Communication Technology

OFFICIAL TRADE JOURNAL OF THE SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS

MARCH 1999

30th 1969-1999

Meet John Clark

SCTE's New Champion

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- Return Path Setup
- NEC/NESC Code Compliance

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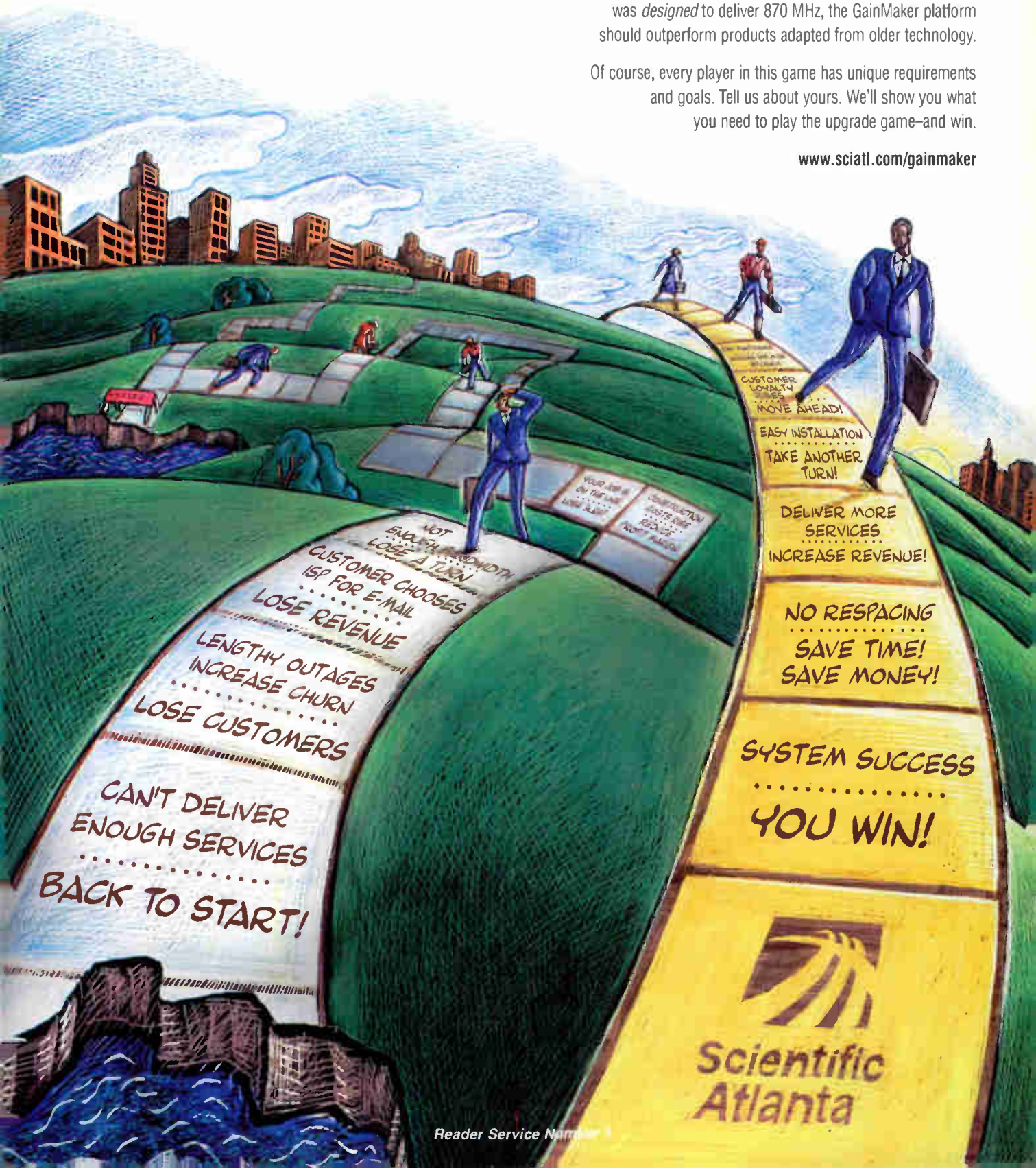

Built on Past Success... Upgraded for Future Excellence

Training

SCTE's training partnerships with state cable associations and the Society's local groups will help to educate nontechnical staff members on the business opportunities and challenges that tomorrow's technologies hold.

Certification

Certification's true value is its pledge to constant learning, encouraging individuals to hone their public presentation skills, write technical articles, attend training programs and serve in volunteer leadership positions during their three-year recertification period.

