COAXIAL PRODUCT**
- **LOWEST ATTENUATION**
- **FULL ALUMINUM WALL THICKNESS**
- **EXCELLENT HANDLING PROPERTIES**
- **FULLY BONDED . . . MOISTURE AND SUCKOUT RESISTANT**

Whenever fiber optic cable is to meet coaxial feeder, the air-dielectric design of .650 MC² assures the most advantageous match. Produced since 1985, .650 MC² is the only coaxial available today that has the diameter and handling ease of a feeder cable, with the electrical performance of a trunk cable.

Foam-core coaxials cannot achieve the attenuation of .650 MC² without increasing cable diameter and sacrificing full aluminum wall thickness. They simply cannot compete with the time-honored capabilities and economies of .650 MC².

MC² Feeds The Future



Call or write for free sample and brochure: Trilogy Communications, Inc.,
2910 Highway 80 East, Pearl, MS 39208 (601) 932-4461 Fax (601) 939-6637
or Call 800/874-5649

Trilogy
COMMUNICATIONS INC.

- Health
- Travel

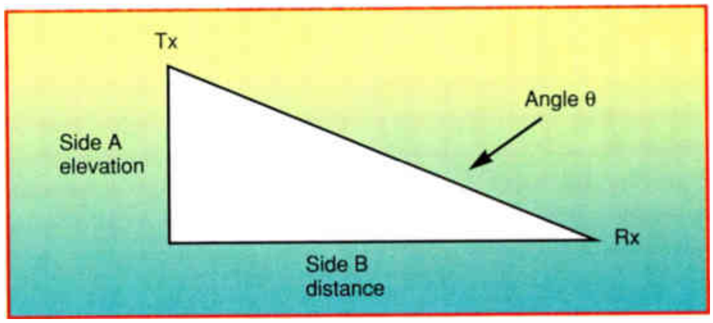
CATV providers

ADSL: Asymmetric digital subscriber line
CATV: Community antenna TV
EDI: Electronic document interchange
IS: Information services
ISDN: Integrated services digital services
VMS: Voice messaging services
VIP: Video information provider

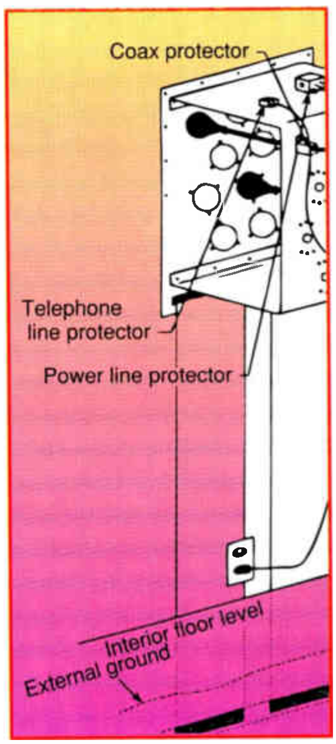
CONTENTS

MARCH 1993

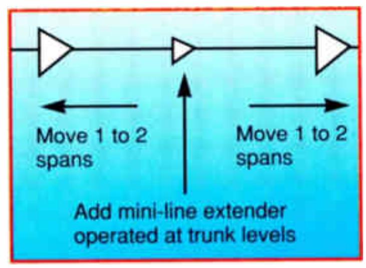
Departments



Microwave prealignment 28



Outage reduction 34



System upgrade 26

Geri Saye

Back to Basics 53

Features

 Communications Technology™ (ISSN 0884-2272) is published monthly by Communications Technology Publications Corp., 50 S. Steele St., Suite 500, Denver, Colo. 80209, (303) 355-2101. March 1993, Volume 10, Number 1. Office of publication is 50 S. Steele St., Suite 500, Denver, Colo. 80209. Second-class postage paid at Denver, Colo., and additional mailing offices. POSTMASTER: Send address changes to *Communications Technology*, 50 S. Steele St., Suite 500, Denver, Colo. 80209.

Extend 300 MHz 550 MHz 650 MHz 750 MHz 1 GHz the Life of Your System

1 GHz–Your Link to Enhanced Services

Expanded bandwidth is required to deliver emerging revenue-generating services like near video on demand, HDTV, multimedia and interactive services, or just adding more channels. Industry projections clearly support the need for bandwidth beyond 550 MHz, even with the advent of compression. If you plan to upgrade or rebuild your plant, ***1 GHz taps and passives make sense...today!***

Upgrade Now and Save Money

Installing 1 GHz taps and passives during your current rebuild will extend the life of your plant, ***reducing equipment and labor costs*** associated with unnecessary future upgrades.

Plan for 1 GHz Now!

Extending your system's 1 GHz capability all the way to the home expands your options, enabling you to implement bandwidth-intensive services when you are ready. Quality 1 GHz taps, line passives and house passives ***are available now...*** from Regal!

Let Regal, the leader in 1 GHz technology, help you design an ***expanded bandwidth system***. Call 1•800•36•REGAL or fax us at 404•416•1545 for our ***1 GHz Planning Kit***.

1 GHz Taps–part of Regal's complete 1 GHz product line. Available now!

REGAL TECHNOLOGIES Ltd
1•800•36•REGAL

EDITOR'S LETTER

Vote and flex your SCTE muscle

This month's "Editor's Letter" is directed at members of the Society of Cable Television Engineers. In particular, it's for those of you who haven't yet voted in this year's national election. For now I'm going to take off my editor's hat and put on my SCTE chairman hat. If past Society elections are any indication, only 3,000 or so of you bothered to vote so far this year. That's a paltry one out of three. (For those of you who did vote, a very big thanks.)

What about the other 7,000 of you? The election packages were mailed Jan. 14, so you should have received yours by now. If your desk is like mine, you probably have stacks of stuff everywhere. Dig down to the part that is late January or early February and pull out the big envelope from SCTE. Open it, read the instructions and candidate biographies, fill out the ballot and optional questionnaire, drop both in the supplied return envelope, affix first class postage and mail it.

The ballot has to be postmarked by March 15, and in the hands of SCTE's independent auditing firm by the 28th.

On the ballot, you'll have the opportunity to vote for two at-large director candidates. About half of you also will be able to vote for a director for your particular region. (If your region isn't listed this time, only vote for the at-large positions.)

The candidates you elect will be representing you on SCTE's board of directors. This group is responsible for setting and maintaining national policies and procedures. In short, the board is building the future of your Society, and your vote is an important part of the process of running the organization. It's a way for you to have a say in the operation of SCTE. But you forfeit all of that if you don't vote.

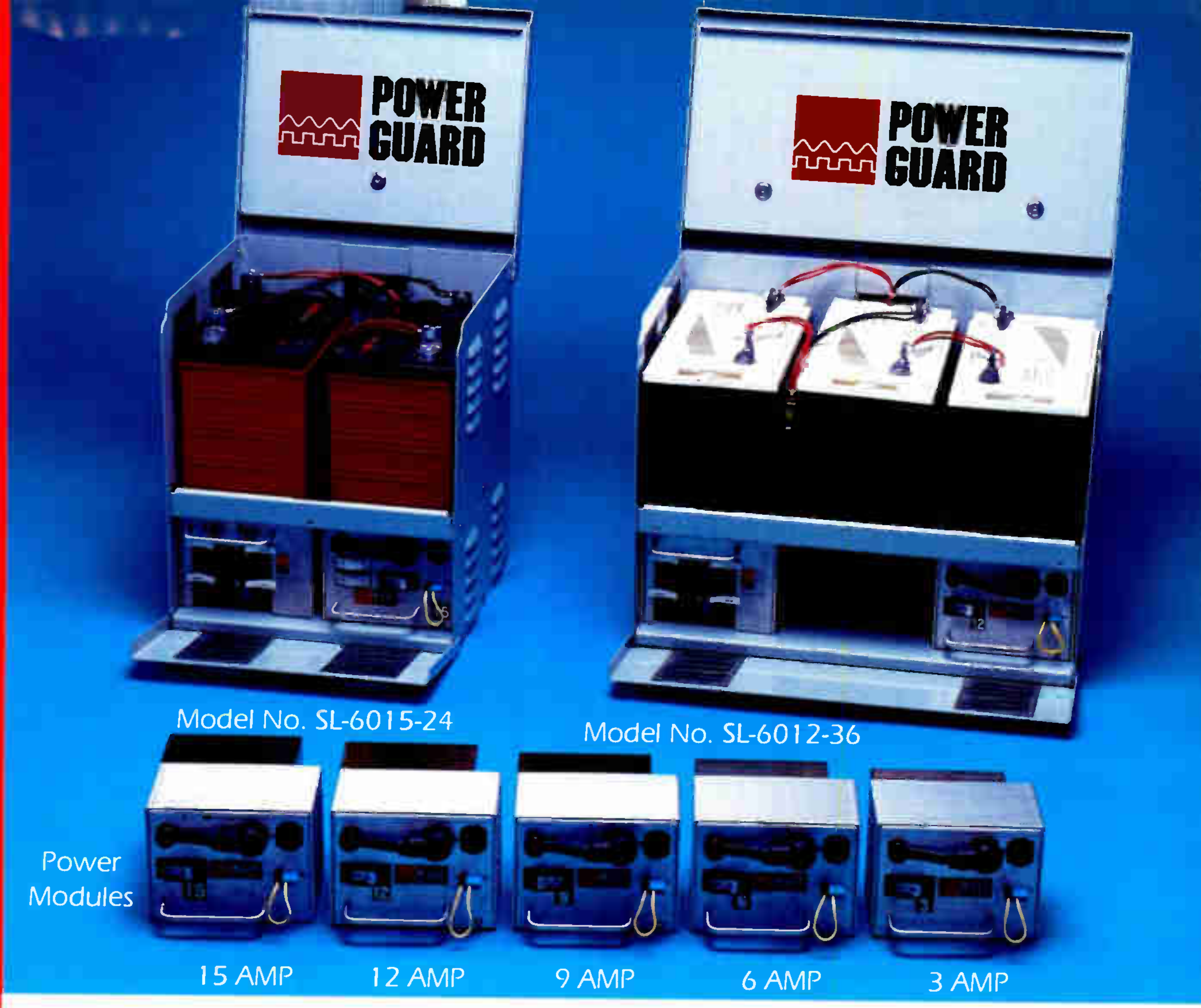
Nothing would please me more than to be able to announce to the other board members and national staff at next month's board of director's meeting in Orlando, FL, that something like 50% (or more) of our national membership voted this year. I fear, though, that the announcement will once again be the usual 30%. Only you can change that. So exercise your right as a national member of SCTE and vote!

Do care!

On a far more important topic, a friend, neighbor and fellow engineer — John Figal — has been the victim of a damned serious medical tragedy. This hits especially close to home, because we're about the same age, his son and mine are high school classmates, and John has been a neighbor (literally) and friend for several years. More details on John's situation can be found on page 14. I urge you to help out. Let's really show that cable cares!

Ronald J. Hranac
Senior Technical Editor

Power by Design



Standby Power Supplies Engineered for Today's Cable TV Networks

Small Simple Standbys™ from Power Guard will save you money, short and long term.

Since SSS™ is available in 3-6-9-12 or 15 amp ratings and in two or three battery configurations, you can maximize efficiency and reduce your power bills and battery costs by choosing the right model for each power supply location. If your power requirements change - simply upgrade the power module. Small Simple Standbys™ will grow with you.

And because our studies have shown that most power supply locations actually use less than 9 amps of power - we strongly recommend that you consider our 24 volt units for those locations. You get an immediate 33% savings in battery costs and still have up to four hours of standby run time.

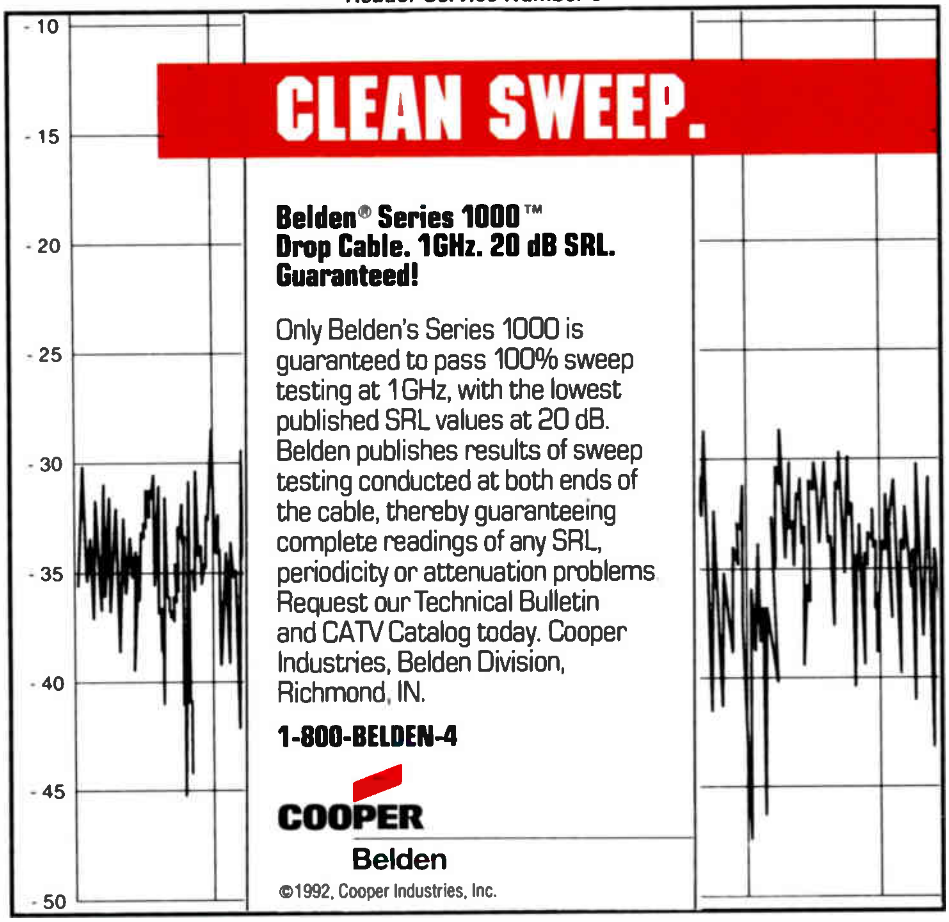
Small Simple Standby™ - The right product at the right time for the right price. No wonder we continue to be the fastest growing power supply company in Cable TV.

Reader Service Number 7

1-800-288-1507 **POWER GUARD** FAX 205-742-0058

Available Nationwide from ANTEC Communication Services

Reader Service Number 8



Reader Service Number 9

COMMUNICATIONS
TECHNOLOGY

A CT Publications Product

Vice President-Editorial, Toni I. Barnett
Executive Editor, Wayne H. Lasley
Assistant Managing Editor, Laura K. Hamilton
Associate Editor, Shelley L. Ollig
Editorial Assistant, Eric Butterfield
Senior Technical Editor, Ronald J. Hranac
East Coast Correspondent, Lawrence W. Lockwood

President/Group Publisher, Paul R. Levine
Vice President-Sales, Charles M. Castellani
Account Executives, Patricia McCollum
Barbara Allen Miller
Bill Parker
Linda Sommer
Classified Sales Manager, Mike Elmer
Advertising Coordinator, Maria Sullivan
Sales Support Manager, Paula Turner

Art Director, Brad Hamilton
Artist, James Watts
Circulation Manager, Mary Sharkey
Production/Traffic Manager, Mary Felker

Controller, Kenneth W. Edwards Jr.
Assistant to Controller, Cathy Sabo
Administrative Assistant, Maureen McDonald

Managing Director, Harry C. Gerhart

CT Publications Corp.
A subsidiary of Transmedia Partners-I, L.P.
50 S. Steele St., Suite 500, Denver, Colo. 80209
(303) 355-2101 FAX (303) 355-2144

SCTE® BPA

Must reading

Ron Hranac's "Editor's Letter" in the January 1993 issue should be reprinted in all the cable trades. This is a well-written indictment of not only the cable TV industry, but many American companies. The sad fact is that far too many executives fail to understand that, in Ron's words, "customer service training, the quality and reliability of our systems and the backbone of cable: our people" are what produce consistent and superior profit growth. Profits and profit growth are the result not the primary focus of successfully operating a business.

Thank you for stating your concerns so well.

David R. Van Valkenburg
President
MultiVision Cable TV Corp.

FCC proofs

I'd like to point out an error in the January 1993 issue of *Communications Technology.* On page 15, there is an article titled "What happened in tech rereg negotiations?" The first sentence of the last paragraph states that "Jan. 30,1993, is the deadline for cable operators to have their first proofs *to the FCC."* (Emphasis added.) As you probably know, the "proofs" are not to be filed at the FCC, but are to be maintained "at the operator's local business office ... " (§76.601(c)).

Stephen J. Flessner
Director of FCC Compliance
Tele-Communications Inc.

Too generic

While "How to select fiber-optic test equipment" in the January 1993 issue of *CT* was an excellent article written by one of our most knowledgeable colleagues in the business (Dennis Horwitz, RIFOCS Corp.), the article was too generic.

In particular, it missed mentioning the fact that CATV fiber-optic systems are generally AM in nature and have very high optical power levels. The typical power levels of an AM system are +3 to +9 dBm and even higher with fiber amplifiers now being introduced. These power levels cannot be measured with most fiber-optic power meters, which saturate (overload) at about +3 dBm. In fact, we have seen evidence that standard power meters were permanently damaged by exposure to the power levels of AM CATV systems. We have worked with vendors of these systems for several years to develop special meters and NIST traceable calibration to properly measure the optical power level in AM CATV systems. It wasn't easy!

And optical time domain reflectometers (OTDRs) are usually highly touted without mentioning their shortcomings, like a uncertainty of ±0.4 dB in measuring splice loss. It's too complicated to explain in a letter, but we have lots of applications notes regarding these issues.

Jim Hayes
Fotec Inc.

Light up your fiber with the best broadcast quality video possible.

With more broadcasters and CATV operators realizing the benefits and switching to fiber optic networks, the demand for "signal purity" and higher signal quality transmission has increased.

DX sheds a new light on high performance for today's cable operators with the new DIR-657 integrated receiver/ descambler. With a long list of features, including RS-250B broadcast quality performance and optional RS-232C interface for remote operation, the new DIR-657 outshines all other satellite receivers in delivering the sharpest video and soundest audio signals possible.

For more information write to DX Communications Inc., 10 Skyline Drive, Hawthorne, NY, 10532 or call (914) 347-4040.

DX ANTENNA

Reader Service Number 13

TW to build "superhighway" system

NEW YORK — Time Warner announced it will build a two-way electronic superhighway into the home, in suburban Orlando, FL. The company plans to demo the network by this year-end and have it operational for some 4,000 residential customers by early 1994. The service is subject to federal and state regulations.

According to TW, the network will offer interactive full-motion video educational services in conjunction with local schools and universities; full video-on-demand including movies, sports, cultural events and documentaries; interactive video games; and full-motion video interactive home shopping. Programming will come from many sources, including all TW businesses — publishing, filmed entertainment, programming and music.

In addition, TW applied to the FCC for an experimental license to test PCS in Orlando. As well, long distance phone access and picture phone services will be available.

Home wiring: Cable Act update

WASHINGTON, DC — The FCC announced that because of time constraints imposed by Congress in the Cable Act, it would limit home wiring rules to the language of the statute. Therefore, under the new rules effective this month, subscribers must be informed of the option to acquire their home wiring when they *voluntarily terminate* service — at a per-foot replacement cost of the cable only.

If the sub refuses the offer, the cable operator may remove the wiring within 30 days. If the operator doesn't remove it within 30 days, no subsequent attempts may be made to remove the wiring or restrict its use. If the operator does remove the wiring, it must do so at no charge and must pay for any damage.

All this applies to cable operator-installed wiring in the sub's individual unit and not "loop-throughs" in MDUs, even if they run through an individual's unit. The demarcation point to charge from is defined as at (or about) 12 inches from outside of where cable enters the premises or unit. As well, once the operator no longer provides service, it has no liability for signal leakage.

New council for CATV: Indy contractors

ALEXANDRIA, VA — The Power & Communication Contractors Association established a new division for independent contractors involved primarily in cable TV construction and maintenance, called the Cable Television Contractors Council. The first meeting was held last October in Atlantic City, NJ, prior to the Atlantic Cable Show. The CTCC will have a discussion forum, "Constructing the cable system of tomorrow," April 21 in Orlando, FL, just prior to the SCTE's Cable-Tec Expo. For information, contact the PCCA, 6301 Stevenson Ave., Alexandria, VA 22304; (800) 542-7222. →

Easy As ABC.

All-Inclusive...Siecor's 2001HR High Resolution OTDR features a standard built-in disk drive, single or dual wavelength modules, and built-in printer. Plus, there's a PC package for batch printing. It's EASY to test and document your fiber optic system with the 2001HR.

Basic...The 2001HR is easy to master, has a few simple controls, quick dual wavelength testing, help screens, and clear operation. It's EASY to understand and use the 2001HR.

Cost-effective...Premium features for a reasonable price makes our OTDR an excellent value. It's EASY to afford the Siecor 2001HR.

Experiencing the Siecor 2001HR is EASY AS ABC. Call us at 800 SIECOR 4 to set up a demonstration or get more details. Outside North America, contact Siemens A.G. Infoservice, 143/2295 Postfach, 2348, D-8510 Furth.

SIECOR

will be shared by up to 500 homes. A converter box outside each customer's home will convert incoming signals to voice or video and connect these to the existing telephone or coax wiring.

AT&T Networks Systems is supplying the entire network from Pacific Bell's central offices to the customer's premises. The coaxial network will feed into an intelligent network interface unit (NIU) on the side of a home or an office. Since the NIU is an active component, Pacific Bell will be able to determine an outage immediately.

Keith Cambron, director of loop access engineering for Pacific Bell, said that the company chose to build the network based on analog technology because it is user-friendly and can handle a wide variety of services. Cambron explained, "The fact is there are 200 million TV sets and some 30% do not have set-top boxes in their home. It is important to be able to hook your customer up to cable-ready sets. That says you need analog."

Furthermore, as technology improves, new services can be modulated onto the analog system without changing out all of the equipment. Cambron said, "The analog network is a linear network, so that if someone invents a new service or way of modulating, you can put it in the analog envelope. Digital transmission is important when you are doing long-haul. With analog, every time you regenerate a signal, you suffer distortion. But if you keep service areas small, you don't need much in terms of regeneration."

Pacific Bell is hoping that this investment will enable it to beat out potential cable TV competitors interested in bringing multimedia services to California. Phil Quigley, president of Pacific Bell said, "We are committed to bringing real products and services to California first. This is the best marketplace in the world and we expect our competitors to target large, cluster markets. Our rapid investment and deployment will significantly reduce our costs of providing telecommunications service, position us as an agile competitor, and help us meet growing customer needs for video, multimedia and wireless communications."

US West, another big telephone company, also has announced plans to bring the multimedia revolution home to its subscribers. In addition to its work with Time Warner, it has committed to spending $750 million over the next two years toward building multimedia networks. The architecture it is considering also looks remarkably similar in some respects to what cable companies have been planning.

Although many are predicting that applications such as video-on-demand (VOD), home shopping, gambling and gaming will bring fortunes to its founders, billions will probably be lost before the real winners are found."

The architecture is a cross between fiber-to-the-node (FTN) and a hybrid fiber/coax approach. For video, a DFB laser operating at 1,310 nm will be coupled into four fibers, which each feed up to 400 homes via a coax bus. For telephony, a fiber carrying a digital signal will feed only eight homes via a curbside pedestal.

Each coax bus will feed dozens of curbside taps so that both coaxial cable and twisted copper pairs will emanate from these pedestals toward each home or office. John Boe, who does wireless and broadband planning for US West, said that in Omaha, both analog and digitized video will be carried to the pedestal exclusively via the coax bus, and voice via the fiber. However, in subsequent trials that may change as new commercial technology emerges.

Bringing the coax through the pedestal provides some interesting architectural advantages. For starters, the pedestal includes a video interdiction unit, which is capable of preventing video pirates from watching a signal without authorization, since no signal makes it to their home.

Secondly, the video distribution system that Scientific-Atlanta is supplying for the project enables power to be carried on the coax. So US West does not need to run a separate powering system to each curbside pedestal.

Within the next two years, US West plans to complete networks based on this architecture in Omaha, Minneapolis-St. Paul, Denver and Boise, ID. By next year, it plans to announce another 20 cities slated for construction.

None of the local telephone companies are likely to stand idly by and let the digital revolution pass them by.

ADSL

Figure 1 (page 25) shows Bell Atlantic's future network architecture. Building a completely new infrastructure is costly and takes time. Bell Atlantic is looking at jump starting its entrance into interactive services through asymmetrical digital subscriber line (ADSL) service. This technology can place 6 Mb/s of data on the 24-gauge twisted-pair copper lines now in use for telephony over a distance of up to 12,000 feet. It will enable Bell Atlantic to provide VCR-quality movies-on-demand and data services operating at 144 kb/s or 384 kb/s.

In Alexandria, VA, Bell Atlantic has already launched a trial of the service to the homes of selected employees. It also is planning a major build to 300,000 homes in the Washington, DC, area.

According to John Hildebrand, vice president of operations at USA Video Corp., ADSL equipment costs as much as $10,000 per subscriber today. That is expected to drop considerably as manufacturers begin to mass produce the ADSL modems.

Bell Atlantic has selected Westell Inc. of Oswego, IL, to supply its Flexcap ADSL modems for part of its market trial in Washington. "Westell has the world's first completely operational and deployable ADSL system," boasted Gary Seamans, Westell's chairman and CEO. The product uses AT&T Paradyne's carrierless amplitude and phase modulation (CAP) line coding technology to deliver data at 1.544 Mb/s. It is currently working on an enhanced version that will support up to 6.912 Mb/s on a single copper pair.

The beauty of ADSL is that it is temporary technology that can be moved around as a more bandwidth-intensive architecture is put into place. Once Bell Atlantic builds a broadband network in the Washington area, it can move those modems to other markets and continue to bring in revenues until those markets are rebuilt as well.

Wireless cable

Cable companies face threats from others besides the phone company. Wireless cable systems capable of supporting bidirectional traffic could be installed for less money than the fiber/coax hybrid networks now being installed. For multichannel multipoint distribution systems (MMDS) the FCC has allocated 33 channels per city (with some restrictions) within the 2.5-2.7 GHz spectrum band. If converted into a digital format, this could carry from 100 to 300 channels, depending on the quality desired. →

Fund set up for hospitalized engineer

John Figal

DENVER — John Figal, a 42-year-old cable TV engineer, has been hospitalized here since early December, after the rupture of an aortic aneurysm and a subsequent cardiac arrest. Emergency repair of the aneurysm required 44 units of blood that the Denver cable TV community replaced with a special blood drive at TCI.

Improving slowly, John continues to make progress. Side effects of some of the life-saving medications compromised circulation to his extremities and his lower legs have been amputated. The cost of medical treatment at Porter Hospital is rapidly approaching $1 milllion, the limit of John's health insurance. Further surgery and extensive rehabilitation will be needed.

John, his wife Barbara, 16-year-old Jeremy and 13-year-old Brianna have a home in Highlands Ranch, south of Denver. A "Figal Family Caring Fund," has been started at Norwest Bank, 66 W. Springer Dr., Highlands Ranch, CO 80126; (303) 791-0344. This is an opportunity for the cable industry to help one of its own in an emotionally and financially devastating situation. Your support could help relieve some of his family's concern.

John started with CableCom General in the late 1970s and moved to United Cable Television in the 1980s and on to United Artists after the merger. In 1991, he joined Sychronous Communications. He is a member of SCTE and IEEE. His contributions to our industry include measurement techniques resulting in more meaningful equipment specifications and testing, improved hardware/firmware techniques for addressable converters making sophisticated features more user-friendly, and in general helping to raise the technical conscience of the industry regarding realistic expectations from CATV equipment systems.

☛ James Moulin, a 30-year cable veteran and member of the Cable Television Pioneers since 1982, died in December. He was the distributor sales manager for Gilbert Engineering.

☛ Tom Osterman, formerly director of R&D for Alpha Technologies Inc., established a manufacturer's rep firm for the Pacific Northwest. Technical sales and power system consulting will be emphasized by the Seattle-based Comm/net Systems Inc.

The Great "Hey, what's this battery for anyway?" Contest

▼ Can You Find the Battery that's Right for Cable?

Test your cable battery knowledge. Here are four typical batteries now being used for standby powering purposes in the cable industry. Only one battery meets the demanding needs of cable. Can you find the cable battery—and match up the others with their intended uses? If you can (and we promise, it's not hard) you could be the lucky winner of a Macintosh® PowerBook™ 145 or an NEC® Ultra Lite™ SL-20 laptop computer (contest details below).

your answers

Dynasty Gel Batteries™—Valve regulated, low maintenance gelled electrolyte dissipates internal battery heating, provides immobilization for installation safety. Designed for float charging and exceptional service life. Chosen by more MSO's world-wide than any other. Has lowest cost-per-year.

A ☐

Cable—Long 'idle times'; float charging typical; not a cycling application. Long periods between performance checks by maintenence personnel. Requires four to five years of service for reasonable payback on upfront battery costs.