Standards

The SCTE Standards Department, the only American National Standards Institute-accredited standards developer in the cable industry, has attained ANSI approval for four standards documents since 1996.

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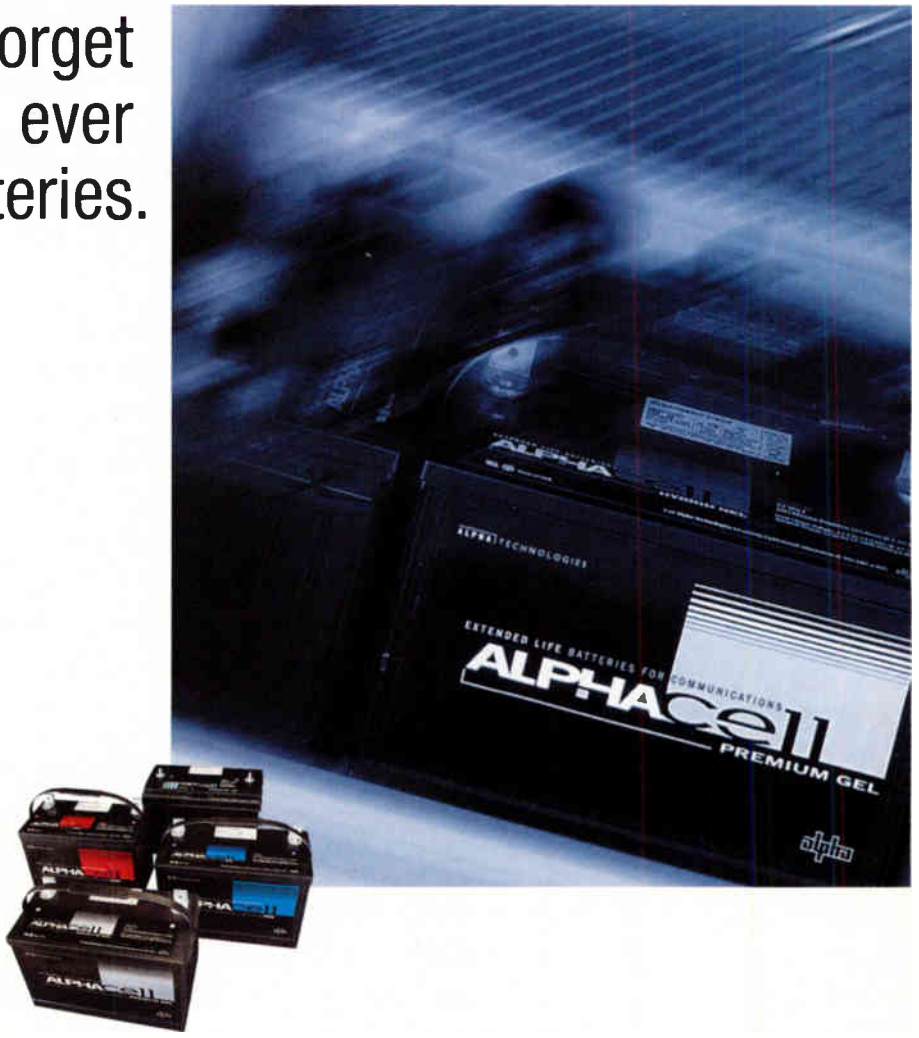
Four reasons to forget everything you've ever known about batteries.



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ALPHA TECHNOLOGIES

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REFERENCE

COLUMNS

Finally. A Cable Modem That Can Be Self-Installed.

Anyone can do it. Just ask TCA Cable TV. A full 80 percent of their Terayon cable modem installations are self-installed by their customers. Anyone can install Terayon's robust cable modems. Grandma, the kids, even Dad.

Proven, Robust Performance

How do they do it? It's built into the box. Terayon's proven, robust S-CDMA technology gives you extra margin, so your modem system stays up and running, even when you're running the hair dryer. No kidding. You can deploy modems over a wider range of cable plant conditions without the usual gold-plated plant upgrade. Put your gold to better use.

Ready to Install

Terayon's modems come fully packaged and ready to install. About as easy as plugging in a toaster. And if you're ready for retail, so is Terayon.

Take it to the Bank

That's not all. The real beauty of Terayon modems is higher revenue sooner. By switching to Terayon, Shaw Communications found that they could deploy modem systems in half the time. And they significantly reduced startup and operational costs. Wake up. You can too.