Delco™—Low-cost liquid battery, designed for starting, lighting and ignition. Offers shorter service life in hot- weather. Since electrolyte is not immobilized, can be safety hazard in transportation and installation in aerial plant.

B ☐

UPS—Long 'idle times'; normally room-temperature operation in computer rooms, headends or offices. Lower-cost batteries which are not suited for extreme environments may be used.

Cable Sentry™—Uses "AGM" (absorbed glass mat) construction, suited to constant temperature applications, typical of equipment rooms. May be subject to thermal runaway when used in outdoor environments, particularly in southern locations.

C ☐

Marine—Typical deep-cycle requirement; discharge to "flat" levels frequently; requires phosphoric acid to resist internal stresses. Cranking service common. Low cost, consumer product.

MK Battery™—A sealed gelled electrolyte battery designed for deep-cycle applications such as marine cranking. Low maintenance. Phosphoric acid used as additive in gel to aid in deep cycle performance, but at the price of reduced service life on float charge.

D ☐

Automotive—Cranking service; use of thin plates to deliver high discharge currents for short period. Typically cycle-charged and low cost. May be sealed or refillable liquid.

▶ **Cable battery life is an important issue** for cost-conscious cable operators. That's why Alpha Technologies and Johnson Controls have been working together to meet the demanding requirements of standby power applications. Dynasty Gel batteries supplied by Alpha with single-source convenience, fill the unique needs of cable like no other. That's why cable operators continue to specify Johnson Controls and Alpha Technologies.

Contest Rules—Enter the ***"Hey, what's this battery for anyway?"*** contest and you could win your choice of a Macintosh® PowerBook™ 145 or an NEC® Ultra Lite™ SL-20 laptop computer! Just fax or mail a photocopy of this ad with the correct answers in the boxes and a completed entry form to Alpha Technologies at (206) 671-4936. Or drop by our booth at the show and fill out one out. The winner will be drawn at the SCTE show in Orlando (need not be present to win).

*Name*____________________

*Company*____________________

*Address*____________________

*City/State/Zip*____________ *Tel:* __________

DYNASTY JOHNSON CONTROLS

ALPHA TECHNOLOGIES

Alpha Technologies
US 3767 Alpha Way, Bellingham, WA 98226 Tel: (206) 647-2360 FAX: (206) 671-4936
Canada 5700 Sidley Street, Burnaby, B.C. V5J 5E5 Tel: (604) 430-1476 FAX: (604) 430-8908

Reader Service Number 18

Certification program incentive update

In September 1992 the Society of Cable Television Engineers asked its membership to submit information on incentives their companies were offering to encourage participation in the Society's Broadband Communications Technician/Engineer (BCT/E) and Installer Certification Programs.

It received notification of the following such incentives:

• Rita Erickson of Jones Intercable in Albuquerque, NM, reports that her system has had an incentive program in place since 1989. "Any associate who passes a BCT/E or Installer Program examination is awarded $100 for each test passed," she comments. "I am pleased to be associated with SCTE and Jones, both of which are organizations dedicated to educational advancement in the industry."

• TCI Cablevision of California, based in San Mateo, CA, recently announced an incentive program aimed at further motivating its employees to, according to Director of Engineering Mark Harrigan, "become fully certified at the Technician, Engineer and Installer levels." Not only will TCI of California pick up the costs of application, testing and seminars, but it will provide the following bonuses: Installer Certification — an SCTE jacket and $50; for the first category passed at the Technician level — an SCTE jacket and $50; for each additional category passed at the Technician level — $75; for the first category passed at the Engineer level — an SCTE jacket and $75; for each additional category passed at the Technician level — $100; Seven Technician categories passed and full certification — $250; and for seven Engineer categories passed and full certification — $400.

"To really get the program kicked off right," Harrigan adds, "the bonus program has been made retroactive for those who have moved forward with certification on their own. This will greatly increase the program's viability."

• Continental Cablevision of St. Paul, MN, offers a generous incentive program to its employees. The company awards its employees a $50 cash bonus per BCT/E category passed at the Technician level, plus an additional $150 bonus when full certification is achieved. For employees enrolled in the program at the Engineering level, Continental offers $100 per category passed and $300 for full certification. The company also pays 50% of the annual SCTE membership dues for each individual enrolled in the BCT/E Program, and 100% of the dues for employees who are fully certified in the program at ei-

MEMBERSHIP APPLICATION

Make check payable to SCTE.
Mail to:

SCTE
SCTE
669 Exton Commons
Exton, PA 19341

☐ I hereby apply for membership in the Society of Cable Television Engineers, Inc., and agree to abide by its bylaws. Addditional member material will be mail to me within 45 days. Payment in the U.S. funds is enclosed. I understand dues are billed annually.

☐ Please send me further information on the Society of Cable Television Engineers.

SCTE is a 501 (c) (6) non-profit professional membership organization. Your dues may be tax deductible. Consult your local IRS office or your tax advisor.

APPLYING FOR: ☐ INDIVIDUAL @ $40 ☐ SUSTAINING @ $250

Please print or type information. Data will be used exactly as it is submitted here.

☐ MR. ☐ MRS. ☐ MS. TITLE: ____________

NAME: ____________ (First Initial Last) TEL.# ____________ (Include Area Code)

EMPLOYER: ____________ (Company Name) FAX # ____________ (Include Area Code)

CO. ADDRESS: ____________ (Street/PO City State Zip)

USE HOME ADDRESS? ____________ (Street/PO City State Zip)

YOUR SIGNATURE: ____________ DATE ____________

Complete the information. Enclose full payment or charge to MasterCard/Visa shown below.

NAME ON CARD: ____________ EXP.: ____________

MASTERCARD NO.: ____________

VISA NO.: ____________

SIGNATURE FOR CHARGE AUTHORITY: ____________

Application without payment will be returned. applications from outside U.S., enclose additional $20 (U.S.) to cover mailing expenses.

☐ I am also an SCTE Installer Member. My Member Number is # ____________

*** SPONSORING CHAPTER OR MEETING GROUP: ____________ *** CT 3/93

SCTE INSTALLER PROGRAM INFORMATION REQUEST CARD

The SCTE Installer Certification Program was created to establish minimum skill requirements for CATV installers and installer/technicians. Participants in the program must successfully complete practical examinations in the areas of cable preparation and meter reading, as well as a written examination on general installation practice. The program is being administered by local SCTE chapters and meeting groups under the guidance of SCTE national headquarters. All candidates for certification in the program are recognized as SCTE members at the Installer level, and receive a copy of the SCTE Installer Manual.

☐ Please send me information and an application for the SCTE Installer Program.

Name ____________

Address ____________

Phone ( ) ____________ FAX ( ) ____________

CT 3/93

SCTE®

The Society of Cable Television Engineers

"Serving the Broadband Industry's Technical Community"

Mail to:
SCTE
669 Exton Commons, Exton, PA 19341
OR FAX TO: (215) 363-5898

Name____

Company_____________________________________

Address______________________________________

City________________________ State _____ Zip _______

Phone _______________________________________

Fax ____

Place Stamp Here

SPECTRUM

803 Forest Ridge
Suite 108
Bedford, TX 76022

Place Stamp Here

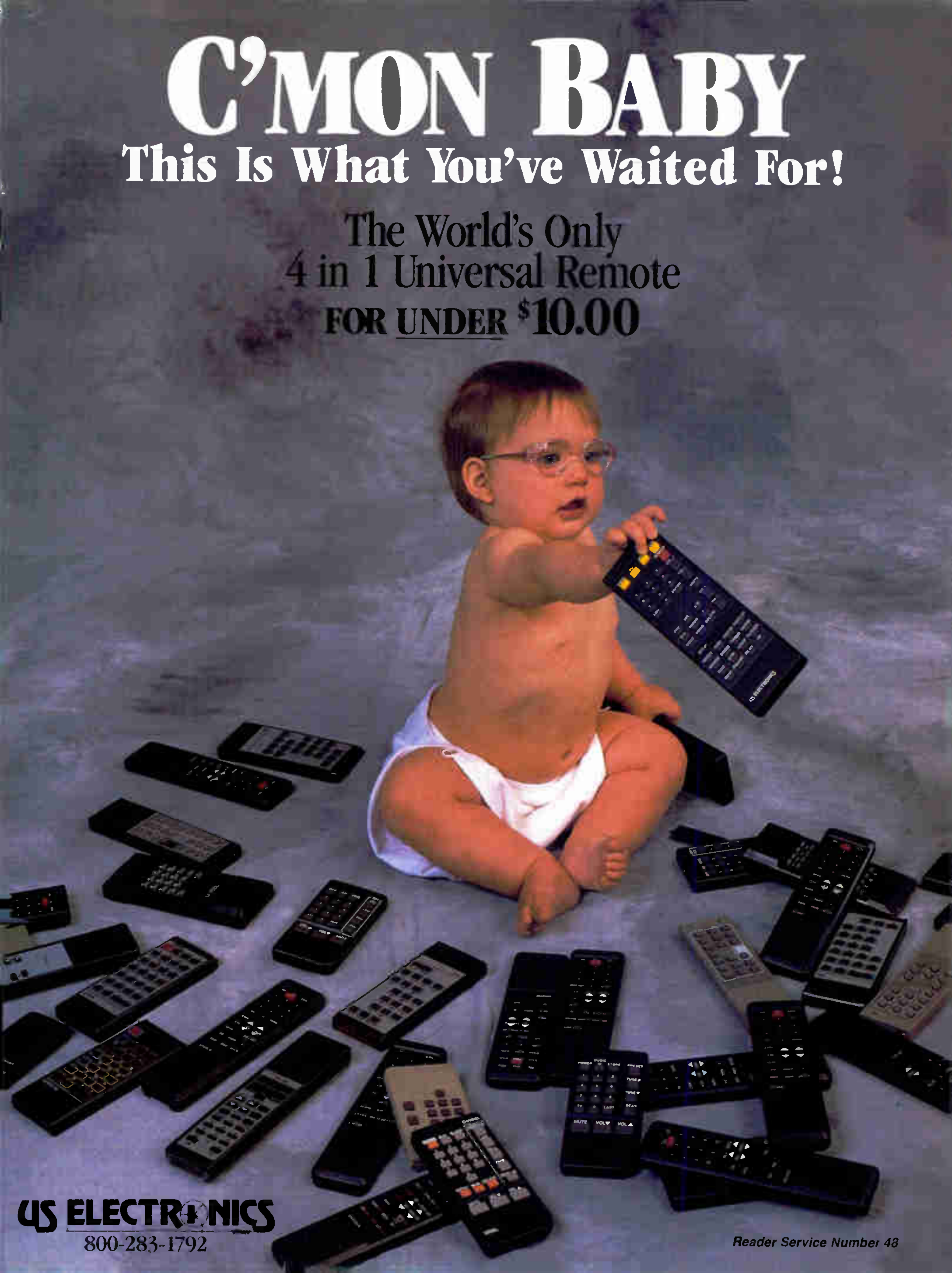
SCTE®

SCTE
669 Exton Commons
Exton, PA 19341

Place Stamp Here

SCTE®

SCTE
669 Exton Commons
Exton, PA 19341


C'MON BABY
This Is What You've Waited For!
The World's Only
4 in 1 Universal Remote
FOR UNDER $10.00
US ELECTRONICS
800-283-1792
Reader Service Number 48

ther level. Personnel enrolled in the Installer Certification Program must pay the initial $25 fee, but the company awards them a $50 cash bonus for full certification in this program.

• Monmouth Cablevision Associates in Belmar, NJ, certifies all of its installers through the Society's certification program, and uses it as a "stepping stone" to the BCT/E Program. "Our goal," says Technical Operations Manager Frank Dagliere, "is to certify all 42 of our technical employees. Prior to being enrolled in the Installer Program, each of our employees must complete interactive programs produced by Jones Intercable (installation) or ATC (service). To date, we have certified 10 employees in the Installer Program. We give thanks to SCTE for continuing to train and educate industry employees."

These programs add to certification incentives previously announced that include:

• Columbia International, San Angelo, TX — $200 cash bonus for completion of Installer Program. BCT/E Technician level: $50 for first exam passed, $100 for second, $150 for third, $200 for fourth, $250 for fifth, $300 for sixth and $350 for seventh. BCT/E Engineer level: $100 for first exam passed, $200 for second, $300 for third, $400 for fourth, $500 for fifth, $600 for sixth and $700 for seventh. Categories can be passed in any order.

• Cardinal Communications, Columbus, IN — Presents each employee who is certified in BCT/E Program with a personalized SCTE jacket emblazoned with a set of BCT/E patches.

• Cochran Communications, Cathedral City, CA — Personalized SCTE jacket provided to each employee who is certified at the Engineer, Technician or Installer levels.

• InterMedia Partners, Santa Clara, CA — Installer Program: salary raises of 20¢ an hour per exam completed and 60¢ an hour for full certification; BCT/E Technician: salary raises of 20¢ an hour per exam completed and $1.40 an hour plus payment of SCTE dues for full certification; and BCT/E Engineer: salary raises of 25¢ an hour per exam completed and $1.75 an hour plus payment of SCTE dues for full certification.

• Northland Communications, 35 systems in United States — $1,000 bonus to any employee who passes all seven categories of BCT/E Program.

• Simmons Cable TV, Long Beach, CA — Salary incentive offered to employees who are certified in the Installer Program.

• TCI of Washington — $100 bonus per BCT/E category passed to TCI employees in the state of Washington.

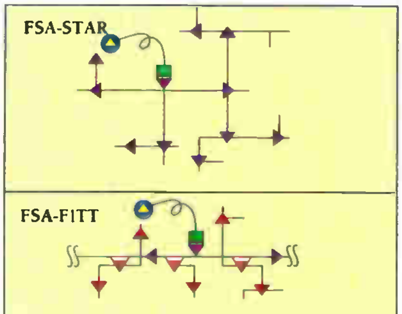
Many major multiple system operators and state cable TV associations have indicated their support for industrywide technical certification by endorsing the BCT/E Program. Among the endorsees are American Television & Communications, Buckeye Cablevision, Colony Communications, the Community Antenna Television Association, Continental Cablevision of Ohio, Mason Brothers Inc., the National Cable Television Association, the Southern Cable Television Association, Trilogy Communications Inc., Viacom Cablevision, Women in Cable, and the California, New Jersey, Oklahoma and Pennsylvania state cable TV associations.

WITH SYSTEM AMP II.

RESPOND TO

- Increased competition from all directions
- The 1992 Cable Act and FCC regulations
- New market and revenue stream opportunities
- Complicated franchise renewals

WITH THE RIGHT NETWORK

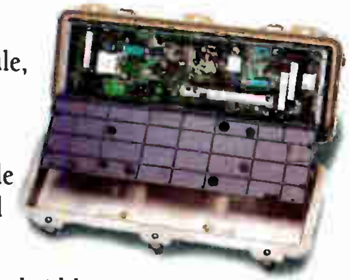


Fiber-to-Service Area (FSA) Architectures

YOU CAN START NOW

The System Amp II is the perfect complement for the network of the future, whether a rebuild or upgrade.

EFFICIENT - Fewer active locations required, 20% more efficient power supply, AGC option, common modules and accessories can be shared with other products.



RELIABLE - Field replaceable unitized module, Surge Resistant Circuitry (SRC™), optional AC crowbar circuit.

FRIENDLY - Easy strand engagement, flexible AC routing, quick fault isolation, side ports and through-the-lid test ports available.

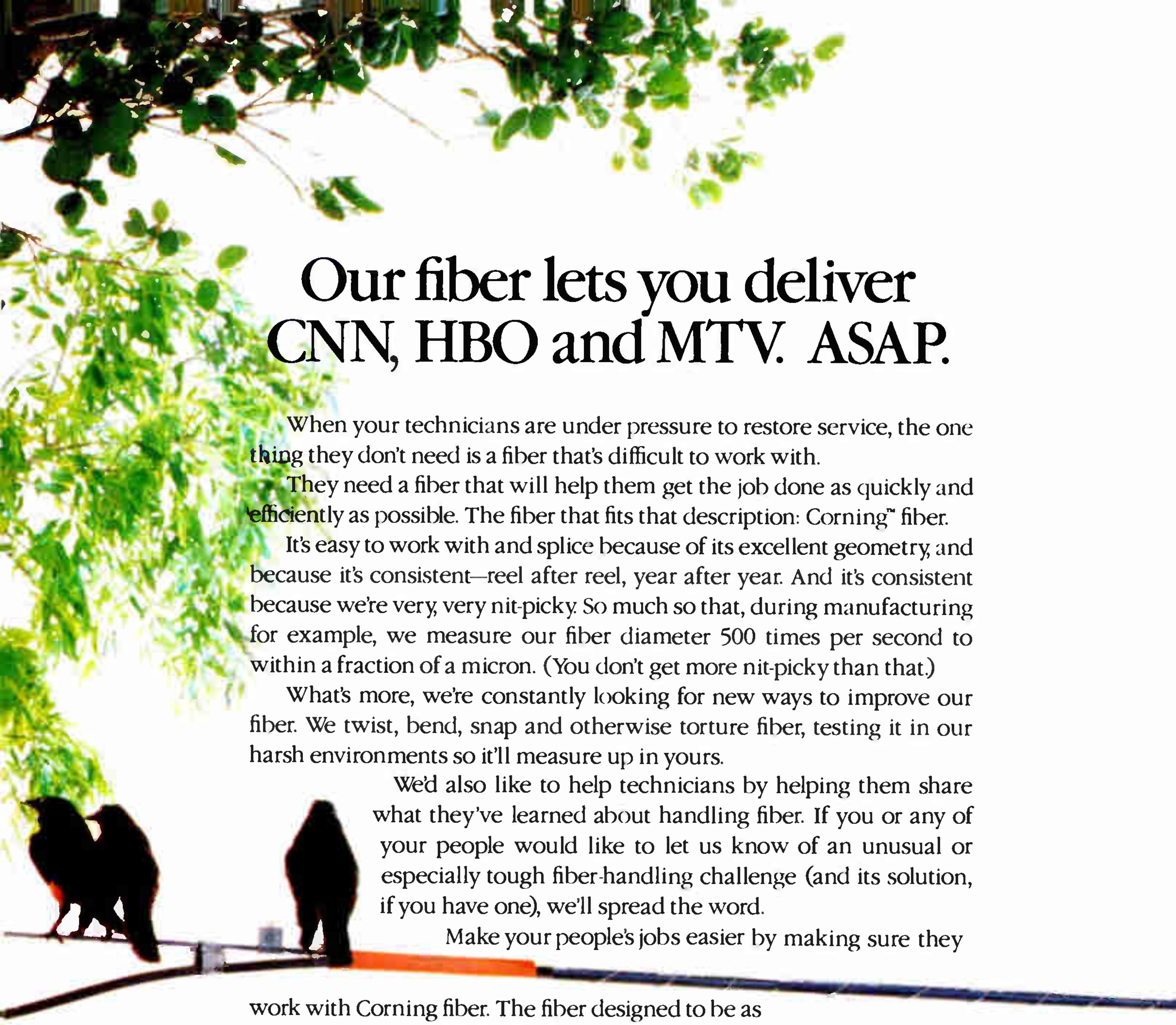
FUTURE READY - 1.5 GHz platform for bandwidth expansion, reversible module, and a replaceable lid for flexibilty.

For more information call 800-722-2009.

Scientific Atlanta

Our customers are the winners.

Reader Service Number 21



Thank You With Every Fiber Of Our Being.

We're proud and delighted to have won the 1993 Award of Excellence from the International Customer Service Association (ICSA). Nothing could be more gratifying than to know our efforts to give our customers all the support they need are truly effective–and recognized. At Siecor, everyone takes an active role in customer satisfaction, always being solutions oriented in providing fiber optic expertise and support.

An international, cross-industry organization, the ICSA yearly bestows its one-of-a-kind award on companies that have distinguished themselves through demonstrated proactive and forward thinking attitudes toward servicing customers. This is a high honor indeed–and a terrific incentive to keep improving. So we'll always listen closely to your requirements when designing our full line of fiber optic products. We'll be quick to respond whenever you need help. And we'll continue our commitment to our Total Quality Management process, now in its 10th year. The first in the industry to use this process, we were also first to initiate rapid delivery and Customer Feedback programs which set the standard for service.

1993 Winner Award of Excellence

We know the key to our success lies in anticipating what you'll need tomorrow through listening and responding to your needs today. To find out how our responsiveness can help you, call 800 SIECOR 4. We'd be honored to do business with you.

SIECOR

Reader Service Number 60

Fiber routes: How to plan for success

This article will discuss some of the issues that need to be addressed when planning fiber-optic cable routes, which include: node and splice point locations; reel lengths; future node placements; slack points; aerial and underground construction; accurate maps; and pre-engineering routes.

By Jeff Weech
Project Manager, Time Warner Construction

Let's begin by discussing node and splice point placements. With fiber optics you are no longer splicing off hooks, on a ladder, or in a bucket. Placement of nodes and splice points should be where there is access to park a splicing vehicle.

At this point, the tails can be brought down or up out of a pedestal and into the vehicle for splicing. Parking lanes, side roads, wide right-of-ways, turning lanes and parking lots are convenient spots to park a splicing vehicle. Strive to place nodes and splice points around these areas.

Future node placements

Keep the following in mind:

1) Beware that there may be a need for future node placement.

2) If a splice point can be designed now, then there can be money saved later.

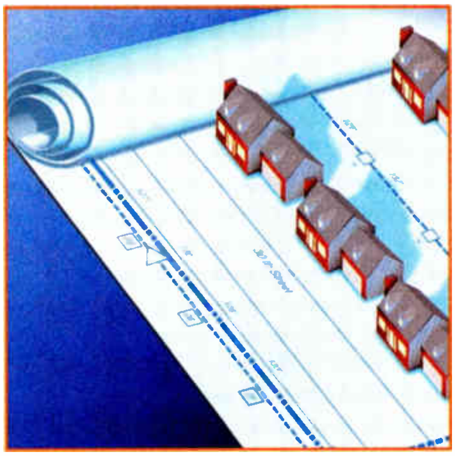
3) Assess the fiber counts for the possibility of a future node placement without running a new fiber back to the headend.

4) Add a 200-foot slack point near the future node if a splice point does not exist.

Reel lengths

It would be great if we could start at the headend and run a fiber 10 miles out to a node without a splice, but the reel would most likely be as big as a house. A reel with 20,000 feet and 120-count fiber cable on it can be as large as 7 feet in height and 4 feet in width. Therefore, it is recommended that cable lengths be kept somewhat shorter so the reels can be handled in a safe manner.

Another issue to consider is that anything over 20,000 feet isn't going to be constructed in one day. The reel will have to be left out overnight. This gives time for mischief (the copper thieves). They can make up to two or three cuts before they realize it is made of glass. Guards can be hired, but this adds to the cost of construction.



"Thorough pre-engineering of the routes is tantamount to a successful fiber project. Spend the time now and it will save you money later."

Slack points

Adding slack points along the routes is important for many reasons including pole transfers, road widening projects and damaged fiber. Slack points can be delashed and moved to where they are needed.

If you ascertain that a route chosen for the fiber is planned for road widening construction, add more slack points at approximately every 1,000 to 1,500 feet. A good rule is to have 7% extra on your fiber order for slack points. Don't forget 2% for sag.

Aerial and underground construction

Accurate maps are extremely important. If map footages are incorrect, you can have enormous problems. If the fiber that was ordered doesn't reach where the node is designed, coax design will change and will result in coax construction on a larger scale. You also might cause the construction crew to go into cardiac arrest if they fall short of their final location during construction.

On aerial fiber routes review old design bundles of cable. If they exist, I recommend rebuilding the cable to delete excess cable. In the event coax does need to be replaced, don't overlash it to the fiber because you'll have to delash the coax first. As we're all aware, coax visibly changes once moved. Take note: Fiber is forgiving and can be delashed/relashed if necessary.

It is not essential to replace coax with underground fiber routes unless there is a design change. However, I do recommend new conduit for the fiber only. If two or more cables go through underground, they wrap together (which makes it difficult to transfer fiber when necessary). If it is not possible to install new conduit, have existing conduits blown out and repaired before construction commences. This will result in a minimum of down time and costs.

Pre-engineering

After all issues have been considered and node locations have been obtained, it is time to finalize routes from the headend to the nodes. "The shortest distance between two points is a straight line" is the rule that applies best for fiber routes. Obviously, the less fiber you need the lower the cost.

The following observations should be made when designing a fiber route: main roads; alternate roads; obstructions that would stop construction; and easy access to the fiber when needed. Try to keep fiber on main roads for faster construction and easier access.

As you ride from the headend out, take note of problems that would halt construction. For example, if there isn't existing plant, can you obtain permits for new aerial or underground construction? Alternate roads or easements can be used to move around any problems that arise on main roads. Thorough pre-engineering of the routes is tantamount to a successful fiber project. Spend the time now and it will save you money later. **CT**

Up-front planning can ease crisis of emergency restoration

By Billy Pyatt
Sales Engineer, Siecor Corp.

"Personnel should practice ... skills frequently to ensure a restoration can be completed expeditiously in the event of an emergency."

Having an emergency restoration plan in place to address fiber-optic cable damage or cuts can make repair work simpler and quicker to complete. More and more cable operators are taking the time in advance to develop a step-by-step plan of action, prepare their staff, and have the appropriate equipment and materials available to answer emergency calls. Quick response time often can be credited to up-front planning.

Ideally, the planning for emergency restoration should begin prior to installation of the cable plant to ensure products are used that meet industry standards and are designed to function consistently and reliably over the expected lifetime of the system. Standards for optical fiber, cable and associated products have been in place in the telecommunications industry for over 10 years. In addition to the fiber-optics products, the system design can impact long-term reliability. Features to consider include advanced monitoring and control systems, backup systems, diverse or redundant cable routes, and 1xN laser protection with optical switches.

Once the system is designed and installed, attention should be given to a maintenance and restoration plan, which defines procedures, equipment, material and personnel required to respond quickly and efficiently to an emergency outage. Once written, the plan should be evaluated regularly and updated as system changes occur. The plan may include such items as:

1) Procedures to notify key personnel.

2) Location and means to access needed equipment and materials.

3) Detailed troubleshooting procedures to locate the cable fault.

4) Proper handling and operation of equipment.

5) Priority for restoring fibers in a multifiber cable.

6) Temporary and permanent repair procedures.

7) Testing and documentation procedures after the repair is made.

8) An evaluation method to identify the cause of the damage, prevention steps to take, as well as the restoration procedure itself.

The plan should be treated as a working document, not simply a formality. Ongoing activities should include preparing employees, maintaining equipment in proper working order and keeping materials on hand that are designated specifically for emergency restorations.

Personnel

The importance of training and practicing emergency restoration techniques cannot be overemphasized. Initial training should include safety, use of cable system-designated splice methods and hardware, proper use of an optical time domain reflectometer (OTDR) to test and document the system, operation of an optical power meter, handling and installation of fiber-optic cables and connectors, knowledge of system documentation procedures, troubleshooting and restoration methods.

However, initial training isn't enough. Personnel should practice these skills frequently to ensure a restoration can be completed expeditiously in the event of an emergency. Refresher training can be accomplished during internal quarterly and semiannual external training sessions. Mock emergency drills permit hands-on experience.

Personnel should be given specific assignments to serve a particular role during emergency restorations. Cross-training can help ensure adequate personnel in any emergency situation. For example, specific personnel should be assigned to maintain test and splicing equipment in good working order, others can ensure adequate materials are always in place, and certain personnel can be assigned specific restoration tasks including troubleshooting and the actual restoration.

In addition, a call list should be developed for the emergency plan. After all, highly trained personnel are of little use if they cannot be summoned at a moment's notice. The list must be checked regularly and mock call-ins should be conducted to determine the accuracy of the plan.

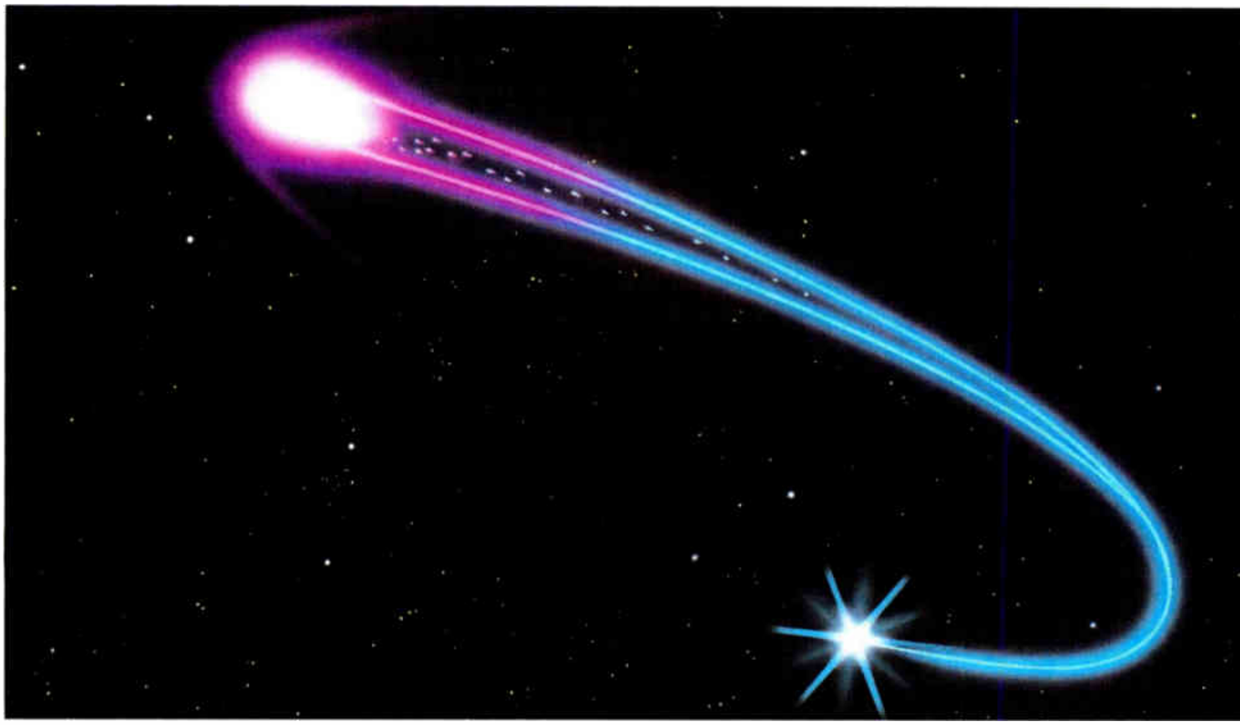
Equipment and materials

Equipment and materials should be set aside specifically for emergency restoration. This ensures supplies are always available. Commercially available restoration kits including preassembled closures and spare cable help expedite the repair procedure. Mechanical splices or connectors, splice trays, splicing tools, materials and test equipment such as OTDRs and power meters should be available. Use of a fusion splicer is preferred for permanent repair. However, one can be used for emergency restoration if available and conditions allow.

It also is of value to have miscellaneous supplies collected. These include attenuators, jumpers, closure re-entry kits, cotton swabs and isopropyl alcohol, compressed air, safety equipment and two-way communication equipment. The restoration materials and equipment should be inspected regularly to ensure proper and adequate operation.

Housed with the restoration equipment should be the as-built documents of the system(s). These documents, which are instrumental in isolating problems, should be accurate and readily available to restoration crews.

(Continued on page 47)



System upgrade for increased bandwidth

Table 1: Hybrid test results of channel loading vs. composite triple beat

Level	+48 dBmV flat level	+48 dBmV flat level	+48 dBmV flat level	+48 dBmV flat level
Hybrid	34 dB/300 MHz 7-pin hybrid	34 dB/400 MHz 7-pin hybrid	34 dB/450 MHz 7-pin hybrid	34 dB/450 MHz 7-pin hybrid power doubler
Channel loading				
20	-68 dB @ Ch. 11	-66 dB @ Ch. 11	-75 dB @ Ch. 11	-77 dB @ Ch. 11
25	-64 dB @ Ch. 11 -63 dB @ Ch. M	-64 dB @ Ch. 11 -64 dB @ Ch. M	-71 dB @ Ch. 11 -72 dB @ Ch. M	-76 dB @ Ch. 11 -77 dB @ Ch. M
30	-60 dB @ Ch. 11 -58 dB @ Ch. Q	-62 dB @ Ch. 11 -60 dB @ Ch. Q	-68 dB @ Ch. 11 -68 dB @ Ch. Q	-74 dB @ Ch. 11 -74 dB @ Ch. Q
35	-58 dB @ Ch. 11 -56 dB @ Ch. W	-62 dB @ Ch. 11 -59 dB @ Ch. W	-66 dB @ Ch. 11 -65 dB @ Ch. W	-72 dB @ Ch. 11 -71 dB @ Ch. W
40	-56 dB @ Ch. 11 -53 dB @ 325.25 MHz	-60 dB @ Ch. 11 -55 dB @ 325.25 MHz	-65 dB @ Ch. 11 -64 dB @ 325.25 MHz	-71 dB @ Ch. 11 -69 dB @ 325.25 MHz
45		-57 dB @ Ch. 11 -53 dB @ 355.25 MHz	-64 dB @ Ch. 11 -63 dB @ 355.25 MHz	-69 dB @ Ch. 11 -67 dB @ 355.25 MHz
50		-56 dB @ Ch. 11 -50 dB @ 385.25 MHz	-63 dB @ Ch. 11 -60 dB @ 385.25 MHz	-68 dB @ Ch. 11 -66 dB @ 385.25 MHz
55		-54 dB @ Ch. 11 -44 dB @ 415.25 MHz	-62 dB @ Ch. 11 -57 dB @ 415.25 MHz	-67 dB @ Ch. 11 -65 dB @ 415.25 MHz

Note that -77 dB is the absolute measurement limit. Actual CTB level is normally much lower.

By Fred J. Rogers
President, Quality RF Services Inc.

The past two years have noted a distinct change in CATV system bandwidth upgrades as fiber optics becomes a new tool. The problems encountered in modern system bandwidth upgrades are as individual as the systems. This article will attempt to touch on re-equalization of amplifiers as trunk cascades are reduced, the use of mini-line extenders (LEs) to solve low tap levels and fixed equalizers to replace one popular trunk amplifier's variable style.

Most systems today use amplifiers with hybrid IC technology in push-pull, power doubling or feedforward versions. Many cable plants use high power microwave or fiber-optic cable to reduce trunk cascades and consequently their distortions.

Often, the trunk portion of a cable system can achieve higher usable bandwidth via fiber to reduce cascades by half or less the number of trunk amplifiers. As trunk cascades are reduced, replacing pads and equalizers will allow higher bandwidth and more channels within the system's distortion budget. At this point, the high level feeder part of the plant often limits how many additional channels can be added.

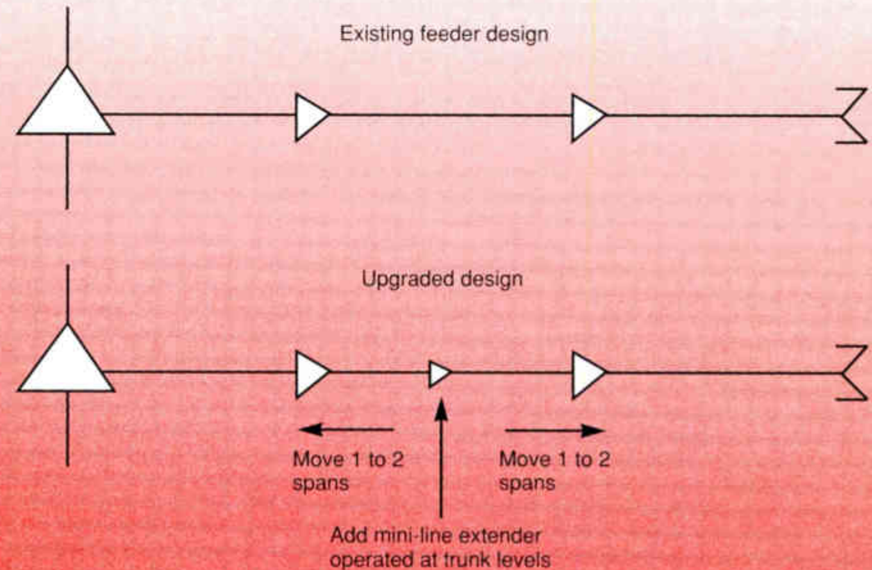
In the trunk section, most hybrid IC amplifiers can be made useful to 450 MHz by replacing the RF hybrids, changing a few key passive components and realigning for extra bandwidth. A complete circuit board replacement may be required for the 300 MHz quad amplifiers and trunk modules using single ended input sections. Additional gain also can be accomplished with either style upgrade by proper hybrid selection. Often, new modules can be purchased that plug directly into existing housings for additional gain, bandwidth and distortion improvements. If a bandwidth of 500 MHz to 750 MHz will be desired, a series of new modules that replace the mother board as well as RF modules may be required. The series and vintage of the equipment will dictate the needed electronics. The goal will be reusing the existing housing at original system locations with high gain, high level amplifier modules.

To better understand how many channels can be added by re-equalization, one must analyze the CATV amplifier and its major building block, the IC hybrid. Most amplifiers are not limited by bandwidth but by input and output distortions. Hybrids manufactured in the 1970s and early 1980s are limited by higher frequency distortions.

A modern day amplifier rated for 400 MHz may have 550 MHz hybrids and can easily operate to 450 MHz. For amplifiers using 10-year-old hybrids rated for 400 MHz, it would be optimistic to consider adding even a few more channels.

Replacing IC hybrids with modern super hybrids or using power doubling technology often will resolve additional bandwidth needs. The key here is to determine the amplifier's distortions under proposed full channel loading to see if IC hybrid replacement will be required. This will take the guess work out of equalizer bandwidth selection and resulting picture quality. (See Table 1.)

Figure 1: Feeder designs



Mini-LEs to the rescue

The mini-LE has found a new "niche" when used to increase tap levels in the high level feeder portion of a cable system. Many times the trunk portion of a cable system can achieve higher usable bandwidth incorporating power doubling or feedforward amplifiers or by reducing cascades using fiber. A simple solution for the feeder portion has been more elusive due to the higher levels required to overcome cable attenuation, tap loss and drop loss encountered with greater bandwidth.

The following problem is all too common to the operator considering bandwidth extensions: Only a portion of the system had low tap levels due to an older style, higher attenuation cable used in that portion. A complete rebuild of the older section could not meet cost and time requirements. The levels to subscriber had to be increased quickly and in a cost-effective manner while maintaining amplifier levels compatible with the rest of the system. The best solution is the mini-LE. Figure 1 illustrates a feeder design concept involving minimal resplicing to incorporate a mini-LE that serves to more evenly distribute the required gain.

The mini-LE required 17 dB gain with plug-in pad, plug-in equalizer and plug-in thermal control. The unit had no gain and tilt control circuits to ensure maximum carrier-to-noise ratio and no field adjustment requirements. The mini-LE used a different housing than the original line extenders to ensure field personnel would not attempt to interchange low gain and high gain line extenders.

The mini-LE allowed minor relocation of existing line extenders while maintaining the same input and output levels as the remainder of the plant. Tap levels were designed to meet the required higher levels. The distortion addition of the mini-LE was negligible. Table 2 shows the addition calculations of a typical upgraded system that added a mini-LE operated at near trunk levels. The bottom line of the table is a minimal distortion contribution.

Table 2: Mini-LE addition calculations

	CTB (in dB)	
Trunk cascade	-67 (precalculated)	
Bridger	-64	
(Pre line extender CTB) ------------>		-59.35 dB
Line amp #1	-66	
(CTB at first line extender)--------->		-56.03 dB
Line amp #2	-66	
Cascade result----------------------->		-53.64 dB
Mini-line extender	-80	
Add to cascade result--------------->		-53.23 dB
CTB contribution from mini-LE --->		-0.41 dB

Are all equalizers equal?

In the past 10 years several CATV operators have requested fixed value equalizers for use in Jerrold "SJ" Series trunk amplifiers. Until this year, only the variable trunk "SEP" style existed. Figure 2 shows the newer fixed equalizer and adapter board combination, and the

Figure 2: Fixed and SEP equalizers

(Continued on page 48)

Microwave antenna prealignment

The following was one of the entries for the Society of Cable Television Engineers' 1991 Field Operations Award. It is reprinted here with permission from the September 1991 "Interval."

By Mike Wohrle
Microwave Technician, Falcon Cable TV

Placing a microwave antenna within a close proximity to its final position during installation could save you time and money later. A simple mathematical calculation using a Texas Instrument calculator TI-30SLR or equivalent can give you an elevation angle in degrees.

Using a topographic map, determine both site elevations and the total path length in miles. Add the antenna mounting heights to each site elevation then subtract the smaller number from the larger of the two to determine the elevation figure to use in the formula. Convert the elevation number to miles by dividing by 5,280. Figure 1 illustrates this process. Divide Side A by B to find the angle (1.01 = 22.12 = .0457). Push the invert key to convert the angle to degrees, then push the tangent key. Your final figure in this example is 2.6°.

Listed in the accompanying table are actual calculations, the final angle readings from each path and the error in degrees between the two from on-site construction. From the previous example, the 2.6° derived from the calculations would represent a down angle at the transmit antenna and an upward angle at the receive antenna. These calculations represent an optical or line-of-sight adjustment; no correction for earth curvature is taken into account.

Using an inclinometer as shown on the feed assembly

(Continued on page 49)

Comparing calculations to final angles

Path	Length	Calculation	Final	Error
1	22.12	2.6	1.4	1.2
2	21.30	2.8	3.5	.7
3	7.96	5.9	5.5	.4
4	25.60	1.2	1.0	.2

Figure 1

Transmitter elevation	8,492′	Receiver elevation	3,184′
Antenna height	+ 60′	Antenna height	+ 35′
	8,552′		3,219′

8,552′
-3,219′
5,333′ ÷ 5,280′ = 1.01 miles

Side A = 1.01 miles
Side B = 22.12 miles

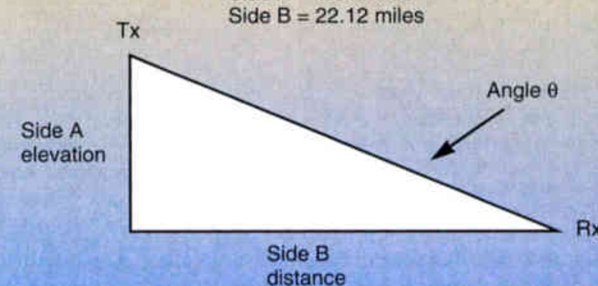


Figure 2: Using an inclinometer to adjust elevation

To catch a cable thief

By Don Shackelford
Vice President, Engineering & Technology
Memphis Cablevision, Time Warner Cable

"We're only interested in prosecuting the ones who are trying to make a living connecting illegal service."

Cable signal theft is an insidious crime. It robs the cable industry of needed revenues while at the same time depriving the community awarding the franchise of the revenues generated by cable customer income. Unfortunately, many people do not think of cable signal theft as a crime nor do they realize the economic impact that it has on their community and on their cable rates.

In fact, over a period of 12 months, the Memphis Division conducted an aggressive field audit and conversion program of 170,000 of its more than 300,000 passings. The results were astounding. Greater than 13% of passings audited were found to have some form of unauthorized services. This equates to a potential of lost revenue greater than $3 million annually. The conversion of the unauthorized viewers to paying subscribers exceeded 39%.

Any cop will tell you that crime is a full-time business requiring full-time vigilance. Since 1991, Memphis Cablevision has had its own specialist in the continuing war on cable service theft, which last year resulted in millions of dollars of lost revenue to the cable industry.

Since the inception of its theft-of-service program, the Memphis Division has succeeded in catching 20 cable thieves. Eighteen have been prosecuted and two others are awaiting trial dates thanks to the investigative talents of Gerald Bullard, system security specialist for the Memphis Division.

"We're only interested in prosecuting the ones who are trying to make a living connecting illegal service," explains Bullard. "There are many others who have just hooked up themselves, so we send them letters and disconnect them." Follow-ups at these addresses are made at least every three months.

This is not a job for the faint of heart. "Most of the ones we go after are not just involved in theft-of-cable service," Bullard said. "They're half crazy. They're usually into drugs, forgery, burglary and various other crimes."

It's a team effort

It's not just a one-man operation. The division works very close with local law enforcement and other revenue protection organizations.

In 1984 the Tennessee legislature passed the Unauthorized Access to Cable TV Services Bill set forth in 39-3-1136 of the Tennessee Code Annotated. This statute sets forth both criminal and civil penalties for obtaining or attempting to obtain unauthorized cable TV service; assisting or instructing any other person in obtaining or attempting to obtain such service; making or maintaining a connection or connections for modification or alteration to any device installed by the company.

All Memphis Division service personnel have in their possession a company identification card with their name and photo on it. Any person soliciting for a cable hook-up or making any type of hook-up on the cable without such identification card is acting unlawfully and without authority from the company.

Whenever a violation of the state statute is reported to the local police department, a warrant is immediately processed and executed by a company-retained attorney under the direction of Bullard. This entire process is usually completed in less than 24 hours.

Because of the tremendous backlog in the court system for more serious crimes and the overall lack of jail space, theft-of-cable service is not given a high priority by judges. Sentences usually amount to court costs and either a small fine or a few days in jail. "But they're put on probation for 11 months and 29 days as a misdemeanor offense," Bullard said, "which means many don't do it again. For others, it's just a matter of time."

On Monday, Oct. 5, 1992, the cable re-regulation bill became law. In addition to the regulatory language in the law, commercial theft-of-cable TV service was upgraded from a misdemeanor to a felony. The law also makes the manufacture or sale of each device used to assist theft-of-service a separate offense.

The tools of the trade

Bullard has all the equipment he needs to be a good investigator: an unmarked surveillance truck guaranteed to fit in with any neighborhood, video and still cameras, and sometimes a partner to help with night surveillance. Dwight Davis, damage claim investigation specialist for the Memphis Division, is usually more than eager to assist.

Many times a theft-of-service investigation reveals excessive vandalism damage to expensive cable equipment.

Thieves are operating later than they used to according to Bullard. "Most of the ones we're after operate between midnight and daybreak." He and Davis take the cameras and shoot video of a thief breaking into an apartment lock-box or underground pedestal and running the cable to individual houses or apartments. This provides indisputable evidence to the police and helps expedite the warrant.

Along with pirating cable, these entrepreneurs are crooked in other ways. One stunt is to go back a couple of weeks after connecting a household to the cable system and disconnect it. Then they will go to the customer and say "I understand Cablevision made a sweep of the neighborhood last week and unhooked you. For another 50 bucks, we'll hook you back up again."

During the day Bullard does a lot of driving. He sometimes catches people in broad daylight running a cable to their homes. At other locations he looks for signs of reconnection at addresses where he knows they've been disconnected. He also follows up on tips he receives from informed sources: relatives, neighbors who are paying for their service and customer service representatives.

With the addition of the smaller systems recently acquired by the Memphis Division, Bullard now must cruise significant parts of Arkansas, Tennessee and Mississippi looking for various types of theft-of-service. That's a full-time job considering the division's cable system now encompasses more than 3,800 miles of cable plant serving more than 170,000 (paying) customers. **CT**

BOTTOM LINE

CONTEC™ Converter Service Makes You Money...

Let's face the facts... the longer a cable converter provides uninterrupted service to your subscriber... the more money you make.Breakdowns mean customers complain, trucks roll, and time evaporates... sound familiar?

At CONTEC, we specialize in building "strategic service partnerships" with cable operators... NATIONWIDE.

By exceeding OEM standards, our quality repairs withstand the test of time... and so do our business relationships.

CONTEC LEADERSHIP PROVIDES:

- ☐ Computerized tracking of repairs by serial number.
- ☐ Experienced, factory trained technicians
- ☐ Stringent quality control procedures
- ☐ Security clearance of each shipment
- ☐ Efficient customer service
- ☐ Fast turnaround and delivery

BOTTOM LINE, CONTEC service centers all work in harmony to keep your converters where they belong... in subscriber homes... And, that makes you money!

CALL TODAY

1-800-382-2723

* CONTEC's Jerrold compatible replacement remote control units.

CONTEC™

INTERNATIONAL

THE LEADER IN CONVERTER TECHNOLOGY+

1023 State Street, P.O. Box 739, Schenectady, NY 12301-0739
Phone: (518)382-8000, FAX: (518)382-8452

Reader Service Number 26

Figure 2: Interaxx machine

Nordberg Capital Inc., based in New York, is predicting that the market for wireless cable will grow from 500,000 subscribers today to between 5 million and 10 million by the year 2000. Today wireless cable companies earn $100 million in revenues. That growth could translate into $1 billion-$2 billion in revenues — some of it at the expense of cable companies.

In the past, it was difficult for wireless cable operators to receive programming, thus limiting their potential market. They often had to pay higher prices than wireline cable operators. But the 1992 Cable Act eliminated this obstacle, by requiring that programmers sell to all at a fair and reasonable price.

The key to wireless cable's growth will come from its lower startup costs, which could enable it to sell services at a lower price. People's Choice Television has estimated the incremental cost of adding a new subscriber is about $525 vs. $1,000+ for wired cable operators when building a new system. (Editor's note: Some MMDS operators can add subscribers for as little as $150 to $450 each.)

Wireless cable providers also have lower operating costs since they do not have an extensive cable plant to maintain. Nordberg Capital believes these financial advantages can enable wireless to offer services for approximately 25% the cost of wired cable. The top 50 U.S. markets could have wireless cable service within the next three years. This would give wireless cable a potential reach of 100 million people. As well, the FCC has licensed some spectrum for return path communications.

Videotron, based in Montreal, has been pioneering bidirectional services on traditional cable systems and is looking at adapting its technology for wireless systems. For wire-based systems, it has developed an addressable box capable of supporting impulse pay-per-view (IPPV) and over 100 different games. It is now in almost 300,000 homes around the world — 220,000 in Canada, 75,000 in London, and 1,000 homes in Dayton, OH.

The service, called Videoway, enables viewers to order instant replays or change the camera angle viewed during a sports event, read news, get weather reports, or gamble in the interactive casino. In Canada, users pay only $7.95 per month for all of these services and $18.95 per month for one pay TV service, which has a take-rate of 60%.

The growth rate for Videotron has been phenomenal. In Canada it achieved a 20% market penetration after only two years of commercial implementation. Now it is looking at expanding across the United States. Videotron has purchased 80% of a wireless system in Tampa Bay, FL, Transworld Wireless TV, which now has 5,000 subscribers and annual sales of $1 million. It also has launched a venture with Transworld Telecommunications, the Tampa company's parent, to buy and develop other wireless systems in the United States.

Of course, there are limitations to wireless cable. Best reception requires line-of-site between the transmitter and the receiver. It is estimated that this closes off the possibility of service to about 20% of all potential subscribers in any given market.

28 GHz

Another potential competitor may come from new ventures planning to offer services in the 28 GHz region. The FCC has announced plans to award two 1 GHz licenses of spectrum in each metropolitan area. With compression, it could enable operators to offer hundreds of channels in each service area.

Perry Haddon, a vice president of GHz Equipment Co. Inc., believes that it can install basic service for about $600 per subscriber, which includes about $300 for the broadcast station/transmitter and $300 for the antenna, downconverter and set-top box. A master headend will cost about $750,000 and each additional cell will cost about $300,000.

GEC's research indicates that each cell site could cover a radius of about six miles, without being adversely affected by the rain. This would enable each metropolitan service area to be supported by three to four transmitters.

For another $300 per subscriber, the system also could support bidirectional telephony. Using normal TDMA techniques, Haddon believes that such a system could support 146,000 simultaneous phone calls.

However, there are still some doubts that a cellularized 28 GHz system will work as well as anticipated. Only one large scale system is currently in operation. It is run by CellularVision in New York, and uses only a single cell. (For more on wireless cable and CellularVision, see Lawrence Lockwood's "Correspondent's Report" on page 20.)

Compact discs

Compact discs are achieving a high level of penetration among personal computer owners. The development of the marketplace offers a glimpse at how interactive applications can develop. They can now support voice, video and text applications in an interactive mode. However, the data rate on most PC-based CD players is only 150 kbytes/s (1.2 megabits/s), which provides borderline quality video at this point.

Compression techniques such as MPEG and fractal technology developed by Iterated Systems in Atlanta, have made this medium a reasonable delivery system for video. Philips is even selling CD-I, a home entertainment unit that uses MPEG compression to place up to 74 minutes of compressed video onto the discs.

Since the beginning, CDs have been sold like any other software. Recently, companies like Blockbuster have started to rent them out. A new development for the industry is advertising-driven CDs that are sent out free.

Last Christmas, Apple worked with EDS and Redgate Communications Corp. to launch En Passant, a CD-based home shopping catalog. Retailers, including L.L. Bean, Land's End, Patagonia and Horchow all had sections. The CD was distributed to a random sample of 30,000 Apple customers.

Pacific Bell is planning a network equipment directory service based on CD, called RE:Source. Its first issue is slated for this month. Advertisers will pay $1,000 for a single panel ad, and $8,400 for up to 30 seconds of video.

A Miami company, Interaxx Television Network Inc., is hoping that the CD will enable it to jump start the development of interactive applications to the home. The set-top device (Figure 2) uses a CD player attached to a 486 computer to store

Conditional access via digital compression

By Graham Stubbs
Consulting Engineer, Graham Stubbs Associates

With the initiative spearheaded by CableLabs, followed by announcements by Viacom and TCI, the cable industry is clearly committed to adopt a digital approach to signal distribution. The use of digitally compressed video signals has the potential to dramatically improve the security of cable programming, but only if conditional access systems using digital encryption are properly implemented. The notion that digital encryption itself assures piracy-proof security is false. Much of the recent activity regarding digital compression has rightly focused on compression methods and standardization of compression algorithms. The cable industry should not assume, however, that settling on a particular approach to compression also resolves the approach to security. The concepts — and technologies — are largely separable.

The Advanced Television Systems Committee has examined conditional access for digital high definition TV (HDTV), and in May 1991 published a list of desirable attributes and features.[1] This listing was intended to provide a first checklist for the development and evaluation of a possible voluntary standard for conditional access for HDTV.

The same kind of thinking can be applied to digitally compressed cable signals. With the delivery of digitally compressed programming to consumers still two years (or thereabouts) away, the industry has an opportunity to determine what it needs in terms of conditional access, and to evaluate the security of proposed approaches. These tasks can be accomplished separately from selection of compression technology.

A comprehensive listing of desirable attributes and features for conditional access and security for digitally compressed cable programming should be developed along with a methodology for thorough evaluation of the security elements. This work should be spearheaded by the operators and programmers who will use (and pay for) compression systems.

"The process of evaluation and selection of a secure conditional access methodology should start with the assertion that this is a decision completely separate from selection of compression technology."

Opportunities and goals

Compression appears likely to be deployed during 1993 for satellite feeds to cable headends. However, compression to subscribers' homes may be two years away. This time frame should provide an opportunity for thorough examination of conditional access and security issues before equipment designs are frozen.

In the past, proprietary scrambling designs have largely controlled the marketing of set-top converter equipment. In the case of digital compression, there is no technical or application reason that this should be the case; it should be important to the cable industry, in fact, to ensure that it does not recur.

Eventually, it may be possible to build decompression technology into TV receivers. With the appropriate development of standardized interface specifications, it also would be possible to build into TV sets the more costly elements of conditional access control systems, leaving external only those elements critical to security at the discretion of operators and programmers.

The cable industry may not achieve this worthwhile goal, however, without a consolidated effort to define the objectives and to hold proposed conditional access systems up to scrutiny against the long-term goals.

Definitions of terms

Some of the terms used in relation to addressable systems employed to secure cable programming have changed in meaning from time to time. In its HDTV recommendations, ATSC has tended to follow CCIR definitions of terms.[2] The following are representative of current CCIR usage and may be helpful to understanding continuing discussion of these topics.

- *Conditional access system:* within a TV distribution system, the means to selectively provide TV programs to specific individual subscribers. The system includes means to track access for accounting purposes. There are two distinct, and in many cases independent, components in a conditional access system — scrambling and access control — each of which is a distinct information process.
- *Scrambling:* alteration of the characteristics of a broadcast video/sound/data signal (i.e., TV program or service) in order to prevent unauthorized reception of the information in clear form. The alteration is a specific process under the control of the conditional access system (sending end). The terms scrambling and descrambling are applicable to programs and services in both analog and digital.
- *Access control:* the function of the conditional access control at the sending end is to generate the scrambling control signals and the provision of information to enable authorized users to descramble the program or service. The availability of this information is controlled by the conditional access system, between the transmitter and receiver(s). Thus, information is structured in secure messages multiplexed with the signal itself. At the receiving end(s), these messages are interpreted by the access control system in order to control descrambling of the signal in authorized receiver(s).
- *Encryption and decryption:* terms used for methods to protect (encrypt) and interpret (decrypt) some of the information within the access-related messages that are transmitted from the sending end of the conditional access control to the receiving end of the conditional access control. (This specific usage of the words encryption and decryption is a substantial departure from the broad meaning the terms acquired during the past several years. In the past, they have had meanings ranging from protection of individual digital messages to provision of security to for an entire TV service).
- *Security:* the degree of difficulty en-

(Continued on page 50)

Outage management, Part 4: Outside plant and headend protection

The following is copyrighted by Cable Television Laboratories Inc.

The CableLabs Outage Reduction Task Force was organized by several MSOs and the CableLabs staff to address the issues that stem from cable system outages. The intent of the developed solution to outage problems was that it would be fully supported by CableLabs' member companies.

CableLabs published the document "Outage Reduction" as a summary of the Outage Reduction Task Force's work. This part details fusing policies and deployment of surge protection that provides a significant reduction of plant outages.

The Outside Plant Protection Subcommittee members of the task force were: Roy Ehman, retired from Jones Intercable; Tom Osterman, Alpha Technologies; Bob Rapp, Lightning & Grounding Systems Inc.; Ray Rohrer, Warner Cable; and Austin Coryell, American Television & Communications.