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Forget the bus. The fastest way to find Terayon is on the web. Check out www.terayon.com or call them directly. You won't regret it. I've got my Terayon modem. Now go get yours. Tell them I sent you.

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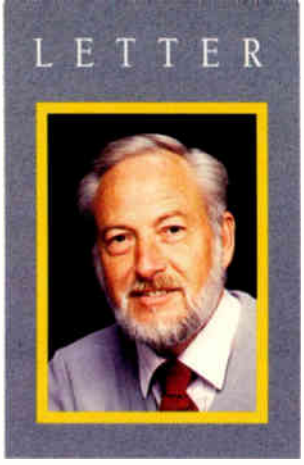
Reader Service Number 3

By Rex Porter



Don't Forget Who You Are

And don't forget what you do. Your broadband hybrid fiber/coax (HFC) architecture can carry services not yet imagined. And business people across the industry know that.

But they may not know the equipment's complexity or the need for continued training. And they may not care.

You work tirelessly to make sure cable's networks deliver TV programming while adding other valuable content. It'll never be easy. But be aware that some will want you to give them an advantage by adding their services, to the detriment of others.

Your obligation is to provide a "clean" network that delivers analog and/or digital TV programming, commercial data, Internet access, telephony and high definition TV (HDTV) when required. Equipment manufacturers are obligated to develop equipment and services that enhance profits without degrading other services.

The Society of Cable Telecommunications Engineers, the American National Standards Institute and CableLabs work tirelessly to make sure industry specifications and standards protect the engineering community.

Be careful in choosing equipment as we move into new waters. Be even more careful of people in your own organization who may attempt to make buying decisions based on less than a full understanding of the network and its equipment.

I have spoken with some sales and marketing people who do not see the importance of specifications and standards. During the past 50 years, our industry has matured because MSO management required operations managers to improve the bottom line by adding programming, improving customer relations, clustering and many other new ideas.

MSO management likewise has required technical managers to improve the bottom line by developing networks to launch new services, ensuring that these networks will continue to deliver a full menu. Before equipment or services are added to your system, you must decide whether the addition is compatible.

You have been trained for this responsibility. Some companies plan to sell "around" you. If you fold and let others make the decisions, they may later say: "You should have known better. You knew I didn't have a technical background."

Communications Technology will not compromise our position. As the SCTE's official trade journal, our responsibility is to the health of the engineering and technical community. We may lose some advertisers, but we'd rather keep your trust.

Rex Porter
Editor-in-Chief

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The DSG2000BD also has a host of convenient, well-engineered features such as front-panel stereo and SAP test jacks, a built-in Bessel-Null Test Signal and an auxiliary audio input for EAS or commercial insertion. Pre-calibrated indicators guarantee critical levels are properly set and available options make it a breeze to add SAP and/or AGC capabilities. And to top it off, each DSG2000BD contains two complete stereo encoders in a single rack-unit of space.

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Reader Service Number 6

AT&T Makes HFC Headlines

Cisco and General Instrument plan to work with AT&T to develop and test a seamless, end-to-end Internet protocol (IP) solution for TCI's cable lines.

At press time, specific agreements had not been reached, but the plan calls for a Cisco/GI backbone that combines broadband Internet, phone and video services over a single cable line. The plan aims for deployment on a mass market scale over AT&T's hybrid fiber/coax (HFC) networks. The proposed network combines advanced networking and voice-over-IP (VoIP) technologies to enable cost-effective delivery to consumers while streamlining operational demands.

Using broadband packet technologies, data, voice and video services, which traditionally required construction of multiple parallel legacy networks, would be delivered using one integrated high-speed infrastructure.

The IP backbone Cisco and GI are discussing likely will contain the Cisco 12000 Gigabit Switch Router (GSR), a multi-gigabit, carrier-class, IP backbone router and the Universal Broadband Router (uBR) to create a scalable interface between subscriber cable modems and the backbone data network.

The packet telephony gateways they're planning are based on the Cisco AS5X00 VoIP gateway servers.

In the proposed architecture, GI's suite of customer premise equipment (CPE) also is integrated into AT&T's network. GI's CPE solutions include stand-alone Broadband Telephony Interface (BTI) terminals and integrated BTI products for the SURFboard high-speed cable modem and the DCT-5000+ advanced set-top.

By integrating the set-top terminal, cable modem and BTI into one system, the platform is intended to offer an alternative to traditional circuit-switched telephony systems. As development efforts advance, the three companies are aiming to conduct a market trial late this year and offer commercial availability in 2000.

DBS Competition Inspires Cable

A recent study comparing pricing and services from cable and direct broadcast satellite (DBS) operators indicates that cable represents the lowest pricing per package, and DBS offers greater programming value per dollar spent.

Carmel Group researchers estimate that U.S. cable TV subscribers are at the 68 million mark. DBS, they say, has attracted 9 million subscribers to its services.

"This study indicates that competition from the 5-year-old DBS industry has forced the cable industry to catch up, in terms of creating more flexible and attractively-priced programming services," says Carmel Group Chairman Jimmy Schaeffler.

The Carmel Group surveyed prices and programming offered by four national DBS service companies and six cable operators. Included in the study were Cox in San Diego and Santa Barbara, CA; TCI in Denver and Monterey, CA; and Time Warner in New York and Lexington, NC.

The study indicated that a consumer's investment in cable TV vs. DBS and the programming value varies substantially. Although cable requires a lower overall payment month-by-month, DBS subscribers are receiving more content and paying a lower cost per channel.

"As the gap closes between the cost of hardware and content offered by both cable and DBS companies, the real battlefield between these two entertainment and information providers will be fought attempting to increase bandwidth," Schaeffler says. "This will control how many new services companies will be able to

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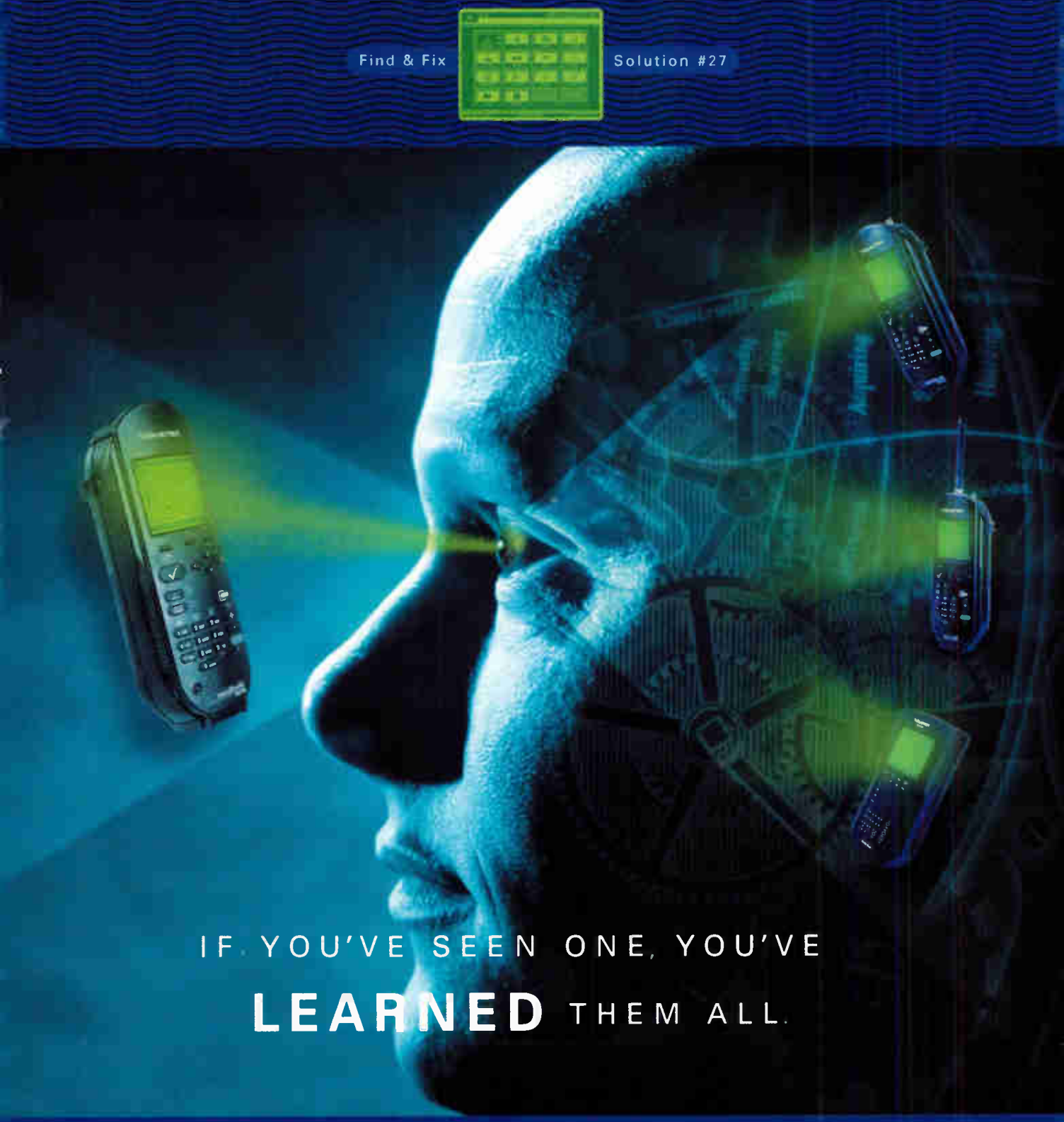
Reader Service Number 8