CableLabs' Outage Reduction Task Force conducted a considerable amount of research into practical solutions to cable system outage reduction. Part 1 of this series of articles provided an agreed-upon definition of an outage, customer acceptability, and an outage detection and tracking specification. A critical threshold of no more than two outages in a three-month period (0.6 outages per month per subscriber) was suggested as a target for cable operators to achieve and maintain. This threshold will likely be a "moving target" in the future, since it is an entertainment model that may not be valid for other services.

Part 2 discussed reliability modeling of cable systems. (The CableLabs document also includes a Lotus 1-2-3 worksheet on an accompanying diskette that can be used as a tool for system reliability analysis.) Part 3 covered plant powering, including reducing power supply cascades, incorporating hardened trunk techniques, understanding and working with the local electric utility, and optimum use of standby powering.

To further reduce the incidence of outages, this installment will focus on outside plant protection. It is important to understand that reducing system outages is a multifaceted issue, requiring consideration of a number of items. The Plant Protection Subcommittee researched equipment fusing, surge protection and bonding/grounding practices. A number of recommendations are provided, including outside plant voltage and current protection. While all of the topics and recommendations of the task force are important, the group feels that implementing effective fusing policies in conjunction with the deployment of surge protection that meets the criteria described later in this article will provide a significant reduction of plant outages related to nuisance fuse blowing and equipment surge damage.

"Reliability analysis has shown that overall cascaded equipment failure rates must be at or better than 7% per year to achieve outage performance that is acceptable to subscribers."

System reliability

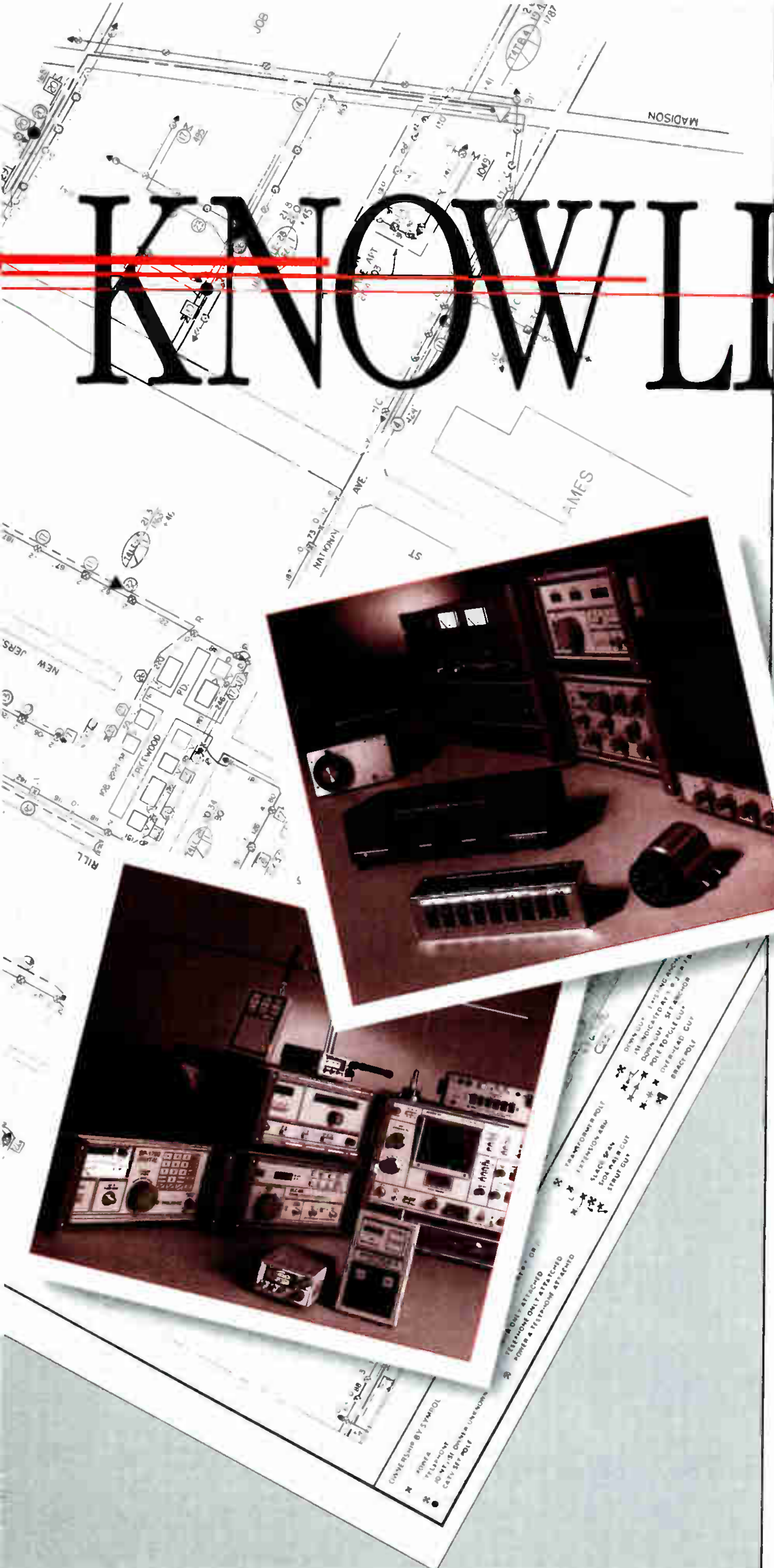
Cable system reliability depends directly on the reliability of the components that make up the system, including those in the headend and outside plant. Reliability analysis has shown that overall cascaded equipment failure rates must be at or better than 7% per year to achieve outage performance that is acceptable to subscribers. This figure includes blown fuses, cut cables and outright equipment failures.

While there may be little that system personnel can do to prevent a backhoe operator from inadvertently cutting a buried cable, achieving a 7% or lower cascaded equipment failure rate to a large extent requires effective protection from excessive voltages and currents. Of the many things that cause outages, these two are among the easiest to prevent.

Excessive voltage conditions are typically of extremely limited duration, for example, surges or transients. They are generally caused by:

- Lightning.
- Operation of power utility protec-

DEPTH of KNOWLEDGE



Trilithic manufactures a comprehensive line of RF test equipment for the CATV industry. Our innovative approach to product design and development gives our instruments enhanced testing features that are more than bells and whistles. Trilithic's advanced engineering and manufacturing capabilities ensure high performance and accuracy at reasonable prices. Plus, we back all of our products with service and support that is second to none.

When you think of RF testing in the field, on the bench, or in the headend, think Trilithic.

- Signal Level Meters
- Signal Leakage Instrumentation
- Digital Leakage Calibrators
- Tuned Frequency Counters
- Headend Switching Systems
- Digital 1 GHz Bench Sweep Systems
- Spectrum Analyzers
- Microwave Downconverters
- Tracking Generators
- Tunable Bandpass Filters
- Power Line Interference Locators
- Attenuators
- Return Alignment Systems

Call today for our latest catalog.

Reader Service Number 28

TRILITHIC

9202 East 33rd Street
Indianapolis, IN 46236 USA
Telephone: (317) 895-3600

Toll Free: (800) 344-2412
FAX: (317) 895-3613

Plans for purchase, rental and leasing available.

MasterCard VISA

tion/switching equipment such as vacuum breakers, as well as utility switching faults.

• Operation of industrial loads such as arc furnaces, switching of large pumps, motors, etc.

• Operation of other moderate-to-heavy loads such as elevators, air conditioners, compressors and electric appliances.

Excessive current is created by short circuit conditions that are usually of longer duration than transients or surges. A common cause is an electrical short between the coaxial cable sheath and center conductor due to a cable cut, maintenance activity or an electronic component failing in a shorted condition. A number of deficiencies in existing voltage and current protection practices have been found to be contributing to reduced system reliability.

Common practices

Many of today's commonly accepted overvoltage and overcurrent protection practices are causing more problems than they solve, either because of incorrect application or actual deficiencies with those practices. The Outage Reduction Task Force has reviewed several areas, and found the following problems:

1) Surges or transients blow fuses, resulting in nuisance fuse blowing. Fuses are technically overcurrent protective devices, intended to protect equipment or components from excessive current as a result of short circuits or overloads. Fuses are not intended to protect from voltage transients or surges. It is not unusual to find cable system outages caused by simple nuisance fuse blowing because of a lack of adequate surge protection or incorrect fusing.

2) The life of some surge protection devices is considerably less than amplifier life, with no practical means to detect device failure. Some types of surge protection devices installed across a line or circuit being protected can fail open. When this happens, there is usually no indication of the device's failure until a subsequent surge damages or destroys the equipment that was supposed to be protected.

3) Some surge protection devices have questionable ability to handle a series of voltage surges, for example, five to 10 surges in less than a second. Certain devices may easily survive one or two closely spaced surges, or perhaps several that occur over a relatively long period of time. But multiple surges over a very short period of time may result in device destruction.

4) Fast-blow fusing is used for protection against long-duration high currents. Equipment or situations that experience long-duration high currents or temporary inrush conditions should be protected by time-delay (also known as slow-blow) fusing.

5) Excessive use of fuses, such as for routing power. Many active and passive components in cable systems provide fusible links for power routing. Excessive use of fuses for applications such as this merely creates more opportunities for outages due to nuisance fuse blowing and the availability of too many "weak links in the chain." Power routing in many cases can be accommodated with simple buss bars when overcurrent protection is available elsewhere in the network.

From this, you can see the need to implement effective surge protection and good fusing practices in cable systems. With regard to these, the immediate question is: "What methods will work the best?" Since CableLabs does not endorse or recommend any specific products or manufacturers, the Outage Reduction Task Force set out to establish a recommended practice that can be used as a guideline by cable operators and equipment manufacturers for surge protection and fusing. The recommendation — detailed later in this article — is twofold, with surge protection in the first part and fusing guidelines in the second.

Surge protection background

Different types of surge protection are available to the cable industry, each suited for specific applications and each varying in its effectiveness for the intended application. As part of the development of a recommended practice for surge protection, CableLabs commissioned independent laboratory testing of several of the most commonly used protection devices, including metal oxide varistors (MOVs), gas-filled surge arrestors (gas tubes), silicon avalanche diodes (for example, ruggedized zener diodes) and crowbar devices (circuits that incorporate thyristor-type semiconductors such as SCRs or TRIACs in a crowbar configuration).

Metal oxide varistors and silicon avalanche diodes are basically voltage-limiting devices, while gas-filled surge arrestors and crowbar devices operate by clamping circuit voltage to a reduced value (in some cases they clamp to ground).

The laboratory testing was done to establish a repeatable measurement procedure that is representative of conditions that might be experienced in outside plant operation and can be used by operators and/or manufacturers to compare the relative effectiveness of various surge protection techniques.

Plant voltage and current protection recommendations

Based on the outcome of the testing, it is the opinion of the task force that use of the ANSI/IEEE (formerly C62.41-1980 Category B2) C62.41-1991 Categories B3 or C1 (6,000 volt, 3,000 ampere) standard is appropriate and useful for cable operators to determine the effectiveness of surge suppression equipment. The task force recommends the use of this test in simulated plant configurations and further recommends that cable operators should ask equipment manufacturers to certify that their equipment meets or exceeds recommended performance criteria set forth in the following recommendations.

Further, it is the task force's opinion that deployment of surge suppression equipment that meets or exceeds the recommended performance criteria, in conjunction with implementing the recommended fusing policy, should significantly reduce limited-duration overvoltage and overcurrent related outages.

Cable operators are encouraged to implement the following voltage and current protection guidelines. The recommendation is based on analysis, surge testing and very successful field testing.

Surge voltage protection: New equipment

Vendor is to certify amplifiers to the following:

1) Amplifier passed five 6,000 volt impulses (3,000 amperes) per

ANSI/IEEE C62.41-1991 Categories B3 Or C1 test. Amplifier tested in configuration simulating cable plant installation.

If surge protection device(s) and/or input current carrying capacity is changed, the equipment is to be retested.

Vendor to certify this item in writing and to provide detailed testing documentation/report upon request.

2) Operating characteristics of the surge protection device(s) will not materially change when subjected to 10 voltage surges of Item 1 previously, spaced 1 millisecond apart.

Because this condition is difficult to test, certification can be achieved by engineering analysis. The analysis is to account for, among other things, voltage drop across the device, subsequent heat buildup and associated device operating characteristic changes.

Vendor to certify the previous in writing and provide detailed testing or analysis documentation/report upon request.

3) Certify the number of ("impulse life") 6,000 volt impulses (3,000 amperes) per ANSI/IEEE C62.41-1991 the surge protection device(s) can withstand. The recommended minimum is 5,000. Certification to be based on published device specification or specific life tests.

Vendor to certify this item in writing.

4) Vendor to state normal and overload current carrying capacity for amplifiers, including surge protector devices, wiring, PC board traces, etc.

Surge voltage protection: Existing amplifiers

This is recommended for all trunk amplifiers and line extenders where there is a known surge problem.

1) Install solid-state surge protection where the surge protection is certified by the vendor to meet the following:

a) Pass five series of 6,000 volt impulses (3,000 amperes) per ANSI/IEEE C62.41-19910 Categories B3 or C1.

b) Vendor to certify surge protection device minimum "impulse life" as per listed previously.

2) Remove gas tube surge suppressers.

Note: Most amplifier manufacturers have developed kits or optional factory-installed components that will meet the recommended criteria. Additionally, other vendors have equipment or kits available to back-fit surge protection, for example, in line power inserters.

"Many of today's commonly accepted overvoltage and overcurrent protection practices are causing more problems than they solve, either because of incorrect application or actual deficiencies with those practices."

Excessive current protection: New and existing equipment

1) Plant AC power supply output protected at 150 to 200% of power supply output rating with time-delay (slow-blow) fuse.*

2) Trunk amplifier power supply module (power pack) input protected just under current carrying capacity of amplifier with time-delay (slow-blow) fuse.*

3) Feeder protected at 150% of normal operation with time-delay (slow-blow) fuse.*

4) Line extender power supply input protected just under current carrying capacity of amplifier with time-delay (slow-blow) fuse.*

5) Fuses used for power routing to be replaced with buss bars except feeder routing port in trunk housing (dead short in feeder should not take trunk station down).

* *Note*: If a circuit breaker is used instead of a fuse, its rating is to be as noted previously and opening/trip characteristics are to be those of a time-delay (slow-blow) fuse.

Grounding and bonding background

Most cable TV engineers would agree that the industry would have fewer problems with voltage surges, transients and sheath currents if the cable system could remain isolated from the utilities. Nevertheless, there also is agreement that this is not possible because it would create a safety problem.

This section covers the requirements, methods, costs and recommendations for bonding and grounding.

Bonding to the utilities is a requirement for safety as delineated in the National Electrical Safety Code (NESC). Pole attachment agreements or local authorities also may establish specific requirements for bonding.

Problems from bonding include the following:

• Sheath currents — Bonding to the power neutral reduces the ground potential differences that would be a safety hazard. But this also creates a problem for the cable system because it shares the power company's neutral load. This load generates undesirable longitudinal sheath currents.

• Voltage surges — In sharing the normal power company neutral load we also share the fault conditions. This can result in substantial surges for extended periods of time.

Grounding is achieved in the bonding process through the common ground at the structure to which the bond is attached. Grounding in addition to the grounds achieved at bond locations may be desirable in some situations. These grounds may be at locations without any other grounding electrodes. This requires driving a grounding electrode and providing a #6 or better copper conductor from the cable system to the electrode (ground rod). Additional grounds are normally placed at an active or before and after an active component. Too many grounds, however, also can create problems for the cable system.

Usually, this type of ground is added in relatively close proximity to an active component providing a lower impedance to earth ground than would a bond to an electrode located multiple spans away. The lower impedance provides an alternate path for transients.

Bonding

The NESC Sections 92C1 and C3 require messenger wires (strand, etc.) to be connected to grounding conductors at maximum intervals of four connections in each mile. The requirement of four per mile allows some flexibility in selecting which locations to use unless the pole attachment agreement or local authority has more specific requirements (e.g., first, 10th and last). Four connections per mile meet the bonding requirements for the NESC as covered in NESC Section 9, "Grounding Methods for Electric Supply and Communication Facilities." Relevant sections are reproduced as

follows for the reader's convenience:

92C Messenger Wires and Guys

1) Messenger wires required to be grounded shall be connected to grounding conductors at poles or structures at maximum intervals as the following list covers:

Where messenger wires are adequate for system grounding conductors (Rules 93C1, 93C2 and 93C5), four connections in each mile.

---

3) Common grounding of messengers and guys on the same supporting structure.

Where messengers and guys on the same supporting structure are required to be grounded, they shall be bonded together and grounded by connection to:

a) One grounding conductor that is grounded at that structure, or

b) Separate grounding conductors or grounded messengers that are bonded together and grounded at that structure.

Bonding costs will vary in different parts of the country depending on labor costs. Material costs will differ only slightly. As of late 1991/early 1992, estimated cost for labor and material for bonding at strand level is about $7 per bond. To bond at the electrode requires a separate downlead and exposing and cleaning the electrode. This costs about $20 for labor and material.

If minimum bonding is completed by bonding to the power company vertical grounding conductor at strand level, the cost for four contacts per mile would be about $28 per mile. On the other hand, if the preferred method of adding a new downlead is used to bond at the electrode, the cost would be about $80 per mile.

Local regulatory authorities or the pole attachment agreement may have other specific requirements. These may require the bond wire to be a #4 rather than #6 specified in the NESC, or some specific requirement of where to bond (at strand level, at the electrode), or specify the type of connections to use.

Bonding should be avoided at pole locations where the electric utility has spark gaps, lightning arrestors or primary switching. These locations have the capability to discharge extremely high electrical potential. A significant portion of that discharge could be transferred to the cable plant. Bonding also should be avoided at locations that indicate a high current in the bonding conductor.

The ideal location for bonds is where the power company has 1 Ω grounds because 80% of the load imbalance would be dissipated through the ground return. While we are not likely to find many locations where the power company has 1 Ω grounds, it does show that we should attempt to place bonds at the best power ground locations. With lower ground resistance, less neutral load is transferred to the cable system.

The preferred method of bonding is to use a separate #6 copper downlead connected directly to the power electrode. This procedure needs to be cleared through the engineering administrator of the pole attachment agreement and may raise the question of creating a hazard by not bonding at strand level. A downlead would typically be 25 feet long plus 25 feet back up the power ground lead for a total length of 50 feet of #6 copper or larger. Number 6 copper has a resistance of 0.3951 Ω per 1,000 feet. Fifty feet of #6 copper would have a resistance of 0.02 Ω, hardly enough resistance to create a hazard.

Parallel leads do not represent much improvement in resistance but do provide a lower impedance for transient-type events. Important in the bonding process is the attachment. The cable industry has been using split bolts and other screw-type devices. Most power companies have discarded those devices and are using compression-type connections that are more reliable for a much longer period of time.

Grounding

Grounding, in this case, is the use of additional grounding conductors and electrodes for the cable system. Additional grounding at or near amplifiers will provide a lower impedance ground and a better path to ground for high rise time transients. This type of additional grounding may be useful in lightning-prone areas although recent experience has demonstrated that if surge protection and fusing recommendations of the previous sections are followed then additional grounding is probably not required. If additional grounding is used then these should be periodically checked to ensure the ground resistance levels have not significantly changed over time. However, grounding beyond the bonding requirements may have limited effect in reducing sheath currents.

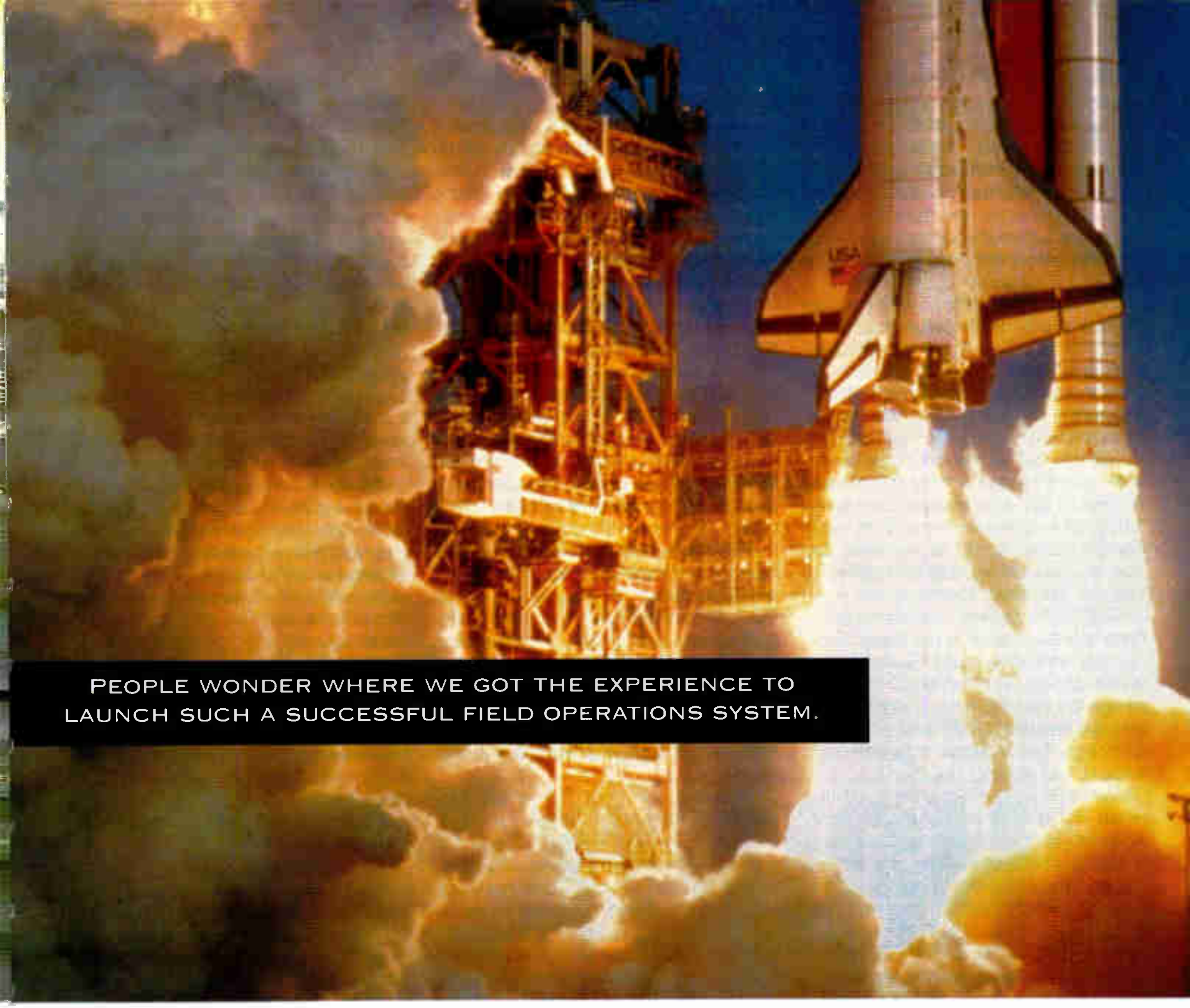
To meet the code for bonding to the multigrounded power system, the cable system has four bonds or grounds per mile. Adding another four grounds per mile to the existing grounded bonds totals eight grounds per mile. If we assume the grounds each measured 20 Ω, the neutral load carried by the cable system would be reduced by only about 6% and therefore may be of limited value.

If used, additional grounds should be placed near an active device. This could be the pole before, pole after or the pole at the active device. However, grounding before and after an active may provide a "safe area" at the amplifier, although recent field experience has shown if the recommended surge protection and fusing is implemented, this grounding is probably not needed. Additional grounding could be beneficial if a transient is induced at some location beyond the ground and the ground does in fact have a low impedance.

Surprisingly, the additional ground may provide very little protection against sheath currents. Normally a ground is considered good if it has a 20 Ω resistance. When we compare this with the parallel resistance of one span, 200 feet of .750, .500 and strand at 0.024 Ω, the ground's effectiveness at shunting sheath currents is questionable, especially if lower resistance grounds or bonds exist farther upstream or downstream from this point.

Number 6 copper wire is used from the strand to the ground rod, placed in a straight line with no sharp bends. The strand attachment needs to be a bimetal connection (with the press-type preferred). The ground rod attachment needs to be a solid connection to a clean surface. (Exothermic welding to the rod will be best.) Any resistance at the connections will reduce the effectiveness of the ground.

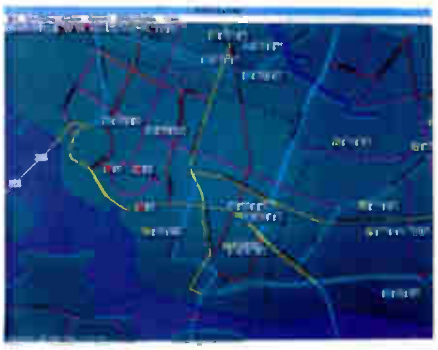
If an existing ground is in place, it is preferable to use a separate downlead and bond at the ground rod. The parallel downloads will provide a lower impedance path for higher frequency transients. This needs to be approved by the administrator of the pole attach-



System managers often wonder where Arrowsmith obtained the experience to bring such a successful field operations management system to market. So successful that it's the only system up and running that integrates an interactive interface with your billing system, and a user-friendly graphical operating environment with automatic vehicle and subscriber tracking and automated data communications to and from field trucks.

Our success is a result of our work with NASA, where we helped re-engineer space shuttle operations, and our systems integration work to support Department of Defense launch operations.

We're now using the same knowledge to help cable operators better manage their systems. It's called FLEETCON. A comprehensive work force management system that helps reduce operating costs, improve productivity and increase customer service, all at the same time.



Real time status can be checked by clicking on icons

FLEETCON is a very cost-effective investment. Measurable benefits include more efficient routing of installers and technicians, reduced drive and radio time, and elimination of excessive paperwork. And, for the first time, managers have access to real-time information about day-to-day operations right at their fingertips.

For more information about FLEETCON or our system integration capabilities, please call 1 800 454-3554.

ARROWSMITH

TECHNOLOGIES, INC.

8900 Shoal Creek Boulevard • Building 300 • Austin, Texas 78758 • 512/454-3554 • 1 800 454-3554

Reader Service Number 33

ment agreement. Should this location be a problem area, the ground resistance could be reduced by the addition of another ground rod. The ground rods are most effective when separated by a distance of 2.2 times the length of each rod. Separate ground rods need to be bonded together with #6 or larger copper wire. If possible, all connections (except to the strand) should be done with an exothermic process.

Grounding should be avoided at pole locations where the electric utility has spark gaps, lightning arrestors or primary switching. These locations have the capability to discharge extremely high electrical potential. A significant portion of that discharge could be transferred to the cable system. Grounding also should be avoided at locations that indicate a high current in the grounding conductor.

Grounding costs will vary in different parts of the country depending on labor costs. Material costs differ only slightly unless there is a requirement for exotic types of grounding such as chemical rods or extremely long rods.

Costs for labor and material for grounding to an existing electrode including a separate downlead and exposing and cleaning the electrode to make the bond are about $20 for labor and material. Driving an additional separate grounding electrode can have a wide range of pricing. If access is available to drive a normal grounding electrode, labor and materials cost about $30.

If minimum grounding is completed by installing a downlead and using the power company electrode, the cost for four contacts per mile is about $80 per mile. On the other hand, if a downlead and newly driven electrode are required, the cost could be $120 per mile or more. These prices were typical as of late 1991/early 1992, and do not consider the cost of removing sections of concrete and then repairing the opening after the grounding is complete, nor do they include the use of exothermic welding (if applicable).

Any area that experiences multiple failures that may be due to power-related problems needs to be investigated. Items to check include:

- Grounds should be tested using an earth null tester.
- Sheath currents should be measured.
- Bonds should be measured for current flow.
- Bonds should be lifted if high current is present.

Problems of high currents or high ground resistance should be referred to the power company and assistance requested to resolve the problem. Improving the ground resistance and lowering neutral current flow is a benefit to both the power and cable companies. If the power company is unable to provide the assistance needed, the bond could be relocated to another location. The important requirement is that four bonds per mile remain.

Longitudinal sheath currents

Longitudinal sheath currents (LSCs) are an unwanted electrical energy induced on the messenger and sheath of the cable. This is the result of bonding to the power company multigrounded neutral.

Most of the power distribution systems today are wye-configured four-wire primary and three-wire secondary with one of the wires being the common neutral. When all the loads are perfectly balanced, there is zero current flowing in the neutral. The probability of all loads being perfectly balanced is unlikely. As a result, there is usually some neutral current flowing most of the time. The consequence of being bonded to the multigrounded neutral is sharing the current flowing in the neutral system.

It is not unusual to find from 50 to 150 amperes of neutral current under normal conditions and well in excess of 300 amperes in a fault condition. The strand and coaxial cable system that has multiple cables will carry a substantial portion of the neutral currents.

Load sharing

Not only will the cable company share the load, in many cases it will carry the major portion of the load. The typical trunk/feeder system may be strand, .750 and .625 cable, with a total parallel resistance of 0.099 Ω per 1,000 feet. The power company neutral may be a 4/0 aluminum, which also would have a resistance of 0.1 Ω per 1,000 feet. With the same resistance in each path and both paths bonded to the same grounding electrodes, the neutral currents would be shared equally. The cable system with a 1-inch supertrunk, .750 trunk and .625 feeder on quarter-inch strand will have a resistance of 0.037 Ω per 1,000 feet. Comparing to the 0.1 ohm of 4/0 aluminum, the cable system would be carrying over 65% of the total neutral current.

A typical system without supertrunk, but with four bonds to power per mile with grounds at about 20 Ω each, results in the cable system carrying 41.5% of the load, a power neutral of 41.1% with 4/0 aluminum, with 17.4% dissipated to ground.

The ratios will change if the power neutral changes, the ground resistance changes, the number of ground rods change or the cable plant changes.

By changing the grounds from 20 to 5 Ω, the percentage of the load dissipated to ground changes from 10.3 to 45.7%. The same change also would occur if the number of 20 Ω grounds were increased from four per mile to 16. A greater percentage of the load can be dissipated by adding additional grounding electrodes or reducing the resistance of the electrodes, although portions of the cable system could possibly be subjected to fairly substantial neutral currents.

Another important component to the mix is what the power company is using for a neutral conductor. Changing from a 4/0 aluminum neutral to 4/0 copper at 20 Ω, the percent of load carried by the neutral changes from 41 to 59%. Conversely, if the neutral were changed from 4/0 aluminum to #4 copper the neutral load would change from 41 to 22% and the cable load would increase from 41 to 55%.

It is worthwhile to calculate all these numbers to understand the possibilities. However, it does not reflect the real world. All grounds are not 20 or 5 Ω. There are different combinations of cables and there may be different combinations of power company neutral conductors. Other differences are changing power loads and load balance. For the cable system to carry 60% of a 5 ampere neutral load would probably not be a problem, but 60% of a 300 ampere or greater fault condition load is a serious problem. Because of this, unless absolutely necessary, bonding or grounding the cable plant more than required by NESC is not recommended.

The headend

No discussion of outside plant protection would be complete without comments about the headend. While efforts to reduce outages in the system will have obvious results, the failure to do so in the headend also will have obvious results. Because headend outages affect all subscribers, it is of equal importance to take appropriate steps to minimize headend outages, including those that affect single channels as well as those that affect all channels.

As is the case with the cable network, particular attention must be given to headend surge protection and grounding and bonding practices. Headends (except for in the smallest systems) should be configured with on-line backup power so the headend does not go down because of loss of commercial power. Very small systems should have ready access to a standby generator that can be made operational in 15-30 minutes.

Surge protection

All lines entering or leaving the headend are potential paths for damaging surges and transients to reach equipment in the headend. Because of this, steps must be taken to ensure that each of these paths has suitable protection.

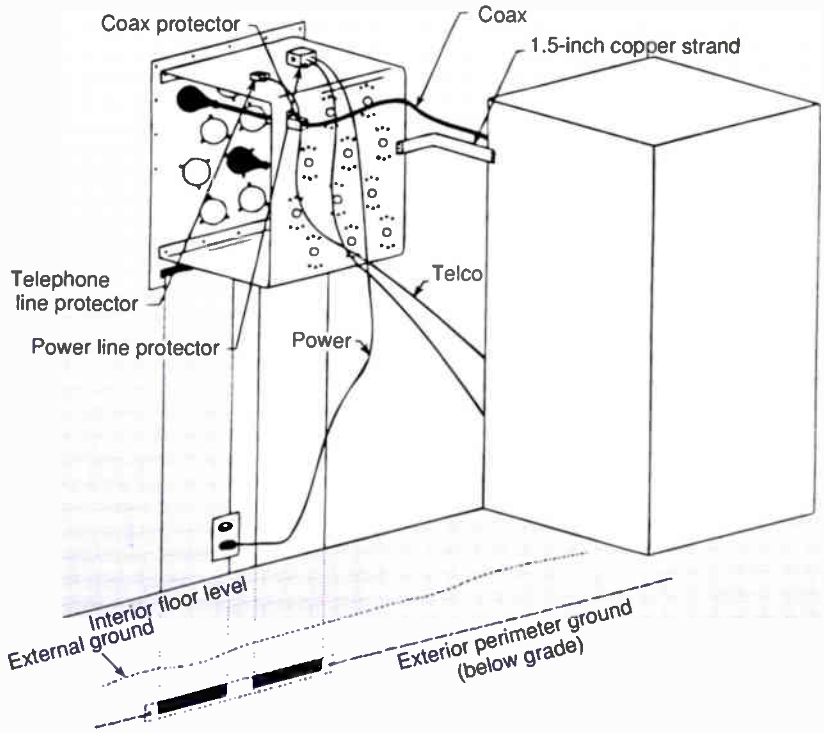
Internally generated transients from air conditioners, power tools, pumps, motors, elevators, office machines and various appliances also present risks to headend equipment. Here, too, preventive measures are important.

Any of several manufacturers can provide suitable surge and transient protection devices. It is not the intent of CableLabs or the Outage Reduction Task Force to recommend specific products, but rather to encourage the use of effective protection in the first place. System staff should take care to consider all possible headend input/output lines that represent likely paths for surges and transients. Among these are the following:

- Power line.
- Telephone/data lines.
- Feed from backup generator.
- Over-the-air antenna downleads.
- Rotor control lines for search antenna.
- TVRO feeds.
- Two-way radio or repeater antennas.
- Tower lighting wiring.

→

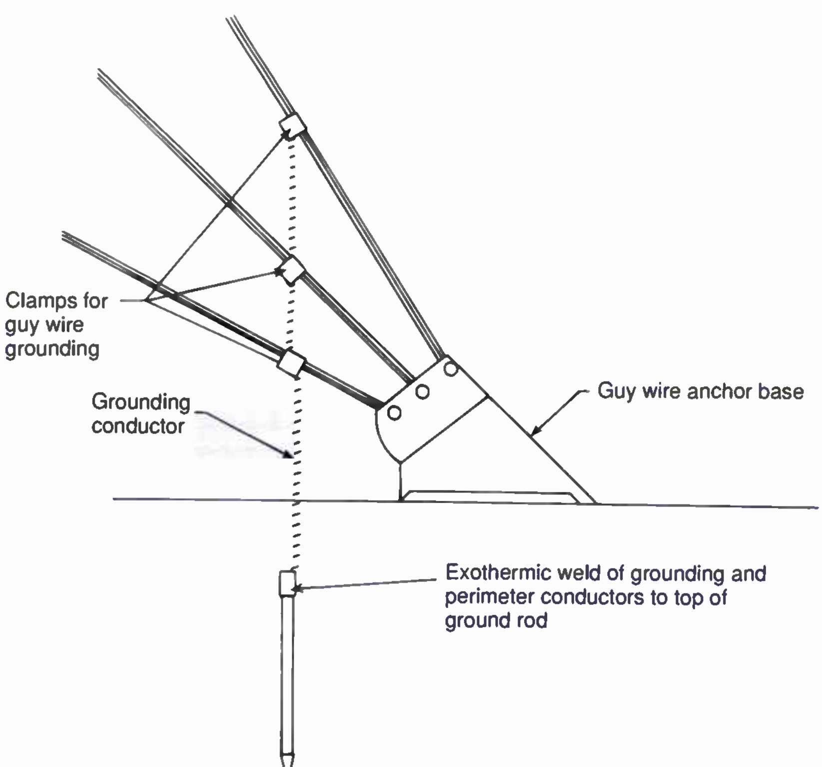
Figure 1: Typical bulkhead panel system, inside view



(Courtesy PolyPhaser Corp.)

- Microwave waveguide.
- Broadcast, translator or MMDS transmitter feedlines.
- Incoming supertrunks or hub interconnects.
- Outbound trunk and feeder cables.

Figure 2: Guy wire grounding detail



It is important not to be lulled into a false sense of security after protecting one or two lines (for example, power and over-the-air antennas) that may have been the only source of surges in the past. Any of the remaining lines can become the new weak links and produce entirely new problems.

A transient-suppression plate (bulkhead) is recommended as a surge/transient "shock absorber." The plate must be in common with the equal potential grounding system as well as the outer shields of all incoming/outgoing cables. Center conductor protection of these same cables is most effective at a sub-chassis or sub-bulkhead attached to the inside of the primary bulkhead. Telephone/data, power and other line protectors also should be mounted on this sub-chassis. (See Figure 1.)

Headend grounding and bonding

Transient and surge protection, (as well as lightning protection) will be ineffective without the implementation of good grounding and bonding practices. The concept of common-point grounding to form an equal potential grounding system at the headend is very important, especially with regard to protection from lightning. While no form of complete protection from a direct lightning strike is available, high-quality grounding/bonding practices will be a good place to start.

At the very least, a perimeter ground system (ring) around the headend building can serve as the basis for creating an equal potential grounding system. It should be buried at least 12 inches to keep it below grade, and deeper if necessary to place it below the frost line. (Frozen earth is a poor conductor.) All building, tower, antenna, power, bulkhead and other grounds must be bonded to this perimeter ground. It is recommended that all outdoor grounding attachments, especially those underground, be done using an exothermic process instead of mechanical connections. Ground rods should be spaced periodically (about 2.2 times the length of a single rod) along the perimeter ring, with connections between the ring and the rods via an exothermic weld process.

In some cases tower manufacturers will void wind-load certifications or structural warranties when ground attachments to the tower legs are done using exothermic welds. It is important to discuss this with the manufacturer of your tower beforehand. If this is the case, the tower manufacturer may be able to recommend or provide suitable alternatives. If exothermic welds will be used for tower grounding connections, remember that the area of each leg where the attachment occurs must be cleaned to bright steel before the welding process. After welding, the weld areas must be protected with a cold galvanize compound, and the tower ground connected to the common perimeter ring.

If the tower is guyed, the guy wires also must be grounded (avoid the use of dissimilar metals when making the ground attachments to the guy wires) to the common system. (See Figure 2.) The grounding conductor will be attached to the guy wires with suitable mechanical connections, but where it attaches to the ground rod(s) and perimeter grounding system exothermic welds should be used.

Wiring and cable grounds (shields) on the tower must be bonded to the structure at the top and bottom using suitable grounding kits, and every 100 to 150 feet in between where applicable. Metallic security fencing around the headend also must be bonded to the common grounding system. Here, too, exothermic welding is recommended for permanent connections.

Ground wires should be large and run as straight as possible and separated from other conductors by 6 to 8 inches. Ground wires should not be run inside or through a conductor or metallic conduit unless bonded to it (preferably at both the entrance and exit). For metal walls, it is recommended that the ground wire be bonded to the wall on both sides rather than passed through it.

There is generally no need to run ground wires up the side of a tower because the resistance difference between copper and galvanized steel becomes negligible as a result of the difference in inductance because of each one's surface area. Even a separate grounding conductor for tower-mounted lightning rods will likely arc to the tower unless spaced about 24 inches from the tower leg. In any case, bare copper wire should never come in contact with galvanized steel because of the dissimilar metals corrosion that will occur.

Buried ground radials extending away from the perimeter ring and the tower(s) should be connected to ground rods (5/8 inch x 8 feet minimum) that are spaced 2.2 times their length apart. For example, if 8-foot rods are used, they should be spaced about 17.6 feet apart. The more radials available, the better the grounding system.

When soil conductivity is poor, the use of chemical ground rods is recommended. These are hollow pipes with weep holes that allow replaceable chemical salts inside the rod to leech out into the soil and improve its conductivity. The salt mixture inside the rod has to be replaced every two to five years. Chemical rods are considerably more expensive than conventional rods, but they will work when poor soil conditions are present.

The objective is to achieve an overall grounding system resistance of 5 Ω or less. This can be measured with an earth null tester. →

Backup power

An easy solution to loss of signal due to commercial power outages at the headend is to provide backup power, usually in the form of a standby generator with an automatic transfer switch. This arrangement will sense the loss of commercial power, start the generator, then switch to the generator for electrical power for the headend. Some packages include provisions for automatic operation of the generator to periodically exercise the equipment and ensure that it works correctly.

While very effective as an alternative to the complete loss of headend operation, there is usually a brief period — perhaps only a few seconds or so — between the failure of commercial power and the availability of electrical power from the generator. In addition to being a source of irritation to subscribers, these brief losses of power are believed to contribute to reduced life with some types of headend equipment.

The task force therefore recommends that an uninterruptible power supply (UPS) be incorporated in the headend to maintain operation during the brief switch-over between commercial power and generator operation. The UPS only needs to have sufficient reserve for perhaps 15 minutes of backup, which is enough to allow the standby generator to stabilize before being switched on-line.

In any event, consideration should be given to some form of status monitoring to allow system personnel to know when the headend is operating on standby power. This is especially critical for remote or rural headends, where extended commercial power outages could exceed the fuel capacity of the standby generator. As with other headend inputs and outputs, the generator lines should be equipped with suitable surge/transient protection.

Summary

The reduction of outages in today's cable systems is a goal that must be on every operator's agenda. Achieving the recommended target of no more than 0.6 outages per month per subscriber will require that a number of important tasks be completed. Among the easiest is outside and headend plant protection.

While the operator must understand the definition of an outage and have effective outage tracking procedures in place, the simultaneous deployment of solid-state surge protection that meets the guidelines presented in this article, and implementation of the task force's recommended fusing practices, will result in a fairly significant reduction in outages. The recommendations for headend protection also should be performed, because headend problems will affect all subscribers simultaneously.

Although not directly related to outside plant protection, headend and system maintenance practices that result in system downtime on one or more channels need to be coordinated and scheduled in a manner that will cause the least disruption to customers, particularly in prime viewing times. Even maintenance downtime is perceived by the subscriber as a form of an outage. Proper scheduling of maintenance "outages" can become part of a system's outside plant protection practices, contributing to the overall reduction of system outages. **CT**

Emergency restoration

(Continued from page 24)

Restoration procedures

If an emergency occurs, what should happen to expedite restoration? Generally, there are four key steps to follow when an outage is reported.

- *Step 1 — Troubleshooting:* The headend technician should inspect the appropriate system electronics for failure or problems. If none is found, the next step is to inspect the optical cable system.
- *Step 2 — Testing the cable system:* The technician can use an OTDR at the headend and obtain an OTDR trace of the optical fiber. This trace is compared to the original signature trace to locate any abnormalities, and isolate which cables and fibers are affected. If a fault is found, the OTDR will give an approximate distance from the headend to the fault, giving you a head start in finding the problem. The designated restoration team is then notified.
- *Step 3 — Evaluating the site:* The emergency restoration team goes to the site with a restoration kit, safety equipment, etc., to find the cause of the problem and prepare for repair.
- *Step 4 — Restoring the cable:* The restoration team inspects the cable, removes the damaged section and begins the repair. The cable ends are prepared for installation into the splice closure and buffer tubes are routed into the splice trays. The highest priority fibers are spliced first, as defined by the restoration plan. Then the crew checks with the headend technician that the status monitoring alarm has cleared. Once cleared, the remaining active fibers plus a few spares are spliced and the closure is temporarily sealed.

Restoration plans in action

Do emergency restoration plans really work? According to system operations personnel with Cablevision Systems, the answer is yes. Jack Eiseman, senior engineer at Cablevision Systems, indicates that having a formal policy in place is essential to quickly restore both fiber and coaxial cable plants when damage occurs.

At Cablevision Systems, designated fiber-optic cable lengths are prepared and stored for use in emergency restoration situations. Normally, Eiseman orders 5 to 10% above the required lengths for cable spans when the initial cable order is placed. The excess cable lengths from the highest fiber count cables are then prepared with a mechanical splice and reserved for use to temporarily restore a cable until the permanent length can be fusion spliced in place. They keep the highest fiber count cable on hand, which enables technicians to restore any cable within the system. That way, no last-minute rush orders have to be placed to repair fiber-optic cables within a system.

In addition, Cablevision Systems builds in 100- to 200-foot loops within the aerial spans. This cable slack can be used for restoration if required. Documentation is a critical element to all fiber systems. "On every project, the installers are required to provide system and corporate documentation on everything that's done — the splicing, where the splice points are located, and what fiber counts are used," Eiseman explained. "Every system keeps maps of the fiber run and lengths between splices and nodes, as well as overlength locations."

An initial OTDR trace is taken when the installation is completed to serve as the as-built records. The records are used to compare with traces taken at a restoration site to isolate problems or determine the extent of damage by comparing "before" and "after" system records. Once the permanent restoration is completed, new traces are taken and kept on file as permanent records.

Mechanical splices installed onto the spare cable length create restoration "jumpers." This ensures that the repair can take place without complications. "It's simple and quick to activate the fibers for temporary restoration," Eiseman said. Once the final, permanent restoration is performed using low loss, low reflection fusion splicing, the "jumper" is disconnected and placed in a specially designated area, should other restoration needs arise.

Often, the damaged cable will be sent to the supplier for evaluation. Cablevision Systems also incorporates personnel training and safety procedures in its formal restoration plan.

Summary

While fiber-optic cables are designed to be rugged and withstand natural and man-made elements, there are times when damage will occur. By having a formalized, standard restoration plan in place, cable repair can be completed quickly and efficiently. **CT**

Figure 3: SEP equalizer adjustments

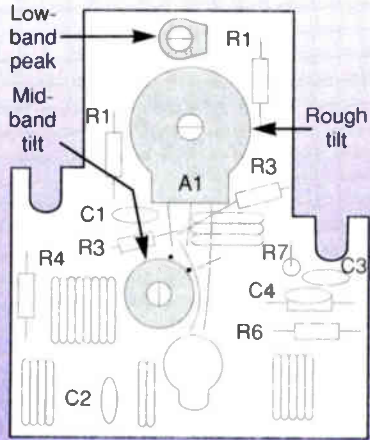
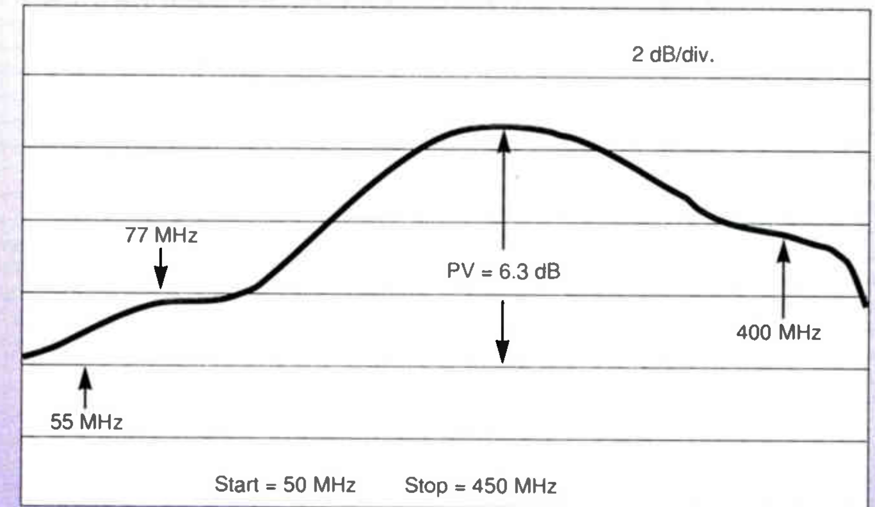


Figure 4: Sweep reponse of trunk with equalizer misadjustments



System upgrade

(Continued from page 27)

older SEP type. The SEP was designed for use with trunk modules not containing tilt controls. Since more than one adjustment was required to set the equalizer for proper tilt and frequency response, a system sweep was required to initially "set up" this style equalizer. Figure 3 illustrates an SEP equalizer and the controls most often adjusted.

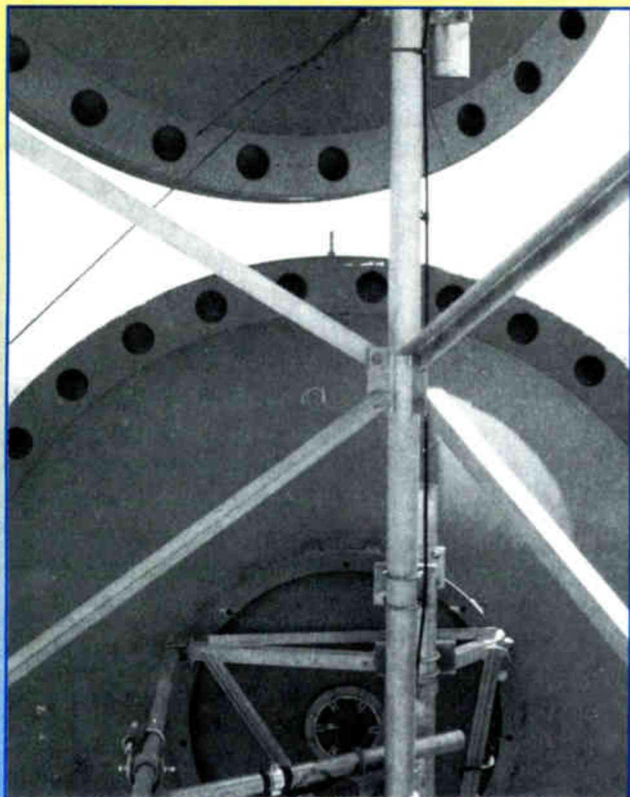
Improperly aligned equalizers usually resulted in a severe roll-off from Ch. 2 compared to Ch. 6. Another symptom was the mid-band channels "humping up" above the high end frequencies of the system. Many times both "low end roll-off" and "mid-band humping" existed due to misaligned SEP equalizers. Even when the system was properly balanced, the temptation to reset equalizers by maintenance technicians using only a level meter often eroded system flatness of response. Figure 4 represents a typical sweep response of a trunk cascade where equalizer misadjustments resulted in an unacceptable peak-to-valley.

The solution was to develop an adapter board that would accept a fixed value equalizer originally manufactured by Jerrold. The fixed value equalizer selected was commonly available in 2 dB steps from 0 dB to 26 dB cable equalization up to at least 550 MHz (lower frequency values, i.e., 450 MHz and 350 MHz, also were available). Although only a limited number of SEP equalizers have been replaced with the combination adapter board and fixed equalizer to date, this new product seems to resolve the SEP equalizer flatness problems. Ironically, the combination adapter board and fixed value equalizer (two separate boards) cost less than a new SEP equalizer.

Conclusion

Fiber optics has become a great new tool for upgrades to reduce trunk cascades. The hybrids within the system amplifiers also play a critical roll in additional usable bandwidth. The use of power doubling, feedforward, super low noise figure input hybrids and quad power (dual power doubling) in conjunction with re-equalization are all tools to add system channel capacity. As well, mini-LEs can be used to solve low subscriber tap levels in the feeder plant. Every tool will be required to meet tomorrow's technical demands. **CT**

Figure 3: Adjusting the azimuth



"Remember, if you are 15-20 dB low from the calculated output you are probably off on a side lobe."

Microwave antenna prealignment

(Continued from page 28)

in Figure 2, adjust the elevation arm to the calculated figure. Next, we need to determine an azimuth (left-right) adjustment. Flash the path with mirrors so each tower can be accurately located or use the azimuth numbers from the path calculations and align with a compass. Be sure to adjust the readings from true north to compass magnetic. Refer to the site topographic maps for the correction figure. Place a 1/2"x3" bolt on the top rim of the antenna at the vertical most position as shown in Figure 3. Now position yourself as far out behind the antenna as possible and center the wave-guide port up with the bolt pointer. Swing the antenna around so it is aimed directly at the other end of the path. Lock down the adjustment arm. Complete the rest of the installation with waveguide, grounding, LNA, etc. Duplicate this procedure at the other end as required. Activate the transmitter per your owner's manual and set the transmitter power level.

Now at the receiver, complete the activation procedures and then connect your SLM to the no-AGC VHF output, do not connect to the -20 test point because the signal is too low for path alignment. Signal should be present at pilot tone but it may be a very low -15 to -40 dBmV so look closely and use a sensitive meter. Now loosen up the receive antenna and do an azimuth swing to peak up on the main signal lobe. Next, make an elevation adjustment and again peak up on the main lobe. Repeat this procedure while adjusting the transmit antenna. Remember, if you are 15-20 dB low from the calculated output you are probably off on a side lobe.

When the signal is peaked up to a maximum level (per path calculations) have the transmit antenna crew begin lock-down procedures while the receiver crew monitors signal level. When completed at both ends, the no-AGC carrier level should be no more than 1 dB less than the pretightening sequence level.

There are many benefits to doing this type of prealignment work. One is to prevent interference into existing CARS stations in close proximity to yours. Or to keep a new licensee coming on line from interfering with your existing system. Another is to more accurately place the waveguide routing to the antennas. **CT**

Conditional access

(Continued from page 32)

countered by an unauthorized user in attempting to gain access to the service. Security may be breached in two ways, representing two aspects of difficulty:

1) Descrambling the signal without reference to the access control process. This is a function of the nature of the services and the scrambling method.

2) Obtaining access control in an unauthorized manner. This is a function of the security of encryption algorithms used to protect access control messages and the method of key distribution.

Security issues

The cable industry has been using security methods of one kind or another to protect cable programming for almost 20 years. For close to half that time, satellite-delivered programs have been secured using technology that includes the application of encryption of digital signals. As cable engineers are well aware, each technology in turn has attracted the attention of "signal pirates," who have in almost every case found it relatively easy to circumvent the security — in many instances in simple ways never envisioned by the system designers. One thing seems to be certain, the greater the attraction and value of the programming and the larger the target audience, the more resources are brought to bear on "cracking" the system. Issues raised by the past performance of security systems are worth discussion in order to set establish goals for the next generation technology.

Almost any proposed system is subject to the possibility of being broken at some point in time. The goal of the system operator and system provider is to make the cost of piracy very high compared with the perceived value of the targeted programming — and to do this with affordable security equipment. Nevertheless, anticipating that the security of a system may eventually be broken, system design should permit recovery from compromise with minimal cost, perhaps by exchange of a plug-in component (e.g., a smart card).

In the past, a common method of attacking a conditional access system has been to purchase authorization of a single service and then by modification of decoder hardware to gain access to all other services. A superior system will not allow the security of any one service to be dependent upon any other.

Most equipment vendors have (and rightly so) tried to keep detailed information about scrambling/descrambling technology out of the hands of would-be pirates. However, even the most complex systems have been quite readily reverse-engineered. Even when all details of how a system works (including circuit and semiconductor details of set-top decoders) become public, it must still be possible to maintain system security.

Modern data encryption technology has progressed to the point where, with proper design, it can be made impossible to decrypt data messages or programming in real-time without access to decryption keys. However, the state-of-the-art in high-speed processing continues to advance; encryption algorithms must be selected to be well beyond any projected future ability to crack encrypted coding in real-time.

The most common methods of compromising existing cable and satellite TV security systems have involved modification of set-top decoders already provided to the public — in many cases in surprisingly easy ways. Attention to the physical aspects of security will still be important. To the extend that security may intentionally be designed to reside in replaceable components (e.g., smart cards) the industry must be satisfied that the cost of cloning and distributing unauthorized devices is extremely high — or provision should be made for electronic countermeasures sent over some path (e.g., telephone lines) other than the cable delivery system.

Desirable attributes list

This suggested list is provided in two parts. First is a list of primarily security/performance attributes that should be considered fundamental for all services. Second is a list of desirable features and other questions that should be addressed case by case dependent upon specific programming service and other business considerations. These lists are suggested as a starting point for industry discussion.

A) Desirable attributes

1) System security

a) General — The system security design should provide:

- System security entirely contained in the delivery and processing of encrypted keys; it should permit recovery from any security compromise.
- That access to any one program service (whether by authorization or compromise) should not facilitate unauthorized access to any other service.
- Secure operation even when threatened by a party with total system information; i.e., the system must be secure even if all details of how the system operates should become public.
- To the extent that withstanding piracy threats over a long time may require the periodic exchanging of some key components of consumer conditional access equipment, this capability for changes should be provided in a way so as to minimize the costs of such exchanges.
- Images and audio of transmitted signals should be unrecognizable when received and displayed by receivers not authorized to receive the scrambled programming.
- Non-feasibility of recovering the clear signal by inspection of the scrambled signal and performance of any reasonable processing on the information contained therein.
- Secure transmission of ancillary services.

b) Physical — Physical security measures should:

- Preclude a typical consumer with household tools from defeating any security function.
- Preclude a commercial enterprise from making cloned units or modifying legitimate units such that security measures are defeated. The cost of cloned devices should be much greater than the value of the deferred service cost.

2) Signal quality

a) Under perfect signal conditions:

- There should be no perceptible artifacts in video caused by the scrambling/descrambling process.
- There should be no perceptible artifacts in audio (or data ancillary services) caused by the scrambling/descrambling process.

3) Signal robustness

a) The effect of noise or signal degradation on reception and descrambling of scrambled signals should be no greater than the effect of such signal-path imperfections on nonscrambled signals.