offer and charge additional fees for in the future."

When comparing premium service packages from both cable TV and DBS companies, the study indicated that cable subscribers in all six markets surveyed save $200 annually. For medium-priced services, cable and DBS have nearly the same number of video offerings. For more information, call (310) 201-8845.

NEWS BITES

- The National Cable Television Center and Museum needs some vintage gear to fill gaps in its collection. Among the needed items are Scientific-Atlanta amplifiers of all kinds and vintages, Ameco Pace Setter amps, Jerrold SX-1 and SLE line extenders, Starline-One amps, and Amplvision 105 low band amps. The Center also would like lists of any other equipment that might be available. Contact Dave Willis at DWillis542@aol.com.
- General Instrument is talking with at least four companies about mergers or investments. Reports indicate that Lucent, Royal Philips Electronics, Cisco and Motorola are potential suitors.
- @Home and Cisco Systems are planning their second Internet Revolution Expo, a "moveable feast" of broadband cable products and services where consumers sample the power of high-speed Internet access in the comfort of the local mall. Building on the response to last year's 12-city excursion, the 1999 tour is slated to kick off in the spring and travel to 20 bustling shopping malls throughout the United States and Canada.
- Scientific-Atlanta has signed up for a portion of Microsoft's WebTV software platform and services. The broadband communication systems supplier plans to integrate Microsoft's WebTV service into its Explorer 2000 set-top boxes. S-A says it will team with Microsoft to design a new set-top that integrates Windows CE into Microsoft's WebTV software platform. S-A's marketing vice president Steve Necessary says the move will help operators roll out services in their systems and advance the cause of interactive services deployment. CT



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Reader Service Number 11

DEPLOYMENTWATCH

By Greta Durr

Whether by itself or in a set-top, cable modem technology has landed. Different approaches to deployment are evolving along with the technology, as the broadband industry embraces the high-speed network dream.

Terayon Advances in Cable Modems

Recent announcements that CableLabs has selected Terayon to co-author the new Data Over Cable Service Interface Specification (DOCSIS), success on the retail front and a data deployment by Frontiervision have the industry talking. Terayon's synchronous code division multiple access (S-CDMA) is at the root of the buzz.

Frontiervision, with nearly a million subscribers, recently bought State Cable of Augusta, ME, and has been working with Internet service providers (ISPs) to build its data service operation via Terayon's S-CDMA technology. Accelerated deployments are planned throughout the quarter in Maine and in Columbus, OH.

Other deployments are taking place through consumer installation. Modems may be obtained from the operator or a retailer. Cablevision, for example, has a deal in New York and Connecticut to market Terapro modems and installation kits through The Wiz, a consumer electronics chain.

TCA in Texas is reporting an 80% success rate with subscriber installations. Customers pick up the modems and installation instructions at a designated location. There, the operator offers tiered services to commercial and residential subscribers. "They're saving a bundle on installation and maintenance," says Terayon's John Hamburger about the operator's deployment of an estimated 10,000 Terayon cable modems.

Hamburger says that Terayon's system allows operators to deploy data services quickly and cost-effectively. The S-CDMA technology, Hamburger says, allows maximum control over bandwidth and works over a range of cable plant conditions—from noisy coaxial systems to upgraded hybrid fiber/coax (HFC) systems.

S-CDMA's success in diverse environments may have helped gain CableLabs' attention for the new DOCSIS spec, Hamburger says. "It's a sign that the technology is moving more mainstream."

S-A's Set-tops Boost Cable Modems

Scientific-Atlanta is using a different strategy to deliver cable modem technology to consumers by attaching it to the Explorer 2000 advanced digital set-top. Subscribers in several systems are now using set-tops that began with Time Warner's Pegasus program several years ago.

S-A reports that it has received purchase orders or commitments for its interactive digital network from 14 cable operators in the United States and Canada, representing 75 systems with 16 million cable subscribers. Operators include Time Warner, Cox, TCI, Comcast, Adelphia, Marcus, Rogers and Videotron.

Cox is launching Explorer 2000 set-tops coupled with network deployments in three of its largest properties. The series of launches has begun in Phoenix, Cox's largest system with an estimated 600,000 subscribers. Subsequent launches include the MSO's 500,000-subscriber San Diego system and its Oklahoma City system, which has 121,000 customers.

Time Warner is now launching the Explorer 2000 in its Austin, TX, system, following the purchase of 100,000 units. The MSO is committed to buy an additional million set-tops for deployment nationwide.

Both operators are rolling out the set-tops' services in phases. Initially, they are offering digital channels and then moving into video-on-demand (VOD), e-mail and electronic commerce. Eventually, a smart card slot built into the Explorer 2000 will allow debit card payments to be made over the set-top.

S-A says that the set-top's open architecture affords great flexibility in the addition of new services. Because the set-top has an Ethernet port, it can connect to a personal computer (PC), functioning as a stand-alone cable modem while also delivering TV services. Internet protocol (IP) telephony is a future option in store for Explorer 2000, says Steve Necessary, marketing vice president of S-A. CT

Greta Durr is assistant editor at "Communications Technology" in Denver. E-mail deployment information or comments to gdurr@phillips.com.

Who's Who in Deployment: HSA's Service Area Booms

High Speed Access Corp. is deploying high-speed data services in several cable systems in Georgia, Kentucky, California and Illinois, passing an estimated 80,500 homes.

HSA is in the process of launching service in **Covington Cable's** Covington, Oxford, Porterdale, and Newton County, GA, systems; **Vista Broadband Communications'** Smyrna, GA, system; **Ultronics'** Chula Vista, East Lake development in Chula Vista, and National City, CA, systems; **Irvine Community Television's** Irvine, KY, system; and **Western Cable Communications'** Plainfield, IL, system.

The various deployments all were slated to begin in the first half of this year.

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SCTE UPDATE

SCTE Member of the Year Award

The Society of Cable Telecommunications Engineers is seeking nominations for its 1999 Member of the Year Award. Each year a member is recognized for outstanding contributions to the goals and purposes of the Society.

All persons nominated for the award must be active members of the Society. SCTE headquarters must receive written nominations no later than April 15, 1999. Nominations are presented to the SCTE board of directors for consideration and selection. The award is presented each year at Cable-Tec Expo, which will be held May 25-28 in Orlando, FL. For more information, contact the Membership Services Department at (610) 363-6888.

SCTE Standards Boast Growth

The SCTE Standards Department reports considerable growth within its Standards Development Organizations (SDOs).

- Existing active membership includes more than 600 professionals from domestic and international organizations, representing 25 countries.
- The 125 organizations represent cable operators, suppliers, educators, government agencies and the interested public.
- There are more than 133 standards documents, many of which are approved by the American National Standards Institute and International Telecommunications Union-Telecommunications, in addition to 35 video training and textbook materials. These are available for sale through SCTE.
- SCTE SDOs, including engineering subcommittees and independent groups, have doubled to 12.
- Standards development meetings have increased to 40 planned sessions in 1999.
- Electronic communications facilities now include two World Wide Web sites and five e-mail reflectors.

For more information on how to join SCTE SDOs, contact Ted Woo, Ph.D., director of standards, at (610) 363-6888 or e-mail twoo@scte.org.

SCTE Announces 1999 Vendor Shows

Local chapters of the SCTE offer industry field personnel unique opportunities to learn firsthand about the latest hardware trends through regional training events.