B) Desirable features and other considerations

1) Addressability and tiering

a) Pre-authorized tiers

- Number available
- Independent control of audio, data and text

b) Addressability

- Size of the universe (per operator/system)

• Data space required per addressable consumer terminal
• Universal key and fail-safe modes
• Interface to automatic ordering systems

2) Subscriber and pay-per-view
a) Lock-out functions
• By rating (parental control)
• By channel or time of day
• By pay-per-view

b) Program tracking
c) Transactions per month
d) Impulse pay-per-view: increment/decrement function
e) Return loop provision
f) Multiple operator pay-per-view
g) Consumer-friendly operation.

3) Multiple operator use and control
a) Feasibility of simultaneous multiple operator use
b) When encrypted signals are delivered to cable headends, provision for local cable system intervention to manage conditional access control and key distribution within the cable system.
c) Separate billing systems for multiple operator use
d) System capacity: multiple simultaneous billing systems

4) Ancillary services
a) Control of multiple sound channels
b) Teletext/captioning capability
c) Allocation flexibility for ancillary services

Evaluation and selection process

The process of evaluation and selection of a secure conditional access methodology should start with the assertion that this is a decision completely separate from selection of compression technology (or selection of compression system vendors). It is suggested that development of a list of requirements, desirable attributes, features, etc., be the subject of a broad effort by program suppliers and system operators, with input from and review by compression and encryption system suppliers. Would-be suppliers should be urged to reveal *all* details of proposed systems, including the results of independent security and analyses, and including details of potential threats.

A key ingredient of a successful program (one that results in conditional access technology that will survive security challenges over the lifetime of compression systems and hardware) is likely to be the inclusion of independent outside expertise, especially experts who can focus on the programmatic methods favored by those engaging in signal piracy.

Conclusions

Although the cable industry appears to be moving rapidly to adoption and standardization of compression technology, it should separately assess the long-term requirements for conditional access and security. Opportunity exists to put together the most representative listing of desirable attributes and to organize the thorough, independent evaluation of proposed security elements before designs for consumer decoder decompressors are frozen.

References

[1] ATSC Document T3/180, "ATV Conditional Access System Characteristics," rev. Sept. 18, 1992.
[2] CCIR Study Group II, Document II/BL/33-E, May 26, 1992.

Acknowledgment

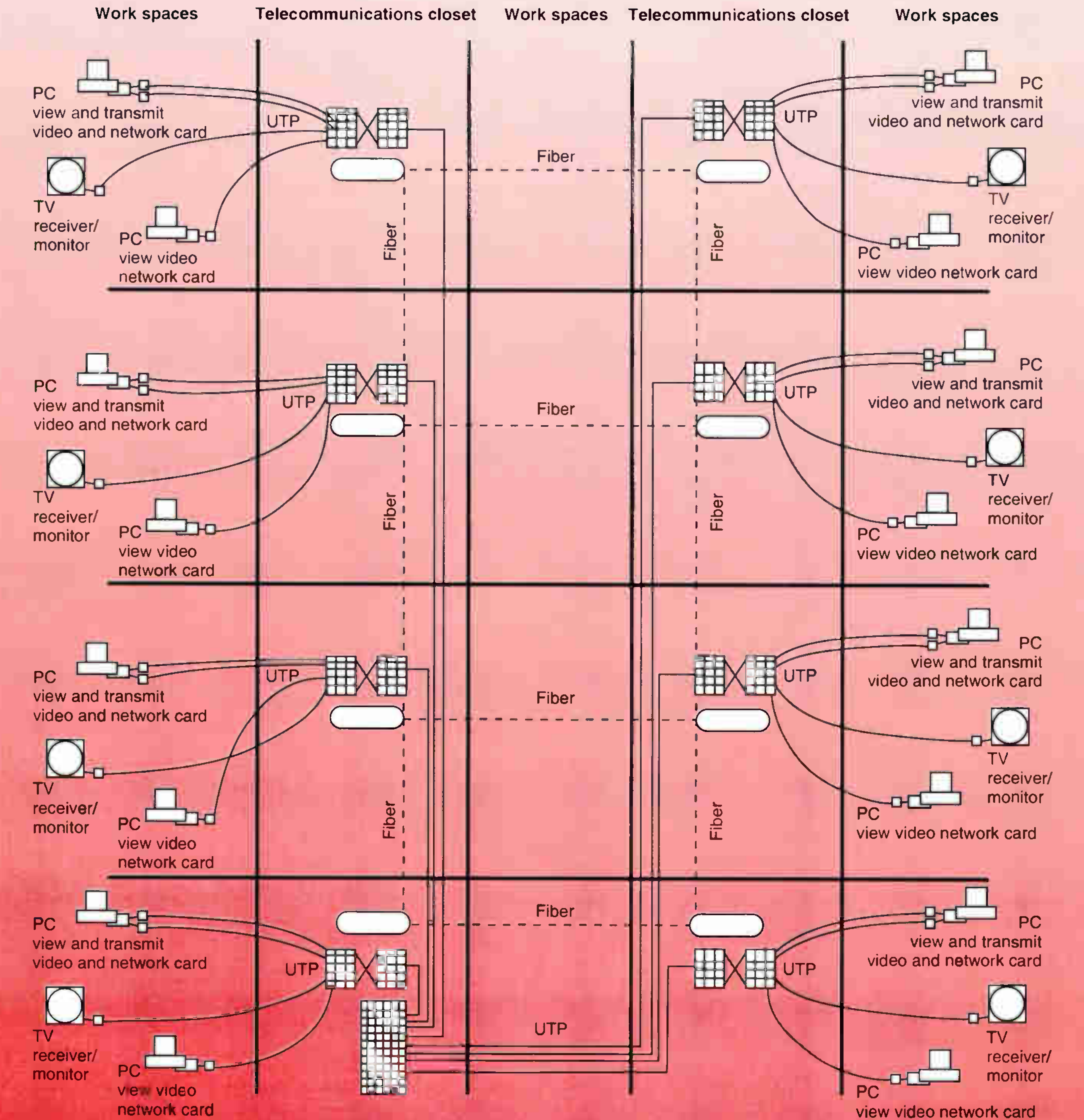
The list of desirable attributes suggested in this article is based substantially on work on similar issues for HDTV, performed and reported by ATSC. **CT**

Video-on-demand to the desktop workstation

By Richard L. Allison
Senior Communications Designer
Sverdrup Facilities Corp.

The intelligent building design of today can provide voice, data and video services to each desktop workstation. All that is required for the video service is the installation of a video matrix switch and a networked video server. A user at a workstation may schedule/view videotapes, over-

Figure 1: Universal wire topology



Intellectual property — Its role in HDTV

By Isaac S. Blonder
President, Blonder Broadcasting Corp.

Intellectual Property (IP) is an all-inclusive term covering patents, trademarks, copyrights, trade secrets and know-how. As an engineer with 36 patents and 40 years of manufacturing behind me, I can relate to the importance of IP to the inventor, manufacturer and user of technology, especially when it is made mandatory by government edict.

On the one hand, U.S. citizens pay royalties and conduct their affairs in relatively precise paths according to the legal strictures set in place by laws and customs. On the other hand, government agencies seemingly ignore the very rules they have set in place for civilians to deal with each other on IP matters, and use privately funded IP without open and clearly defined compensation to the inventors.

The FCC may be the most frequent pilferer of IP among all of the government agencies. I well remember the BTSC Committee on which I served. If ever we needed an inspired invention to serve the American public, that was the right committee. But what awaited the inventor in his fabled garage? Was he assured a secure license, at a reasonable rate, to reward him for his lonely and usually underfinanced efforts? Of course not! What he faced was the need for deep, deep pockets to pay incredibly high priced lawyers to fight interminable battles in courts.

Now, it's HDTV

Now the commission has sounded a clarion call for an American solution to the HDTV quagmire. What incentive, other than good citizenship and a pat on the back is offered to the winner? Let us assume another Armstrong appears with the perfect HDTV system. If he is lucky, he will not have to commit suicide, he may only face a minor jail term (perjury), or take cover under the friendly legal blanket of Chapter 11. Apparently, once the commission has decided to accept a specific technology and issue precise, unyielding guidelines for a new service to be operated in the public interest, the inventor is on his own to profit from his invention and must sue everyone for whatever royalties his lawyers can scare out of the users.

The Constitution, Article 1, Section 8, gives Congress the power to award patents that, in turn, give the inventor exclusive right to the income derived from licensing the invention to others. There should be no reason (this non-lawyer speaking) why the FCC couldn't require the users of the new technologies to pay a prescribed royalty, and virtually preempt any legal battles by assigning to the inventors their fair share of the income according to the value of their contribution.

To me, a tattered victim of many legal battlefields, the stench of the oncoming HDTV courtroom slaughterhouse is plainly clouding the landscape. Here are a few of the issues on which the legal beagles will pile up their briefs:

1) No agreements have been signed by the proponents that they will abide by the technical judgments of the Advanced Television Test Center (ATTC).

2) No royalties in amount or extent have been specified by the FCC.

3) Every proponent has to be assured

that he was treated equally by the testers, both in time, equipment and tolerance for defective equipment hindering his presentation.

4) Every disclosure of technology has to be kept absolutely confidential so that patentability is not affected.

5) Each proponent must fully document the source of any inventions so that no one can appear after the tests and claim priority of the technology.

And the winner is ...

Progress in science is well known to be imprecise. Out of the many HDTV systems to be tested by ATTC, it is highly unlikely that a clear winner will emerge. Is the committee that has been designated to choose the winner from a pack of question marks, likely to escape intense questioning about their morals and motives in a court of law? Haw! Probably the FCC commissioners themselves will be forced to make the final choice. The inevitable delay in sorting out the pitfalls and options will put 1993 in the ash can.

Finally, it has been suggested by some individuals, mostly from the academic world, that all the parties get together and divide up the patent pie and present the commission with a pretty solution. I have never seen this kind of an antitrust situation settled amicably and without a courtroom full of "you know who." (read lawyers) Time is not on our side.

Is there an answer? "Muddle through" is about all. **CT**

March 1993

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

Primer on fiber

Table of Contents

Fiber-optic cable designs advantages and disadvantages

This article, which is reprinted with permission from the "1991 NCTA Technical Papers," presents an objective view of the different fiber-optic cables being offered to the CATV market and the advantages and disadvantages of each. Different basic designs such as loose tube, central core tube, slotted core, and tight buffer are discussed. The advantages and disadvantages of dielectric vs. armored, and steel bearing cable also are examined. In addition, a short discussion on future developments in fiber-optic cable design is presented.

By John C. Chamberlain
Fiber Optics Product Manager
Comm/Scope Inc.

Although fiber-optic cable is relatively new in the CATV industry it has been a commercial venture in the telephony industry for over ten years. This mature fiber-optic cable industry offers a number of cable designs for different applications.

Design objectives

The design objectives in fiber-optic cable are fairly simple. The first concern of the cable designer is to protect the glass fiber from the outside environment. The fiber must be protected from the physical rigors of being installed and placed for up to 20 years in the outside plant. These include forces such as impact, tensile, twist and compressive loads. In addition, the fiber must be protected from any moisture. The fiber itself is degraded by moisture and if water were to get into a cable and freeze, it could physically crush the fiber. Probably the most critical design parameter is temperature performance.

The typical specified operating temperature range of fiber-optic cable is from -40 to +70°C. The design problem is that the fiber has a coefficient of expansion on the order of 10^{-7}, while the majority of the plastics used in fiber-optic cable design have coefficients of expansion on the order of 10^{-5}. Therefore, when the cable is subjected to temperature extremes the plastics expand and contract 100 times more than the glass fiber. If the fiber-optic cable is not designed correctly this coefficient of expansion differential could impart forces onto the fiber that would manifest as drastic increases in attenuation or, in the extreme case, fiber breakage.

The cable designer offsets this differential in coefficient of expansions with high modulus, low coefficient of expansion materials such as fiberglass reinforced plastics and steel. The cable designer gives room for the fiber to collapse and expand like a spring by placing it in a loose tube.

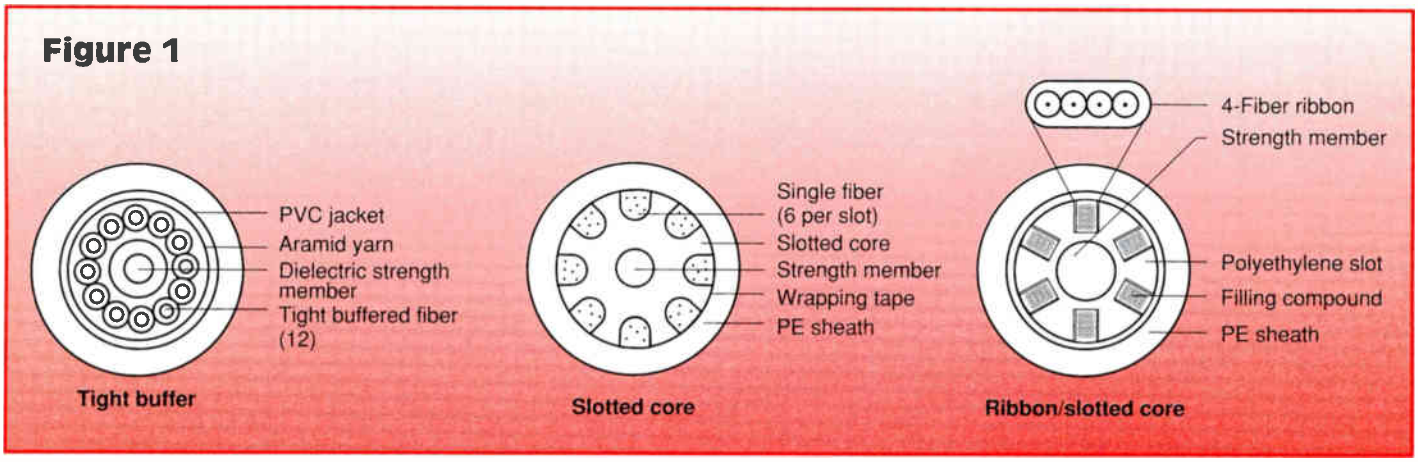
In addition to the above technical design problems, the fiber-optic cable must be easy for the craftsman to work with. It should be easy to access and identify the fibers, as well as lightweight and small.

"Because of field performance and ease of handling, the predominant cable designs being offered to the CATV industry are the loose tube and central tube types with bundled fibers."

Fiber-optic cable designs

There has been a number of different solutions to the design problems just discussed. For the purpose of this paper, tight buffer, slotted core, loose tube and central core cables are discussed. But because loose tube and central core cables are the products being offered to the CATV industry, the comparison sections of the article will be limited to those two designs.

Tight buffer cables are called so because a layer of plastic is extruded directly onto the acrylate-coated fiber, thereby creating a tight structure around the fiber. The advantages of such a design are in handling. Each fiber unit is larger and less sensitive to handling mishaps because individual fibers have a relatively thick plastic protection covering them. Although these products have been used in outside plant environments, largely in the past by the Japanese, they are not well-suited for those applications. The first problem is that whatever compressive or tensile forces are experienced by the cable also are experienced by the fiber. This means a large amount of high modulus, low coefficient of expansion materials, such as steel and aramid yarn, must be used in order that the fiber not see high strain levels. In addition, tight buffer cables become comparatively large and difficult to design when fiber counts exceed 24.



Slotted core cable is employed a great deal overseas and was used initially to some extent in North America. Slotted core cable consists of a cylindrical plastic core with longitudinal slots cut into it. The fibers are then placed into these slots. After the fibers are placed into the core any number of a variety of armors and jacket layers can be applied. In some applications this design fell out of favor because of the difficulty in handling when the jacket was stripped off. Also the difficulty in filling and placing the fiber into the slots made for an expensive product. Slotted core cables combined with fiber ribbons are again gaining some popularity, especially in Japan, due to the high density of fiber that can be attained in such a configuration. (See Figure 1.)

Loose tube cables are one of the two most popular designs offered in North America. One to 12 fibers are placed within a gel-filled tube for protection. The tubes are then stranded around a dielectric or metallic strength member. The combination of the loose tube around the fibers and the stranding pitch of the tubes creates a tensile and contraction window. This window allows for the cable to contract and be elongated on the order of 0.3% while imparting no stress on the fiber. The cable therefore can be designed such that at specified temperature extremes and tensile loads little or no strain is experienced by the fiber. This fiber-optic cable core then can be protected by any number of different sheaths, depending on the application. This product has been very successful because of performance in the field and handling issues for fiber counts over 72.

The central tube fiber-optic cable is the other popular design in North America. In this design the fibers are all encased in one large tube. The fibers are separated into groups either by ribbons or fibers bundled by colored ID threads. The ribbon design is applicable for high fiber count cables that are being put into systems that do not require low splice losses. These cables can be shipped preconnecterized with easily used array splices, although the losses of the array splices can be sporadic and relatively high for single-mode fiber. The fiber bundles have up to 12 fibers per bundle. Each individual fiber and binder thread is color-coded. In fiber counts higher than 72 it can sometimes be difficult to manage all the fibers in one tube. In some sheath designs for this core a number of steel wires or small dielectric rods are used for strength and temperature compensation. These "cross-ply" sheaths are very environmentally stable but also very difficult to enter. A recent innovation to make these cable designs more user friendly is to armor the core and place either six dielectric or two steel strength members 180° from one another longitudinally along the tube. After jacketing the cable, additional armoring and jacketing can be applied. This design, like the loose tube design, allows a contraction and tensile window for the fiber. Again, the cable can contract or elongate on the order of 0.3% with no effect on the fiber. (See Figure 2.)

Because of field performance and ease of handling, the predominant cable designs being offered to the CATV industry are the loose tube and central tube types with bundled fibers. These two cable designs are themselves offered in a variety of different configurations. The remainder of this article will compare and contrast these two cable designs and the different configurations of each.

Existing fiber-optic cable specifications

There are a number of existing fiber-optic cable specifications for the telephone industry that are used for the CATV and other industries. The

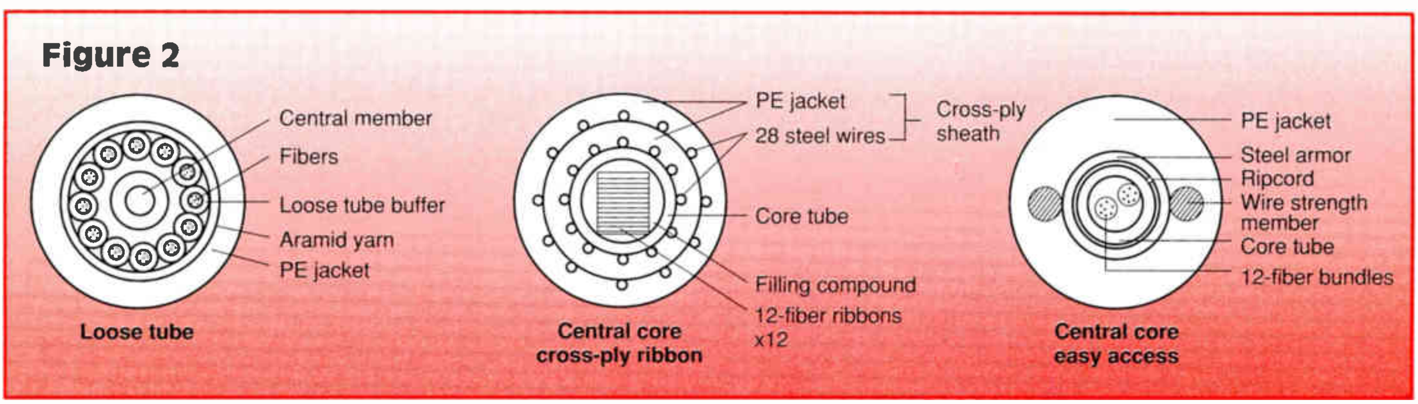


Table 1: Mechanical and environmental tests

Test	EIA-455 specifications	Mechanical requirement	Optical requirement
Tensile strength	FOTP-33	600 lb, Bend radius = 20 x cable OD	≤0.1 dB increase @ 1,550 nm
Compressive strength	FOTP-41	1,000 lb, total load	≤0.1 dB increase @ 1,550 nm
Cable twist	FOTP-85	±180° twist, 10 cycle	≤0.1 dB increase @ 1,550 nm
Low and high temperature bend	FOTP-37	Bend radius = 15 x cable OD 4 wraps ea. at -20°F, 140°F	≤0.1 dB increase @ 1,550 nm
Cyclic flex	FOTP-104	Bend radius = 15 x cable OD	≤0.1 dB increase @ 1,550 nm
Impact resistance	FOTP-125	52 ft lb, impact, 25 cycles	≤0.1 dB increase @ 1,550 nm
External freezing	FOTP-98	1 hr. min. freeze at -2°C	≤0.1 dB increase @ 1,550 nm
Temperature cycling	TR-20	-40 to +70°C, 4 cycles	100% ≤0.2 dB/km increase 80% ≤0.1 dB/km increase
Temperature aging	TR-20	+85°C, 5 days	100% ≤0.2 dB/km increase 80% ≤0.1 dB/km increase

Table 2: Lightning and rodent testing

Design	Construction	Lightning resistance	Rodent resistance
Loose tube	Steel core, no armor	80 kA	Poor
	All-dielectric	N/A	Poor
	Dielectric core, armored	150 kA	Excellent
Central tube	All-dielectric	N/A	Poor
	Dielectric core, steel armored	105 kA	Excellent
	Dielectric core, copperclad steel armored	150 kA	Excellent

most common specifications are written by GTE, Sprint, REA and Bellcore. Bellcore's TR-20 is in most cases the more comprehensive and difficult specification to meet. TR-20 covers cable qualification tests, material qualification, mechanical and environmental tests with allowable decreases in performance for each test. It is important to note that all measurement methods in Bellcore TR-20 are referenced to an ASTM or EIA-455 test procedure standard. Some tests that to date have no standards such as lightning and rodent tests are spelled out in detail in the document. A summary of the mechanical and environmental tests with their corresponding allowances is listed in Table 1.

As just mentioned, two of the more important tests — the lightning and rodent ones — have no standard testing procedure per se. Although specifications do not require that certain test levels be met, they do require that the tests be performed and the level of resistance reported. Each cable construction of the two designs being discussed must be tested in every one of these tests because the result depends upon the core and sheath construction. Typical classifications of the results of these two tests are listed in Table 2.

It is important to note that all suppliers of fiber-optic cable to the telephone industry must meet these specifications in order to be a supplier. Consequently, the performance of any cable that meets Bellcore TR-20 will be about the same as any other cable that meets that performance standard. Characteristics of handling, weight, lightning and rodent resistance that are dependent on the construction of the cable should be considered, but each supplier has an option available to satisfy these requirements.

Comparison of loose tube and single tube constructions vs. specifications

For each of the two designs being discussed there are a number of sheath designs. Each sheath design has cost/benefit trade-offs.

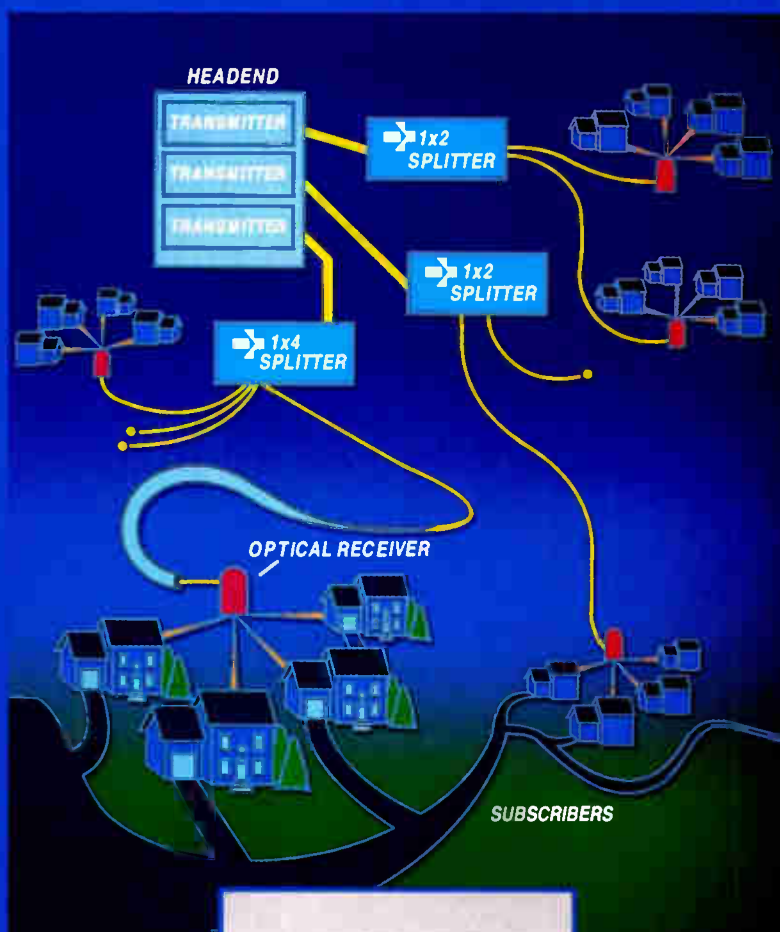
For the central tube cable there are basically two different cable constructions. Both constructions, by the definition of this design, have a dielectric core. This is important in the case of lightning protection. If the purchaser of the cable is concerned about lightning protection, it is important that no metallic member be within the fibers such that a high current surge could short to that member and destroy the fiber in its path. The cable can have no metal in it at all if lightning is a serious concern or if grounding of any metallic members could be a problem. In this case the strength members in the cable would be some combination of aramid yarn, fiberglass roving and fiberglass reinforced plastic (GRP or FRP). On the other hand, an all-dielectric cable has almost no protection against rodents.

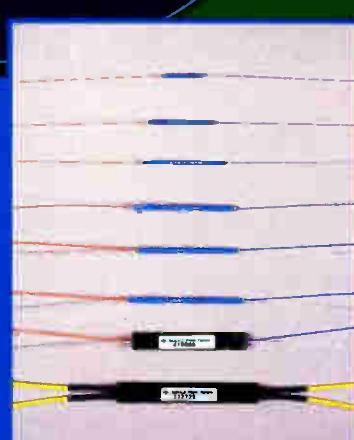
When rodent protection as well as some lightning protection is desired, an armored version is available. In this case the dielectric core is surrounded by an armor sheath. Strength members inside the armor are generally dielectric and those outside the armor can be metallic. If additional rodent or lightning protection is needed, different configurations of armors and jackets can be used to give the necessary protection. (See Figure 3 on page 58.)

In the case of loose tube cables, solutions to the above listed problems also exist. The most inexpensive loose tube cable made has a steel central member and no armor. This is a dangerous design in that it yields both poor lightning and rodent protection. In a loose tube cable a dielectric core should be specified when lightning is a concern. An all-dielectric construction

Gould Fiber Optics Has. . .

The Passive Components You Need Today
The Specifications You Count On
The Service You Depend On
The Quality You Rely On





For CATV systems Gould has wavelength independent splitters with low insertion loss and high directivity (≤-65.0dB) -- guaranteed for environmental stability and performance at the headend or in the field. Components are in stock in a variety of standard and customized package styles.

GOULD
Fiber Optics

Gould, Inc
Fiber Optics Division
6740 Baymeadow Drive
Glen Burnie, MD 21060
1-800-54-GOULD (46853)
Phone: (410) 787-8300
FAX : (410) 787-2831

European Office
Mennystones, Butts Lane, Ideford
Chudleigh, Devon, TQ13 OBD
United Kingdom
Phone: 0626 853 964
FAX: 0626 854 355

Figure 3: Center core tube constructions

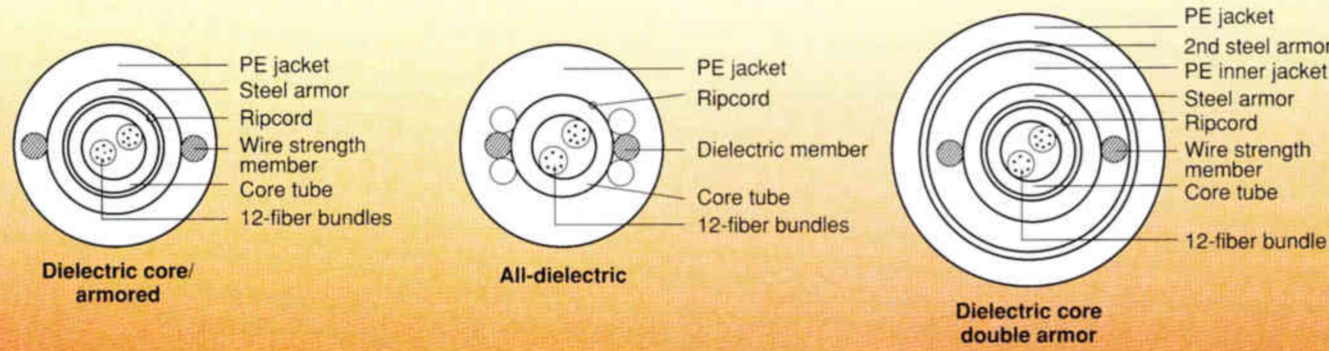


Table 3: Cable construction comparisons

Design	Construction	Lightning resistance	Rodent resistance	Cost
Loose tube	Steel core, no armor	Poor	Poor	1
	All-dielectric	Best	Poor	2
	Dielectric core, armored	Excellent	Good	3
Central core	All-dielectric	Best	Poor	2
	Dielectric core, armored	Excellent	Good	1

Design	Fiber count	OD (in.)	Weight (lbs/kft)	Fiber ID
Dielectric core, armored	48	0.49	105	Excellent
Loose tube	96	0.59	150	Excellent
Dielectric core, armored	48	0.63	170	Excellent
Central tube	96	0.74	230	Good

is completed with aramid yarn for strength and a PE jacket for protection. When rodents are a concern, an armor sheath and additional jacket can be added. If both lightning and rodent resistance are desired, an armored cable with a dielectric central strength member should be specified. (See Figure 4.)