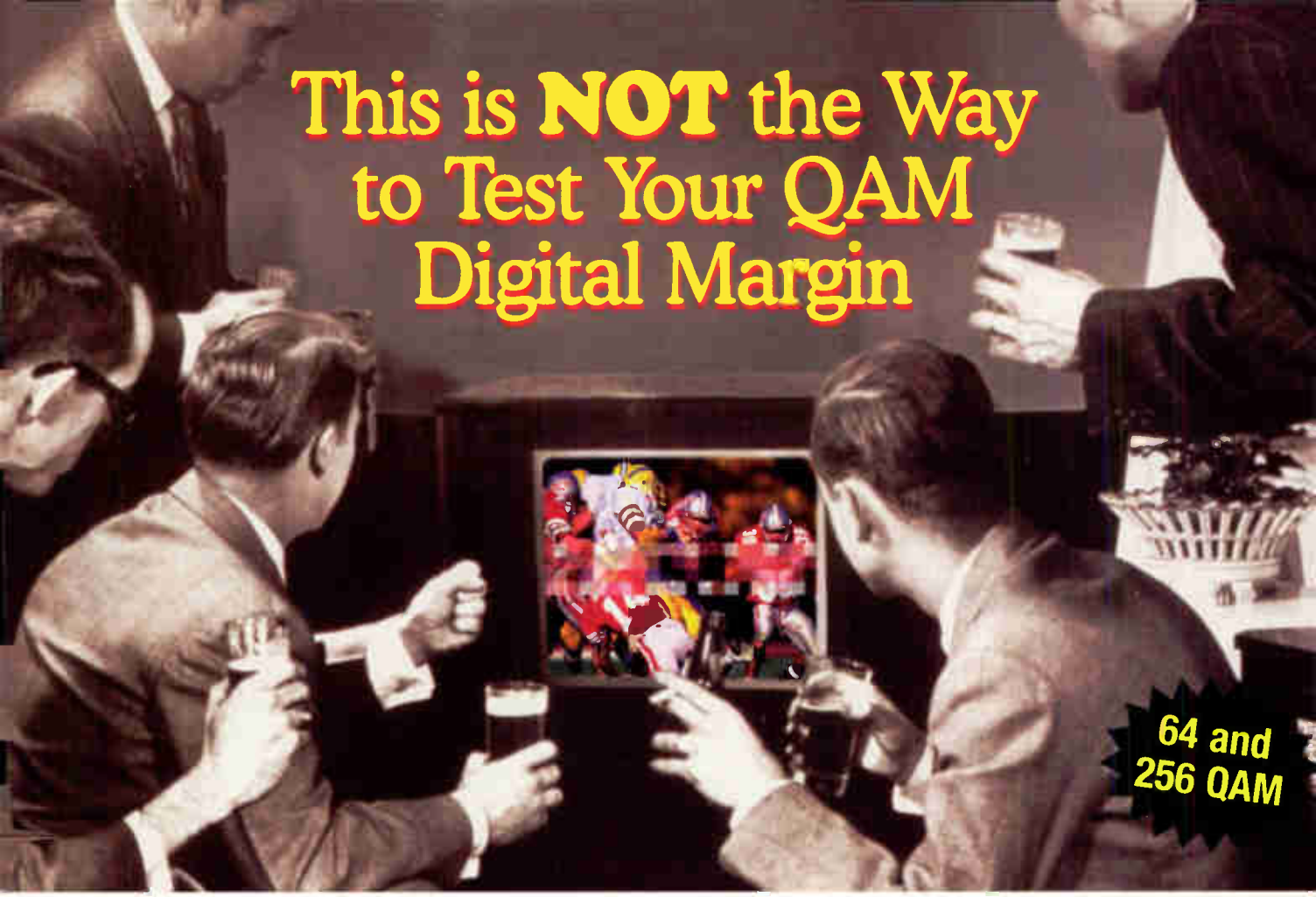
SCTE Vendor Days were created to bring broadband products, services and information to operations personnel at the local level. The annual shows, which focus on education rather than sales, provide a wide variety of learning experiences that allow attendees to enhance their professional knowledge with intensive training that's cutting edge and cost-effective.

These events feature tabletop displays and hands-on demonstrations, plus comprehensive technical training seminars. For attendees, Vendor Days are a valuable chance to share experiences with industry peers through networking and "problems-and-solutions" exchanges.

Scheduled Vendor Days include:

- March 10-12: Northern California Chapters (Concord, CA)
- March 11: Ohio Valley SCTE Chapter (Columbus, OH)
- March 17: Great Lakes SCTE Chapter (Troy, MI)
- March 17: Old Dominion SCTE Chapter (Richmond, VA)
- March 25: South Florida Chapter (Fort Lauderdale, FL)
- April 15: Wheat State Chapter (Wichita, KS)
- May 13: Penn-Ohio SCTE Chapter (Pittsburgh)

For more information about these events, contact SCTE Director of Communications Steve Townsend at (610) 363-6888, fax (610) 363-5898, or e-mail to stownsend@scte.org. Chapter and meeting group information also can be found on SCTE's Web site at www.scte.org. CT



The Hukk CR1200 QAM Monitor
A Much Better Way!