Since the performance of all cables meet the same specification, the only comparisons to be made between the two types of products are that of what construction is best suited for each individual application. Table 3 shows a summary of the best options available and their relative costs based on material usage for the loose tube and single tube designs. Handling issues are essentially a matter of fiber identification, sizes, weights and personal preference.

Summary

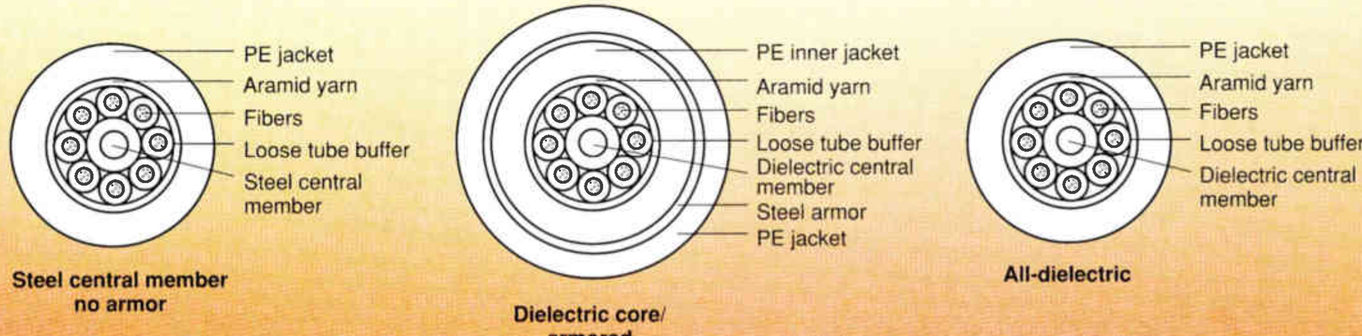
All suppliers of fiber-optic cable to the Bell system must meet TR-20 specifications. The product they sell to markets other than Bell companies do not necessarily meet all TR-20 specifications. Therefore, it is important that either a well-written specification be submitted or an existing specification such as TR-20 or equivalent be referenced in a request for quotation. When another existing specification is referenced, any special considerations that may be required for CATV installation must be included, since all existing specifications have been written for the telephone industry with digital transmission in mind.

If the fiber-optic cable meets the specification then the important issues are attenuation levels, lightning resistance, rodent resistance and personal preference. All of these issues are addressed equally well by different methods.

There is no one design best suited to the CATV market. Both central tube and stranded loose tube products

(Continued on page 62)

Figure 4: Loose tube construction



SATISFY YOUR SATELLITE APPETITE

BLONDER TONGUE

NOW SERVING TODAY'S SPECIAL

Appetizers

Single Height Rack Mount - Only 1.75" High .... *Free*
Front Panel Access to Descrambler Module .... *Free*
C and Ku Band Compatible - 950 MHz to 1750 MHz .... *Free*
Ultra-Stable PLL Demodulator - Extremely Low Noise .... *Free*
Synthesized Frequency Control - 0.5 MHz Increment .... *Free*
70 MHz IF Loop - Allows Insertion of TI Filters .... *Free*
Wide Array of Audio and Video Outputs .... *Free*

Main Course

The IRD- 6175 is a high performance, professional grade Satellite Receiver with an integrated VideoCipher II Commercial Descrambler module. It achieves a balance of razor sharp video and crystal clear audio through state-of-the-art receiver technology. Rock solid, no-drift receiver out put is maintained by a synthesized , high stability frequency reference. The PLL Demodulator provides excellent picture quality, even under weak signal conditions. Included are a full complement of user controls and indicators that make installation and setup a piece of cake.

Side Orders

All IRD - 6175's are served with the following side orders at no extra cost: system design assistance, technical support, U.S.A. workmanship, and quality assurance testing. An industry leading 3 YEAR WARRANTY is included at no charge. Take a bite out of your headend costs while satisfying subscriber hunger, at the same time! Give us a call today and reserve an IRD - 6175, your satisfaction is guaranteed.

BLONDER TONGUE LABORATORIES, INC.

One Jake Brown Road, P.O. Box 1000
Old Bridge, NJ 08857-1000 USA
Tel: (908) 679-4000
Fax: (908) 679-4353

Reader Service Number 46

Splicing applications for fiber-optic cables

By Randy Reynard
Manager of Training
Optical Networks International

Splicing of fiber-optic cables has been one of the most challenging aspects of the use of fiber since its inception. Achieving low loss, low reflection, high strength splices that are environmentally stable and long lasting has created a whole new discipline of the art. The entire process centers on getting the 8 to 10 micron core of one fiber precisely aligned with the similarly sized core of another fiber, and keeping it in alignment over a long period of time. This article will explore the three most common types of splicing now in use.

Mechanical splicing of fiber has taken two basic forms: cleave and mechanically retain (e.g., 3M's Fiberlok, AT&T's CSL, etc.) and engineered cleave (e.g., AT&T's Rotary Mechanical Splice). The cleave and retain methods are generally the quickest to accomplish and in some cases yield very good loss characteristics. These also tend to have very good reflection characteristics if the cleaves are of high-quality. The engineered cleave methods involve inserting the fiber ends into some sort of mechanical holder that becomes part of the splice. Once the fiber is secured in the holding device, the end is polished in two or more steps to achieve a properly treated end. These generally can be optimized with the assistance of an electronic measurement device.

Fusion splicing has become the most widely used method in CATV due primarily to the low per splice cost in systems where there is a high volume of splicing to be done. Fusion splicing yields very high-quality splices with almost no reflection (in a properly performed splice). Fusion splicing equipment is considerably more expensive upon initial investment but if there are as many as 900 splices to be done in a year, the fusion splicer will pay for itself in the first year. To put this in perspective, more than 900 splices will be performed if an operator is using 48-count cable and there are as few as 19 splice locations. With the increasing use of connectorized jumpers at the transmit and receive locations, many operators are fusing premade jumpers onto their field cables to terminate them, increasing the splice count considerably.

General considerations

Probably the most important aspect to any type of splicing is the need to have an appropriate work space. Although many splices have been accomplished in the back end of a pickup truck with a camper shell, the technicians that have done this will readily agree that there must be a better way. Ideally, a van (or trailer) should be outfitted with the proper necessities to perform the splices. If fusion splicing is to be done, the facility should be clean and have at least basic heating and cooling.

Some operators have found that outfitting a van with an RV air conditioner and heater, lights and a generator works well. One of the aspects of getting consistent high-quality splices is to provide a good working environment for the person doing the splicing. This applies to both mechanical and fusion splicing. The work is somewhat meticulous and requires long periods of high concentration. In any case, at least basic environmental control is necessary. A trailer can be similarly outfitted.

The factor that contributes the most to fusion splicing and cleaved mechanical splicing is the cleave. Generally, the better the cleave, the better the finished splice will be. Cleaving has been done with tools ranging from as simple a tool as a "Swiss Army" knife (not very successful) to the most advanced electronic ultrasonic "automatic" cleavers. The best compromise lies somewhere in between these (although more toward the higher end). A good cleaver should be able to repeatedly yield cleaves of less than 1° variation from perpendicular to the axis of the fiber with no chips or "hackles." (Good luck doing this with the old pocket knife!)

Another significant factor involved in the splicing of fiber is cleanliness. For this reason, some recommend doing the cable break out and housing installation with a separate vehicle or at least at a separate time and cleaning up the vehicle before it is to be used for the final splice operation. Any filling compound and sheath materials should be disposed of and the fibers cleaned and sorted in the housing before returning to do the final splice.

> **"Any of the quality splices that are available will work satisfactorily if the system is designed with the characteristics of the splice to be used in mind."**

There are many concerns about how fragile the fibers are and how much care must be exercised when handling them. While it is true that a degree of care must be used, the fiber is actually quite tough as long as the coating is still on it. Once the coating is stripped off and cleaned with alcohol in preparation for the final splice process, the fiber becomes fairly delicate (but anything would be that is 1/8 millimeter in diameter). The modern housings and splice trays that are being used are designed to assist the splicer in the handling and storage of fiber.

Applications

There are two basic situations where splicing will be done. First is the initial installation "permanent" splice. This is done in a production-type environment. It needs to be as perfect a splice as can be done with the available equipment. Most operators are specifying a splice of no worse than 0.1 dB average loss for a permanent splice. (This has come a long way from less than 10 years ago when we considered any splice better than 1 dB to be a good splice, and we were overjoyed with splices better than 0.5 dB.

(Continued on page 62)

THE SOUND INVESTMENT

))) IN STEREO (((

It's a tough market out there and the smart money goes with a sure thing whenever it's available. That's why more top MSO's put their money on Leaming audio equipment. It has the proven assets to return a high yield of performance and reliability.

It's clear why the industry is bullish on Leaming equipment. Products like the MTS-2B BTSC Stereo Generator offer more standard features than any comparable unit and at a very comparable price.

Sharp, clean audio with a frequency response flat out to 15 kHz, typical stereo separation >30 dB, true AGC, Bessel-null test-tone, dbx® noise processing, and stereo synthesis for ad insertion are basics that Leaming buyers have come to expect.

This is the kind of dependable equipment that operators want to have on-line for the not-so-far-away day when every minute of broadcast time will be in stereo.

So, if you're in the market for success, take this insider tip and call or write today for more information on the full line of audio equipment. Make Leaming your next sound investment.

LEAMING INDUSTRIES

15339 Barranca Parkway, Irvine, CA 92718
(714) 727-4144 • FAX (714) 727-3650
(800) 4-LEAMING

THE MTS-2B IS PREFERRED BY MORE TOP MSO'S THAN ANY OTHER ENCODER

Reader Service Number 47

As a cable operator, you want to give your subscribers the best picture and programming. But you don't want to give anything away. That's why the Pioneer BA-9000 addressable converter provides line-by-line ***digital signal security*** coupled with Dynamic Picture Shift (DPS) encoding.

An established leader in cable system security, Pioneer knows the importance of a secure revenue stream, as well as the value of revenue enhancing options like Near-Video-On-Demand.

You'll find they're a valuable part of the BA-9000, along with ***icon-driven on-screen menuing, backwards compatibility*** and a ***future expansion port***. So give your revenue stream and yourself a feeling of security by calling Pioneer - the right people to help you send the wrong signals.

PIONEER
The Art of Entertainment

Reader Service Number 6

TECH TIPS

A quick check for substitution carriers

By Mark Harrigan
State Engineer
TCI Cablevision of California

For some unknown reason the fire alarm in the motel I was staying in went off at 3 a.m. Ugh! Unable to get back to sleep, I turned on the TV set and was greeted by pictures completely wiped out by beats — and the cable system supplying signals to the motel was my company's. The next morning they were back to being just fine. I had my suspicions so I went directly to the system's headend that morning where I checked the substitution carriers' levels, all of which where way out of whack and unfortunately one of them was used as the system's amplifiers' high pilot automatic gain control (AGC).

Asking why they let their substitution carriers go so long without being checked, I was told that they did not want to disrupt pictures during the day, and with the high pilot AGC taking its reference from one of the processors, they were concerned that also would be disruptive.

While visiting our Merced system last year I came across a very simple innovation brewed up by Steve Pacheco. He had installed spring-loaded switches on each of his processed channels that connected each unit's substitution carrier activation terminal on the rear panel to ground, thus allowing him to instantly and very briefly (usually around 2 seconds) activate the substitution carrier during weekly level checks. This made it a snap to compare with the channel's normal output level and all with minimal disruption. (It could even be done during commercials.)

I won't try to get into the specifics of which terminal each manufacturer uses to manually activate their substitution carrier, but a quick manual check will bring the answer. The key is the switch, which must be spring-loaded. (In other words, it cannot be left on without someone applying pressure to it.) Most of the systems in my state have installed these switches anywhere from groups on a blank rack panel to individual buttons installed in the front panel of the substitution carrier model itself. **BTB**

FO designs advantages and disadvantages

(Continued from page 58)

meet the same specifications and each design has a construction that can meet the demands of almost any environment. **BTB**

References

1) Bellcore TR-TSY-000020 Issue 4.

2) "Compact Lightguide Cable Design," P.D. Patel, C.H. Gartside III, *International Wire & Cable Proceedings*, 1985.

3) "Optical Stability of Single-Mode Fiber in Loose Tube Cable Designs," K.A. Emig, et al, *IWCS Proceedings*, 1985.

4) "Qualification Testing of Fiber-Optic Cables," R. Ohlhaber, et al, *IWCS Proceedings*, 1984.

5) "Multi-Hundred-Fiber Cable Compared to Optical Fiber Ribbons Inserted Tightly Into Slots," S. Hatanoetd, *IWCS Proceedings*, 1986.

6) "Lighting Considerations in Optical Cable Design," J.A. Olszewski, J.B. Masterson, *IWCS Proceedings*, 1986.

7) "The Effect of Temperature-Dependent Materials on Fiber-Optic Cable Design," K.L. Coupe, et al, *IWCS proceedings*, 1986.

8) "Qualification Procedure for Fiber-Optic Cable Design," G. McKay, et al, *IWCS Proceedings*, 1986.

9) "A High Performance Non-Metallic Sheath for Lightguide Cables," C.J. Arrogo, A.C. Jenkins, P.D. Patel, *IWCS Proceedings*, 1987.

10) "LXE - A Fiber-Optic Cable Sheath Family with Enhanced Fiber Access," P.D. Patel, M.R. Reynolds, *IWCS Proceedings*, 1988.

Splicing applications

(Continued from page 60)

Now it would be very hard to accept a splice loss of that magnitude.) The measurement of these splices should be done with a two-way optical time domain reflectometer (OTDR) plot and the loss of each point averaged between the two directions (EIA/TIA standard practice). This is the type of splicing where fusion really shines.

Second is the restoration splice. This generally is done after a "backhoe fade" or some other type of catastrophic damage to the cable occurs. The restoration splice typically is performed under considerable pressure, in considerably less than ideal splice conditions and the loss is not nearly as critical. There is plenty of time to come back after the initial emergency and perform a permanent high-quality splice. It is in the area of restoration that the quick mechanical cleave and retain type of splicing is in its best light. Someone who has done very few mechanical splices can simply break out the cable, clean it, cleave it and place it in the mechanical splice sleeve and fix it in place. This process takes very little time. and with the potential of thousands of subscribers out of service, time is the most significant factor.

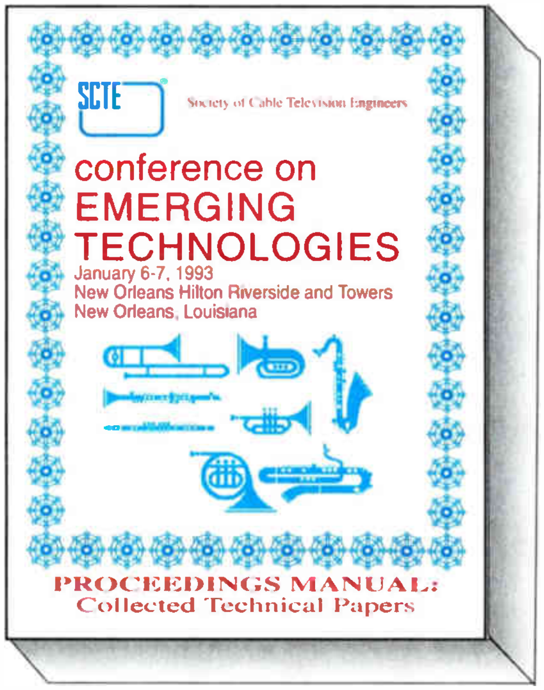
As a matter of interest, with most AM optical receivers, a 1 dB change in optical power results in a 2 dB change in RF levels. Thus, if you increase the loss of a given fiber route by 0.5 dB due to quick restoration splicing, there will be only a 1 dB change in RF levels at the receiver. This should result in no more than a 1 dB reduction in the carrier-to-noise ratio to the customer, which is considerably more desirable than a long outage.

Plan for success

The type of splicing to be done in a given system is very much a matter of choice of the engineers designing the system. Any of the quality splices that are available will work satisfactorily if the system is designed with the characteristics of the splice to be used in mind. The important thing to consider is that the personnel doing the splicing are properly trained and that the documentation of the system is complete. The best splicing products will yield poor results if the persons doing the splicing don't utilize proper methods and care. **BTB**

WELCOME TO THE SHOW!

Well, actually, we can't welcome you to the show, since SCTE's smash "1993 Conference on Emerging Technologies" occurred Jan. 6-7 in New Orleans! If you were there, you know that over 700 cable TV industry leaders were on hand to witness fascinating presentations on the cutting edge technologies affecting our industry today



and in the future! But even if you weren't there, you don't have to miss the show! For a limited time, the Society of Cable Television Engineers is offering the *Emerging Technologies 1993 Proceedings Manual*, a deluxe publication containing each of the groundbreaking technical papers presented at the conference, for the special show price of only $25 each!

This deluxe 306-page publication includes the following papers:

ADVANCES IN FIBER OPTIC COMPONENTS AND ARCHITECTURES

- *The Importance of Optical Fiber Geometry on Cable TV Splicing and System Performance*
- *Application of the Tapered Fiber Optic Cable: A Case Study*
- *Advances in AM Supertrunking*
- *Expanded Channel Capacity Laser/Receivers*
- *Applications and the Evolving Regional Interconnect*

DIGITAL COMPRESSION IN TYPICAL CATV SYSTEMS

- *Nuts and Bolts of Video Compression: Preparing Your System for Digital Video Compression Technology*
- *Compression Techniques and Coding Options*
- *CATV - Cable Systems Digital Characterization Utilizing 16 and 64 QAM 45 Mb/s Telecommunications Modems*
- *Channel Characterization for Digital Transmission*
- *Orthogonal Frequency Division Multiplexing: An Alternative Digital Modulation Scheme*

CABLE'S FUTURE OPPORTUNITIES

Enabling Technologies:

- *PCS Via Cable: An Enabling Technology for Cable's Future Opportunities*
- *Code Division Multiple Access for Personal Communication Systems*

Integration of Systems:

- *The Role for Cable and PCN*
- *Digital Transport and Program Delivery Systems: Deployment and Implementation Options*
- *Integrating Entertainment and Voice on the Cable Network*

VIDEO AND TELECOMMUNICATIONS SYSTEMS OF THE FUTURE

- *Millimeter-Wave Video and Telecommunications Distribution System (MLDS)*
- *ADSL - Video and More Over Twisted Pair*
- *Instant Video: Video Fax Technology and the Future of Video-on-Demand*
- *A Store-and-Forward Architecture for Video-on-Demand Service*
- *DBS in the USA*

SPECIAL: GET THE EMERGING TECHNOLOGIES 1993 AND CABLE-TEC EXPO® 1992 PROCEEDINGS MANUALS FOR ONLY $40! (Limited Time Offer!)

TO ORDER: All orders must be prepaid. Shipping and handling costs are included in the Continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. NO CASH REFUNDS.

MAIL TO: SCTE, 669 Exton Commons, Exton, PA 19341 or FAX with credit card information to: (215) 363-5898.

Ship to: (Name): ____________________

Address (NO P.O. BOXES): ____________________

____

____

____

Phone: ( ) ____________ Date: ____________

❑ Please send me ____ copies of the *Emerging Technologies 1993 Proceedings Manual* at $25 each.

❑ Please send me ____ sets of the *Emerging Technologies 1993 and Cable-Tec Expo '92* Manuals at $40 each.

❑ A check or money order for the appropriate amount shown above and made payable to the Society of Cable Television Engineers is attached.

❑ I wish to pay by credit card (please check one)

❑ MasterCard ❑ VISA

Account Number: ____________ Card Expires: ___/___

Signature for Credit Card: ____________________

Reader Service Number 1

AD INDEX

It's so simple! To obtain additional information from any of the display advertisers appearing in this issue of ***Communications Technology,*** please use one of the **Reader Service Cards** on the facing page (pass the others along). The ad index below has been expanded to include not only the page number of each advertiser, but also each corresponding reader service number to be circled on the Reader Service Card.

	Reader Service #	Page #
Adrian Steel	52	70
Alpha Technologies	18	15
Antec Corporation	54,5	80,5
Antennas for Communications	43	51
Arcom	9	8
Arnco	19,57	16
Belden Wire and Cable	8	8
Ben Hughes/Cable Prep	34	42
Blonder Tonque	46	59
Cable Tek Center	55	66
Cable Resources	29	36
Cable Security	6	6
Cadco	31	39
C-Cor Electronics	25,16	29,14
Channelmaster	41	49
Coast CATV Supply	40	52
Contec International	26	31
Corning	22	20-21
DH Satellite	12	10
DX Communications	13	11
FM Systems	35	43
Gould Fiber Optics	45	57
Intercept Communications	39	48
Jerrold Communications	56	25
Keptel Inc.	14	12
Leaming	47	61
Line Ward	38	47
Mega Hertz		16A
Microwave Filter	36	45
Molex Fiber Optics	17	14
NaCom	42	51
NCTI	32	40
Porta Systems	23	23
Power Guard	7	7
Pyramid Connectors	20	18
Quality RF Services Inc.	58	65
Radiant Communications Corp.	11	10
Riser Bond Instruments	33	41
RMS Electronics	27	33
Sadelco	30	37
Sawtre Electronics	37	46
Scientific Atlanta	21	19
SCTE	1	63
Sencore	2	2
Siecor	15	13
Superior Electronics	53	79
Telecrafter Products	4	4
Trilithic	28	35
Trilogy	3	3
Tulsat	50,51	68,69
US Electronics	48	17
Wavetek	10	9

COMMUNICATIONS TECHNOLOGY

Communications Technology is distributed ***FREE*** of charge to qualified cable TV personnel. Incomplete forms will not be processed.
I wish to receive/continue to receive ***Communications Technology.***
Yes ☐ No ☐

(please print or type)

Name ____________________
Title *(please print or type)* ____________________
Company Name ____________________
Address ____________________
City __________ State ___ ZIP ______
Signature __________ Date ______

(Signature and date required)

1. Are you a member of the SCTE (Society of Cable Television Engineers)?
Yes ☐ No ☐

2. In the performance of my job, I authorize, specify or recommend products and/or services for purchase.
Yes ☐ No ☐

CT 3/93

3. Please check the category that best describes your firm's primary business (please check one only).

1. Cable TV Systems Operations
   - ☐ a. Independent Cable TV Systems
   - ☐ b. MSO (two or more Cable TV Systems)

- ☐ 2. Cable Tv Contractor
- ☐ 3. Cable TV Program Network
- ☐ 4. SMATV or DBS Operator
- ☐ 5. MDS, STV or LPTV Operator
- ☐ 6. Microwave or Telephone Company
- ☐ 7. Commercial Television Broadcaster
- ☐ 8. Cable TV Component Manufacturer
- ☐ 9. Cable TV Investor
- ☐ 10. Financial Institution, Broker, Consultant
- ☐ 11. Law Firm or Government Agency
- ☐ 12. Program Producer or Distributor
- ☐ 13. Advertising Agency
- ☐ 14. Educational TV Station, School or Library
- ☐ 15. Other __________ *(please specify)*

4. Please check the category that best describes your job title/function.

- ☐ A. Corporate Management
- ☐ B. Management
- ☐ C. Programming
- ☐ Technical/Engineering
  - 1 ☐ Vice President
  - 2 ☐ Director
  - 3 ☐ Manager
  - 4 ☐ Engineer
  - 5 ☐ Technician
  - 6 ☐ Installer
- ☐ E. Sales
- ☐ F. Marketing
- ☐ X. Other (please specify) __________

COMMUNICATIONS TECHNOLOGY

Name ____________________
Title(Please specify) ____________________
Company Name ____________________
Address ____________________
City __________ State ______ ZIP ______
Phone __________ Date ______

FREE INFORMATION

Reader Service Card
March 1993 (Valid until June 1993)

CT 3/93 - 1

Simply circle the number(s) below corresponding to products of interest!

—	19	38	57	76	95	114	133	152	171	190
1	20	39	58	77	96	115	134	153	172	191
2	21	40	59	78	97	116	135	154	173	192
3	22	41	60	79	98	117	136	155	174	193
4	23	42	61	80	99	118	137	156	175	194
5	24	43	62	81	100	119	138	157	176	195
6	25	44	63	82	101	120	139	158	177	196
7	26	45	64	83	102	121	140	159	178	197
8	27	46	65	84	103	122	141	160	179	198
9	28	47	66	85	104	123	142	161	180	199
10	29	48	67	86	105	124	143	162	181	200
11	30	49	68	87	106	125	144	163	182	201
12	31	50	69	88	107	126	145	164	183	202
13	32	51	70	89	108	127	146	165	184	203
14	33	52	71	90	109	128	147	166	185	204
15	34	53	72	91	110	129	148	167	186	205
16	35	54	73	92	111	130	149	168	187	206
17	36	55	74	93	112	131	150	169	188	207
18	37	56	75	94	113	132	151	170	189	208

COMMUNICATIONS TECHNOLOGY

Name ____________________
Title(Please specify) ____________________
Company Name ____________________
Address ____________________
City __________ State ______ ZIP ______
Phone __________ Date ______

FREE INFORMATION

Reader Service Card
March 1993 (Valid until June 1993)

CT 3/93 - 2

Simply circle the number(s) below corresponding to products of interest!

—	19	38	57	76	95	114	133	152	171	190
1	20	39	58	77	96	115	134	153	172	191
2	21	40	59	78	97	116	135	154	173	192
3	22	41	60	79	98	117	136	155	174	193
4	23	42	61	80	99	118	137	156	175	194
5	24	43	62	81	100	119	138	157	176	195
6	25	44	63	82	101	120	139	158	177	196
7	26	45	64	83	102	121	140	159	178	197
8	27	46	65	84	103	122	141	160	179	198
9	28	47	66	85	104	123	142	161	180	199
10	29	48	67	86	105	124	143	162	181	200
11	30	49	68	87	106	125	144	163	182	201
12	31	50	69	88	107	126	145	164	183	202
13	32	51	70	89	108	127	146	165	184	203
14	33	52	71	90	109	128	147	166	185	204
15	34	53	72	91	110	129	148	167	186	205
16	35	54	73	92	111	130	149	168	187	206
17	36	55	74	93	112	131	150	169	188	207
18	37	56	75	94	113	132	151	170	189	208

Place
Stamp
Here

COMMUNICATIONS
TECHNOLOGY

Transmedia Partners
P.O. Box 9106
Plainview, NY 11803-9106

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 535 RIVERTON,NJ

POSTAGE WILL BE PAID BY ADDRESSEE

COMMUNICATIONS
TECHNOLOGY

A Transmedia Publication
P.O. Box 1843
Riverton, NJ 08077-9443

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 535 RIVERTON,NJ

POSTAGE WILL BE PAID BY ADDRESSEE

COMMUNICATIONS
TECHNOLOGY

A Transmedia Publication
P.O. Box 1843
Riverton, NJ 08077-9443

Calibrators

Sadelco announced two new instruments based on its patented white noise generator technology. According to the company, both Models SC600 and SC1000 have flatness specs of ±1/4 dB, calibrate signal level meters and check the response of all CATV and local area network distribution equipment.

Features include: expanded frequency ranges (4.5-600 MHz for Model SC600 and 4.5-1,000 MHz for Model SC1000), increased noise output level to +20 dBmV, a new precision rotary attenuator, horizontal and vertical sync pulse modes of the CW signal, switchable 1 kHz modulation of the noise and the facility for inputting external markers.

Reader service #208

Software

Cable Leakage Technologies released its new software enhancements. One click of the mouse will produce the fastest, most accurate $I_{3,000}$ calculation ever, according to the company. The user of Wavetracker has the ability to obtain the total plant miles driven without having to deal with odometer readings.

This cable leakage software is now compatible with LES and CLIDE, which eliminates the need to input each leak individually. Also new to the Wavetracker package are new GPS algorithms that the company says make constellation jumps a thing of the past.

Reader service #206

Multimeters

Simpson Electric Co. introduced the 490 Series of hand-held digital multimeters designed to combine the high reliability, range and accuracy of a high-end professional meter with maximum usability on the job.

According to the company, Model 494 offers a unique solar recharging capability, utilizing a solar cell and rechargeable lithium battery, reducing the expense of continuing battery replacement. Models 493 and 494 feature a backlit display with large, easy-to-read numbers.

Features of the 490 Series meters include: memory and read memory function; relative value measurement; maximum and minimum value measurements; hold and timer hold measurements; 3,999 count display (999 for frequency measurements); autopolarity and autoranging on voltage, resistance, frequency or capacitance measurements; and 40 segment bar graph for peaking or nulling.

Ranges covered by the Model 494 include: voltage to 1,000 VDC and 750 VAC; resistance to 40 MΩ; amperage to 12 amps AC and DC; frequency to 999 kHz; and capacitance to 40 µF.

Reader service #207

Ferrule alignment

Storm Products Co. says its new fiber-optic coupling adapters provide precision ferrule alignment and can be used for both multimode and single-mode. In addition, performance benefits include elimination of unnecessary mating losses and improved test mea-

surement accuracy. Various flange styles are designed for standard patch panel/bulkhead mount. Temperature range is -20 to +60°C. Repeatability is less than ±0.2 dB, tested up to 500 matings, according to the company. Numerous styles are available from stock.

Reader service #205

Deoxidizer

DeoxIT, a new one-step treatment by Caig Laboratories Inc., is a deoxidizing solution that cleans, preserves, lubricates and improves conductivity on all metal connector and contact surfaces, according to the company.

The company says this new formula contains improved deoxidizers, preservatives, conductivity enhancers, anti-tarnishing compounds, arcing and RFI inhibitors and provides extended temperature range (-34 to +200°C). The solution also prevents dissolved oxides and contaminants from reattaching to metal surfaces, providing longer lasting protection. It is available in spray, liquid, wipes and pen applicators. Recommended for use on switches, potentiometers, relays, PCB edge connectors, batteries, faders, interconnecting cables, plugs, jacks, etc.

Reader service #204

Simulator brochures

KeyTek Instrument Corp. published four new brochures describing the individual pulsed EMI simulators that form components of the company's new ECAT expert computer-aided test system. Each brochure covers a tester for a different aspect of pulsed EMI: ESD (electrostatic discharge), EFT (electrical fast transients), surge and PQF (power quality failure).

The brochures describe integration of user-friendly combinations of simulators into a variety of customized ECAT systems, for testing to meet the whole range of pulsed EMI threats. The characteristics of each simulator are covered, whether used alone or in combination.

Reader service #203

Optical fiber analyzer

Telecommunications Techniques Corp. introduced the Fiberscan 1000, an optical fiber analyzer that functions as an optical time domain reflectometer (OTDR), stable source and power meter. The unit features proprietary technology that allows the analyzer to operate in a pulsed OTDR mode or as a stable CW source. An optical power meter can be added to complete the set.

According to the company, this is the only test set that provides the functionality of a power meter, source and OTDR in one portable test set. It is designed for the installation and maintenance of fiber-optic carrier, telco and CATV systems. The unit is designed for outside plant use and is weather-tight. It includes an internal charger, eliminating the need for an external charging adapter.

Reader service #202

CALENDAR

March

3: SCTE Desert Chapter seminar, FCC rules, regulations and testing, San Gorgino Inn, Banning, CA. Contact Greg Williams, (619) 340-1312, ext. 277.

3: SCTE Penn/Ohio Chapter seminar, Installer exams to be administered, Pittsburgh. Contact Marianne McClain, (412) 531-5710.

3: SCTE Ozark Mountain Meeting Group seminar, FCC testing, electronic upgrades and avoiding rebuilds, Executive Inn, Springdale, AR. Contact Bob Griffith, (501) 648-1966.

3: SCTE Snake River Chapter seminar, powering, system design and reverse path, and fiber-optic design and powering, Installer and BCT/E exams to be administered in all categories at both levels, Weston Plaza, Twin Falls, ID. Contact Mike Dudley, (208) 377-2491.

4: SCTE Heart of America Chapter, BCT/E exams to be administered in all categories at the Technician level, Kansas City, MO. Contact Don Gall, (816) 358-5360.

4: SCTE Lake Michigan Chapter, BCT/E exams to be administered, Morely, MI. Contact Karen Briggs, (616) 947-1491.

6: SCTE Tip-O-Tex Chapter seminar, basic electronic theory, system powering, amplifier sweep, test equipment and procedures, TCI Cablevision, McAllen, TX. Contact Joe Lopez, (512) 425-7880.

9: SCTE Desert Chapter, BCT/E exams to be administered in all categories at both levels. Contact Greg Williams, (619) 340-1312, ext. 277.

9: SCTE Magnolia Chapter seminar, equipment repair, satellite retrofits and troubleshooting, Ramada Coliseum, Jackson, MS. Contact Steven Christopher, (601) 824-6010.

9: SCTE Wheat State Chapter seminar. Contact Lisa Hewitt, (316) 262-4270, ext. 191.

9-11: SCTE Technology for Technicians II seminar for broadband industry technicians and system engineers, Hyatt Regency, Minneapolis. Contact SCTE national headquarters, (215) 363-6888.

9-12: Siecor training course, fiber-optic installation, splicing, maintenance and restoration, Hickory, NC. Contact 1-800-SIECOR1, ext. 5539 or 5560.

10: SCTE Bluegrass Chapter seminar, hands-on installer and technician troubleshooting, BCT/E exams to be administered in all categories at both levels, Howard Johnson's, Elizabethtown, KY. Contact Alan Reed, (502) 389-1818.

10: SCTE Heart of America Chapter seminar, Kansas City, MO. Contact Don Gall, (816) 358-5360.

11: SCTE Satellite Tele-Seminar Program, *Customer Service and Safety Issues (Part One)*, videotaped at Cable-Tec Expo '92, to be shown from 2:30-3:30 p.m. ET on Transponder 14 of Galaxy I. Contact SCTE national headquarters, (215) 363-6888.

11: SCTE Badger State Chapter seminar, FCC rules and measurements, Holiday Inn, Fon du Lac, WI. Contact Gary Wesa, (414) 496-2040.

11: SCTE Gateway Chapter seminar. Contact Chris Kramer, (314) 949-9223.

11: SCTE Penn-Ohio Chapter, Installer exams to be administered, Warrandale, PA. Contact Marianne McClain, (412) 531-5710.

15-17: North Central Cable Television Association convention, Hyatt Hotel, Minneapolis. Contact (612) 641-0268.

16: SCTE Cascade Range Chapter, Holiday Inn, Wilsonville, OR. Contact Cynthia Stokes, (503) 230-2099.

16: SCTE Pocono Mountain Meeting Group seminar, emergency broadcast system, Holiday Inn, Hazleton, PA. Contact Anthony Brophy, (717) 462-1911.

16-18: C-COR fiber-optics seminar, Sheraton Inn Atlanta Northwest, Atlanta. Contact Kelly, (814) 231-4422.

16-18: Philips mobile training course, RF and video distortions, headend basics, amplifier applications and operation, record keeping and maintenance, Mobile, AL. Contact Yvonne Jordan, (315) 682-9105.

17: SCTE Golden Gate Chapter seminar, hands-on FCC proof-of-performance testing. Contact Mark Harrigan, (415) 358-6950.

17: SCTE Great Lakes Chapter seminar, rebuilds, Holiday Inn, Livonia, MI. Contact Jim Kuhns, (313) 541-4513.

17: SCTE Iowa Heartland Chapter, BCT/E exams to be administered, Triax, Cedar Rapids, IA. Contact Mitch Carlson, (309) 797-2580, ext. 3700.
17: SCTE Piedmont Chapter seminar, NEC, NESC and installer certification, Installer and BCT/E exams to be administered, Greensboro, NC. Contact Tod Dean, (919) 934-9711.
17: SCTE South Jersey Chapter seminar, HDTV and compression, state policy on expanded connection, alternate access, Ramada Inn, Vineland, NJ. Contact Mike Pieson, (609) 967-5115.
17-18: SCTE Ohio Valley Chapter seminar, data/transportation, Cincinnati. Contact Jon Ludi, (513) 435-2092.
18: SCTE Central Indiana Chapter seminar. Contact Gregg Nydegger, (219) 583-6467.
18: SCTE Lake Michigan Chapter seminar, construction. Contact Karen Briggs, (616) 947-1491.
18: SCTE Mount Rainier Chapter seminar, Eastgate, WA. Contact Gene Fry, (206) 747-4600, ext. 107.
18: SCTE North Country Chapter seminar, hands-on technical training, Hyatt Regency, Minneapolis. Contact Bill Davis, (612) 646-8755.
18: SCTE Ohio Valley Chapter seminar, data networking and architecture, Cleveland. Contact Jon Ludi, (513) 435-2092.
20: SCTE Cactus Chapter seminar, hands-on system and FCC testing. Contact Harold Mackey, (602) 352-5860, ext. 135.
20: SCTE Cascade Range Chapter, BCT/E exams to be administered, Paragon Cable, Portland, OR. Contact Cynthia Stokes, (503) 230-2099.
22-23: Scientific-Atlanta training course, distribution, San Antonio, TX. Contact Bill Brobst, (404) 903-6306.
23: SCTE Chattahoochee Chapter seminar. Contact Hugh McCarley, (404) 843-5517.
23-25: Philips mobile training course, Kansas City, MO. Contact Yvonne Jordan, (315) 682-9105.
24-26: Scientific-Atlanta training course, headend and earth station, San Antonio, TX. Contact Bill Brobst, (404) 903-6306.
24: SCTE Appalachian Mid-Atlantic Chapter seminar, audio/video measurements. Contact Richard Ginter, (814) 672-5393.
24: SCTE Central California Chapter seminar, back to basics, Almond Tree, Turlock, CA. Contact Dave Bell, (209) 667-5006.
24: SCTE Great Plains Chapter seminar, basic electronics theory, The Knolls restaurant, Lincoln, NE. Contact Jennifer Hays, (402) 334-2336.
25: SCTE Upstate New York Chapter seminar. Contact William Grant, (716) 827-3880.
27: SCTE Chaparral Chapter seminar, headend theory and maintenance, Albuquerque, NM. Contact Scott Phillips, (505) 761-6253.
29-April 2: UNIVentures management development workshop, Radisson Hotel Denver South, Denver. Contact Donna Carlon or Candace Fox, (303) 791-7053.
30-April 1: Philips mobile training course, Dallas. Contact Yvonne Jordan, (315) 682-9105.
31: SCTE Ark-La-Tex Chapter seminar, video compression. Contact Randy Berry, (318) 238-1361.

Planning ahead

April 21-24: Cable-Tec Expo '93, Orlando, FL. Contact SCTE, (215) 363-6888.
May 2-5: WIC National Management Conference, Chicago. Contact (312) 661-1700.
June 6-9: National Show, San Francisco. Contact (202) 775-3669.
Aug. 24-26: Great Lakes Cable Expo, Indianapolis. Contact (517) 482-9350.
Aug. 25-27: Eastern Cable Show, Atlanta. Contact (404) 252-2454.

April

6-8: Philips mobile training course, RF and video distortions, headend basics, amplifier applications and operation, record keeping and maintenance, Albuquerque, NM. Contact Yvonne Jordan, (315) 682-9105.
8: SCTE Satellite Tele-Seminar Program, *Customer Service and Safety Issues (Part One)*, videotaped at Cable-Tec Expo '92, to be shown from 2:30 to 3:30 p.m. ET on Transponder 14 of Galaxy I. Contact SCTE national headquarters, (215) 363-6888.
12-13: Scientific-Atlanta training course, design considerations and system sweep and balance, Atlanta. Contact Bill Brobst, (404) 903-6306.
15-16: Scientific-Atlanta training course, 8600 System operation and maintenance with System Manager 4/5, Atlanta. Contact Bill Brobst, (404) 903-6306.

the-air TV and video teleconferencing.

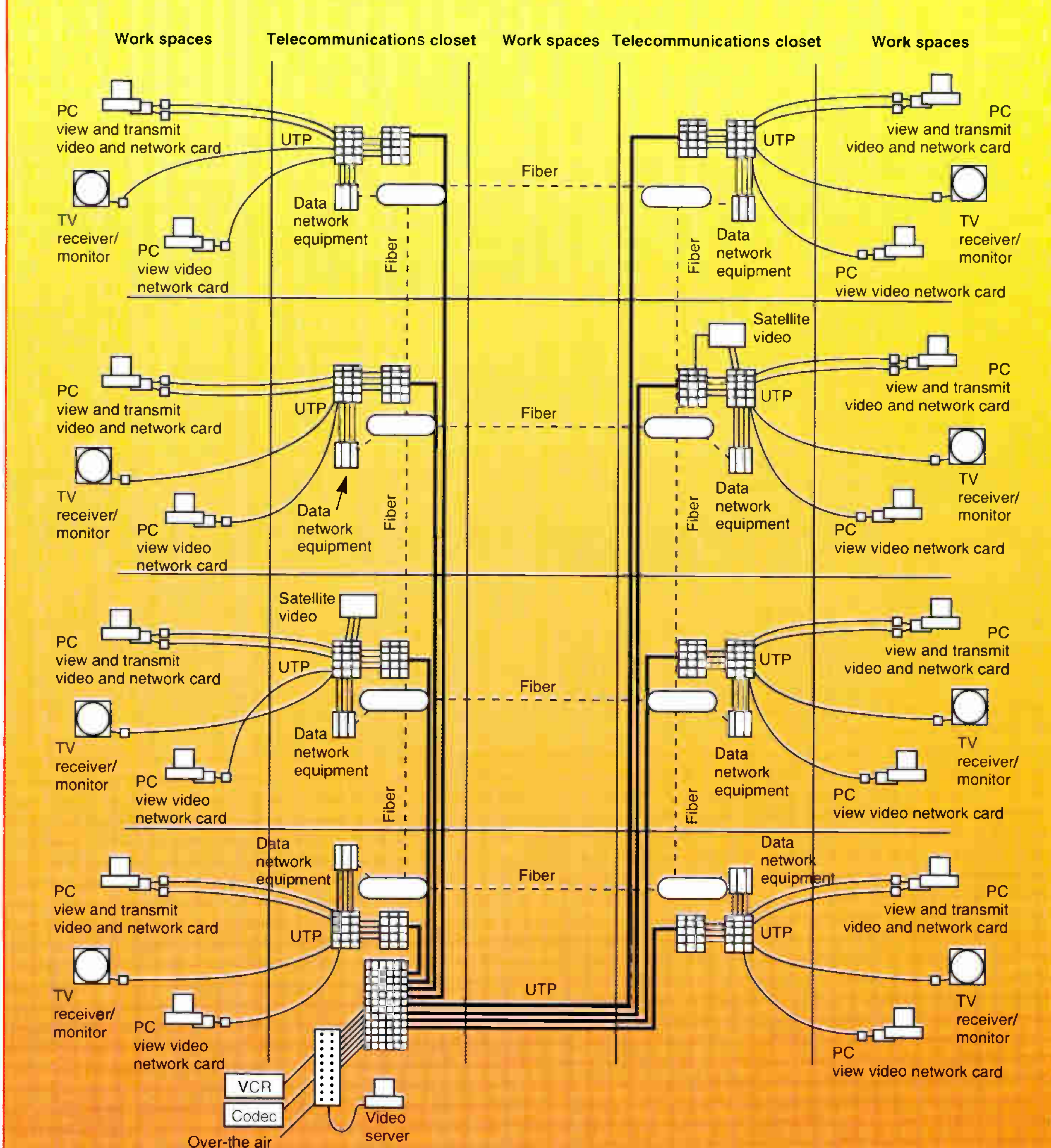
Building blocks

The building blocks for video-on-demand (VOD) at the desktop include: the Electronic Industry Association (EIA) Standards 568/569; Category 5 unshielded twisted-pair (UTP) cable; and a universal wiring system (UWS). EIA standards were developed to support standard product performance and guidelines to deliver high-speed data, voice and other communications signals throughout a building or facility.

Category 5 is a subset of the EIA standards that sets operational parameters on the transmission speeds that can be used on a cable. Category 5 defines a 0-100 Mbps data transmission speed with a 0-100 MHz bandwidth. This transmission is maintained over a multiconductor twisted copper wire generally consisting of three to six pairs.

The UWS topology used by Sver-

Figure 2: Switched video topology



BOOKSHELF

The following is a listing of videotapes currently available by mail order through the Society of Cable Television Engineers. The prices listed are for SCTE members only. Non-members must add 20% when ordering.

- *BCT/E Certification: An Overview of Technical Certification and Related Category Examinations* — This tape features Marvin Nelson and Leslie Read and is geared toward candidates in the BCT/E Program and those entering the program. It provides both an overview of the requirements for each category and insight into key topics of importance. A discussion of the types of questions that will be found on the examination is provided, along with a candid discussion of the types of answers that the respective committees expect. If you will be taking a BCT/E exam in the near future, the SCTE urges you to review this presentation. (70 min.) Order #T-1115, $45.
- *Customer Service: Doing the Job Right the First Time* — This presentation features Connie Buffalo, Ralph Haimowitz and Willis Smith. Who in your system spends the most time face-to-face with your subscribers? Who do you think has the greatest impact on the image your subscribers have of your system? Drawing upon data from a nationwide survey, this program provides valuable insight into how customer-oriented training for technical personnel can greatly improve relations with your subscribers. (70 min.) Order #T-1116, $45.

Note: Videos listed this month were recorded at Cable-Tec Expo '92 in San Antonio, TX. They are available in color and in the 1/2-inch VHS format only. Videotapes are available in stock and will be delivered approximately three weeks after receipt of order with full payment.

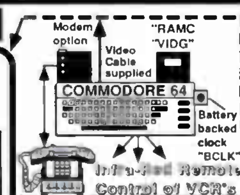
Shipping: Videotapes are shipped UPS. No P.O. boxes, please. SCTE pays surface shipping charges within the continental U.S. only. Orders to Canada or Mexico: Please add $5 (U.S.) for each videotape. Orders to Europe, Africa, Asia or South America: SCTE will invoice the recipient for additional air or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

To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Orders without full and proper payment will be returned. Send orders to: SCTE, 669 Exton Commons, Exton, PA 19341 or fax with credit card information to (215) 363-5898.

A listing of other publications and videotapes available from the SCTE is included in this month's issue of the Society newsletter, "Interval."

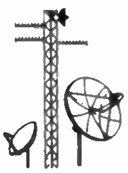
Reader Service Number 52

BUSINESS DIRECTORY/CLASSIFIEDS



Modem option
Video Cable supplied
"RAMC
"VIDG"
COMMODORE 64
Battery backed clock "BCLK"
Infra-Red Remote Control of VCR's

WSDM
PK8
UPS1
WX1
to C64
DVM2
Rack Mounted
A X B Audio/Video Switches 8 ch. mono/stereo
"RMAV"



Professional Services/Design/Construction

Career Opportunities

Career Opportunities (Continued)

Equipment Sales & Service

Software

Cable-Tec Expo '93 — Don't miss it!

By Bill Riker
President, Society of Cable Television Engineers

As I write this message, I am traveling to Orlando, FL, to make final arrangements for SCTE's 11th annual Cable-Tec Expo, to be held April 21-24 at the city's newly expanded Orange County Convention Center.

The entire SCTE national headquarters staff is working hard to ensure that it will be the greatest expo ever, and I have been informed that registrations are "pouring in." This year marked the first instance that we printed our "Expo Registration Package" in full color, and the response to the brochure, which was mailed to our entire membership, has been very favorable. The registration package also appeared in last month's issue of *Communications Technology*, but if you want to receive a package, you can request one by calling SCTE at (215) 363-6888.

We are glad to know that many people are excited about this year's event and are planning to attend. Following up last year's record-breaking and extremely popular conference, held June 14-17 in San Antonio, TX, will not be easy, but I believe we have assembled a technical program that will benefit all expo attendees, as well as a schedule of special events sure to make Cable-Tec Expo '93 enjoyable and memorable — a good time for all.

Coordinating the plans for this event brings to mind all of the exciting training opportunities we will be offering to attendees of this year's expo. The entire program has been designed to be the most cost-effective means of obtaining the maximum technical training for all levels of technicians and engineers working in the field of broadband communications.

What's in store

The Annual Engineering Conference, while geared toward engineers, will contain topics of interest to all levels of SCTE's membership. The conference, to be conducted April 21, will be packed with six hours of technical and management papers to be presented and discussed in a panels made up of many of the industry's engineering leaders. These panels will concentrate on applications of digital technology, cable and telephony integration, and the balancing of revenue opportunities and network evolution, new technologies and their effects on the subscriber, and cutting-edge pay-per-view technology. Engineers from the Federal Communications Commission, National Cable Television Association and technical advisory committees will discuss current issues that will impact the future directions to be taken by our industry.

The Annual Membership Meeting, to be held at the conclusion of the conference, will offer attendees the opportunity to meet members of the Society's national board of directors.

The expo itself, scheduled for April 22-23, will offer a total of 10 technical training workshops, focusing on distortion analysis and troubleshooting, effective personal communication skills, fiber-optic architectures and construction practices, digital technology, the new FCC regulations, outage reduction techniques, safety (including NEC, NESC and OSHA regulations), test procedures under technical reregulation, the use of basic test equipment, and fiber-optic documentation, restoration and testing.

No other activities will be scheduled during workshop periods in order to maximize attendance and participation in the workshops, which have been geared to offer practical experience for system technicians and installers as well as engineers.

Expo '93 will afford attendees the opportunity to prepare for and participate in the Society's Broadband Communications Technician/Engineer (BCT/E) and Installer Certification Programs, as testing will be conducted April 22-24.

The legendary expo exhibit floor will have its usual focus on education, as many industry suppliers will present live demonstrations of their products, supplies, equipment and services used in the design, construction, installation, repair, maintenance and operation of cable TV systems. These exhibitors have been encouraged to gear their booth presentations toward hands-on training, and a Technical Training Center on the floor will offer additional equipment demonstrations. At present, booth space on the exhibit hall is being rented quickly — we anticipate that over 200 suppliers will be exhibiting this year.

Going, going, gone — international

Cable-Tec Expo will offer attendees from other countries special opportunities this year. The International Lounge will allow attendees from around the world to socialize, and *International Cable* magazine is arranging to translate this year's engineering conference for the first time into at least two languages: Japanese and Spanish.

As exciting as the agenda for this year's event is, we are equally proud of the fact that registration fees for Cable-Tec Expo '93 have not changed since 1986. The fee for registration to the Engineering Conference and expo for an active SCTE member remains $195, which includes a ticket to the Annual Awards Luncheon set for April 21, as well as admission to the 1993 Expo Evening at Sea World, which promises to be an enjoyable (and wet) social gathering.

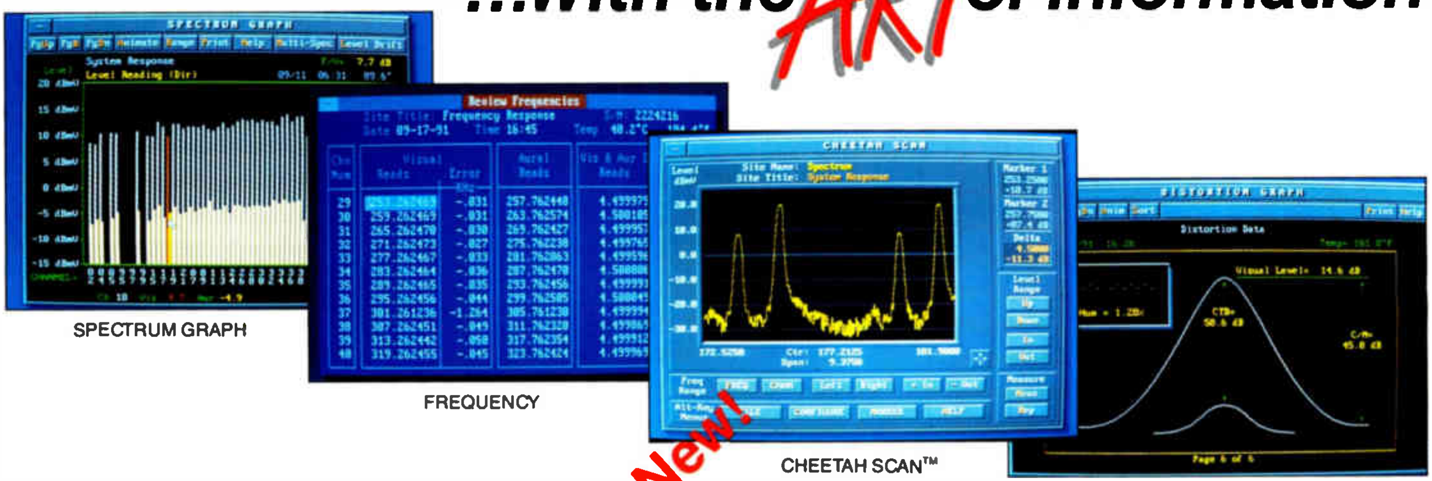
Always a highlight of any expo, the Annual Cable-Tec Games will be held April 21 during the Welcome Reception. Don't miss this thrilling competition, which pits industry personnel from around the country in practical tests of technical skill and knowledge.

SCTE has arranged discounted rates for expo attendees at four hotels in Orlando, a city that offers attendees and their families a wealth of recreational and entertainment possibilities. We hope all of you will be able to join us for Cable-Tec Expo '93 and benefit from all of the training and education it will offer. But don't delay registering — the deadline for preregistration is March 15! If you have any questions about Cable-Tec Expo or any of SCTE's programs and services, please call us at (215) 363-6888 or fax to (215) 363-5898.

I hope to see you in Orlando! **CT**

Save time and money
Every time you test.

...With the ART of Information



SPECTRUM GRAPH

FREQUENCY

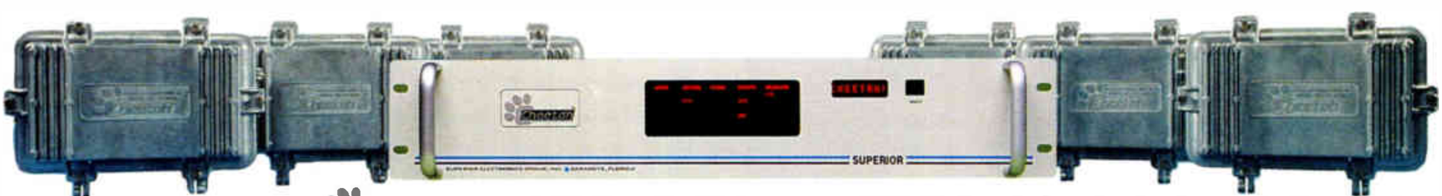
CHEETAH SCAN™

DISTORTION GRAPH

Cheetah™ saves you time and money because it automatically records test results every time you test. Doing it the old manual way is just too tedious. ***Cheetah***™ engineers made automated documentation one of the design goals of the ***Cheetah***™ system. This forethought saves ***Cheetah***™ users lots of time and money!

Now, more than ever, cable systems are required to perform and document technical compliance test measurements. The automation of recording documentation is a real necessity, especially when testing at multiple systems and sites. The ***Cheetah***™ system provides accurate, printed documentation every time you test, ***Automatically!*** As you can see, ***Cheetah***™ was designed right from the beginning with ***You*** in mind.

For more information, call ***Cheetah***™ **direct at: (813) 351-6700.**



Automated Remote Testing™

WE MEASURE THE BEST!™

Cheetah™

SUPERIOR ELECTRONICS GROUP, INC.
2237 Industrial Boulevard, Sarasota, Florida 34234
Telephone (813) 351-6700 • Fax (813) 351-9193

Reader Service Number 53

We've done what nobody else has. Become the *first* fiber optic cable manufacturer who's earned ISO 9001 Registration from Bellcore Quality Registration Services in the *first* attempt.

We knew we made quality products. We have for more than 100 years. Pirelli customers knew it too. But now, with ISO 9001 Registration, the entire international communications market recognizes the significance.

And, the world's talking.

Not only about Pirelli—but what this registration means for business. For effective communication, the world depends on quality fiber optic cable. Without it, you risk system interruption or failure.

Plus with Pirelli, you can tap into world markets that might have been inaccessible before. With the knowledge that Pirelli cable *exceeds* both domestic and international standards.

Call 1-800-669-0808. Because—whatever the language—quality talks.

PIRELLI

FIBER OPTIC CABLES

PIRELLI CABLES NORTH AMERICA — COMMUNICATIONS DIVISION

700 Industrial Drive • Lexington, South Carolina, USA 29072-3799
(803) 951-4800 • FAX (803) 957-4628

13340 - 76th Avenue • Surrey, British Columbia, Canada V3W 2W1
(604) 591-3311 • FAX (604) 591-9874

Reader Service Number 28

WE'VE CHANGED!

You know us as Anixter Cable TV. We have been your source for superior products, service and delivery for over twenty-five years. You know us as people who care about your success, and the industry we all work in together.

Today, our industry is growing beyond traditional video entertainment to include voice, data and expanded video services. We're growing too, investing in new people, product systems and enhanced services to help you take advantage of these opportunities. As always, we are bridging the technologies of our world-class supplier partners with your evolving needs to create solutions that will help you remain competitive in this exciting and changing market. Our new name, ***ANTEC Communication Services***, reflects our expanded focus.

As ***ANTEC Communication Services***, you can always count on us for the responsiveness and personalized service you've come to expect throughout the years. After all, when people come first, the rest comes naturally.

ANIXTER CABLE TV

ANTEC COMMUNICATION SERVICES

Marty Ingram
President

ANTEC[SM] COMMUNICATION SERVICES

2850 West Golf Road • Rolling Meadows, Illinois 60008 • 708-437-5777