Digital Video can give your subscribers picture quality unmatched by analog technology. Unfortunately, with digital, there is a very small difference between a channel working and not working at all. A picture that looks perfect, may be only a couple dB away from breaking up. The Hukk CR1200 QAM Monitor can tell you for sure the quality of your installation, so you don't have to learn about it from angry subscribers.

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The CR1200 includes a constellation display, bit error rate testing, average power and signal-to-noise ratio so you'll know the quality of your 64/256 QAM signals anywhere in your network, right up to the set-top converter.

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Built for the field, the CR1200 provides unmatched digital testing capability in a rugged, lightweight package. So you don't have to carry two instruments, the CR1200 even includes an analog signal level meter with automated 24 hour FCC testing.

Call For a Demo

Don't leave the success of your digital implementation to chance, try out a CR1200 in your system today. Your subscribers will thank you, especially during the big game!

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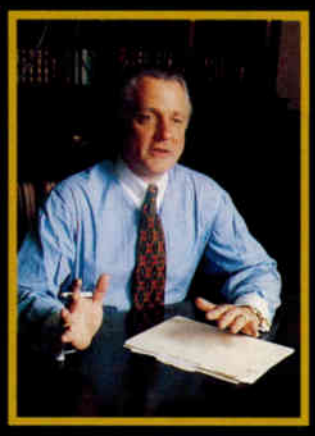
Reader Service Number 14

Interview with a Leader

By Rex Porter

SCTE President John Clark



John Clark

John Clark, new president of the Society of Cable Telecommunications Engineers, is no stranger to cable TV. Clark has held numerous and varied positions within the industry. He is a former CTAM TAMI and Case Study Award winner and a former chairman of the CTAM National Pay-Per-View Conference. He was a managing director/CEO for Telecom New Zealand's First Media cable subsidiary and served as senior vice president of marketing and programming for Crown Media and Cencom Cable Associates. Most recently, Clark served as executive vice president for TELE-TV Media.

Communications Technology: *John, give us a little background about where you're from.*
John Clark: I am originally from New Jersey. So with family in the Exton, PA, area, it's great to be back East, having been gone for 25 years—especially to an area as beautiful as Chester County. I have an undergraduate degree and a master's degree in business from the University of Maryland. I started out after graduate school in the hotel and fast-food businesses.

Communications Technology: *Everyone seems to have entered cable in a novel way. How about you?*
John Clark: I joined the cable TV business in January 1980 under some very unusual circumstances. The way I got into this business all starts with the classified ad section from the Columbus, OH, *Dispatch* newspaper. There was a small ad in the classified section that said, "Wanted—Contestants for Sports Trivia Television Show," and I called the number.

It turned out to be tryouts for contestants on a QUBE/Columbus live, two-way, interactive show called "PowerPlay." I went over to the QUBE studios, and there were 20 people who had applied for the roles—19 bartenders and myself. I was fortunate enough to win one of the preliminary rounds and ended up becoming a contestant on QUBE Cable's "PowerPlay," and that's really how I got into cable TV.

I kept winning different rounds of the "PowerPlay" contest, and this kept me going back and forth to the QUBE studio. Now, while I was doing that, I kept running into such people as Larry Wangberg, who at the time was general manager, and Scott Kurnit, who was programming manager.

So, I started to see what cable TV and new cable technology was all about. I got so excited that Larry and I worked out a new position for me at QUBE/Columbus in the area of franchising. And because I lost in the semi-finals of the championship round of "PowerPlay," I didn't win a trip for two to the Rose Bowl, but I did gain a job in the new cable TV business, and I've been in it ever since.

Communications Technology: *I was pleased to serve on the search committee this last year and really am pleased that we could find such a qualified candidate for SCTE president. I know you have been involved with CTAM and other organizations. How's cable been to you so far, John?*
John Clark: I think I've certainly enjoyed, over the 20 years, meeting the people of the cable business. I think we share a pride in building a business that some people, such as broadcasters, used to laugh at, and now we've converted it into a media powerhouse.

Another thing I've enjoyed is the variety of opportunities that cable has offered. I've worked at the system, regional and corporate levels. I've worked on both the programmer and the MSO/operator

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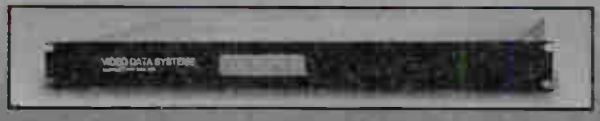

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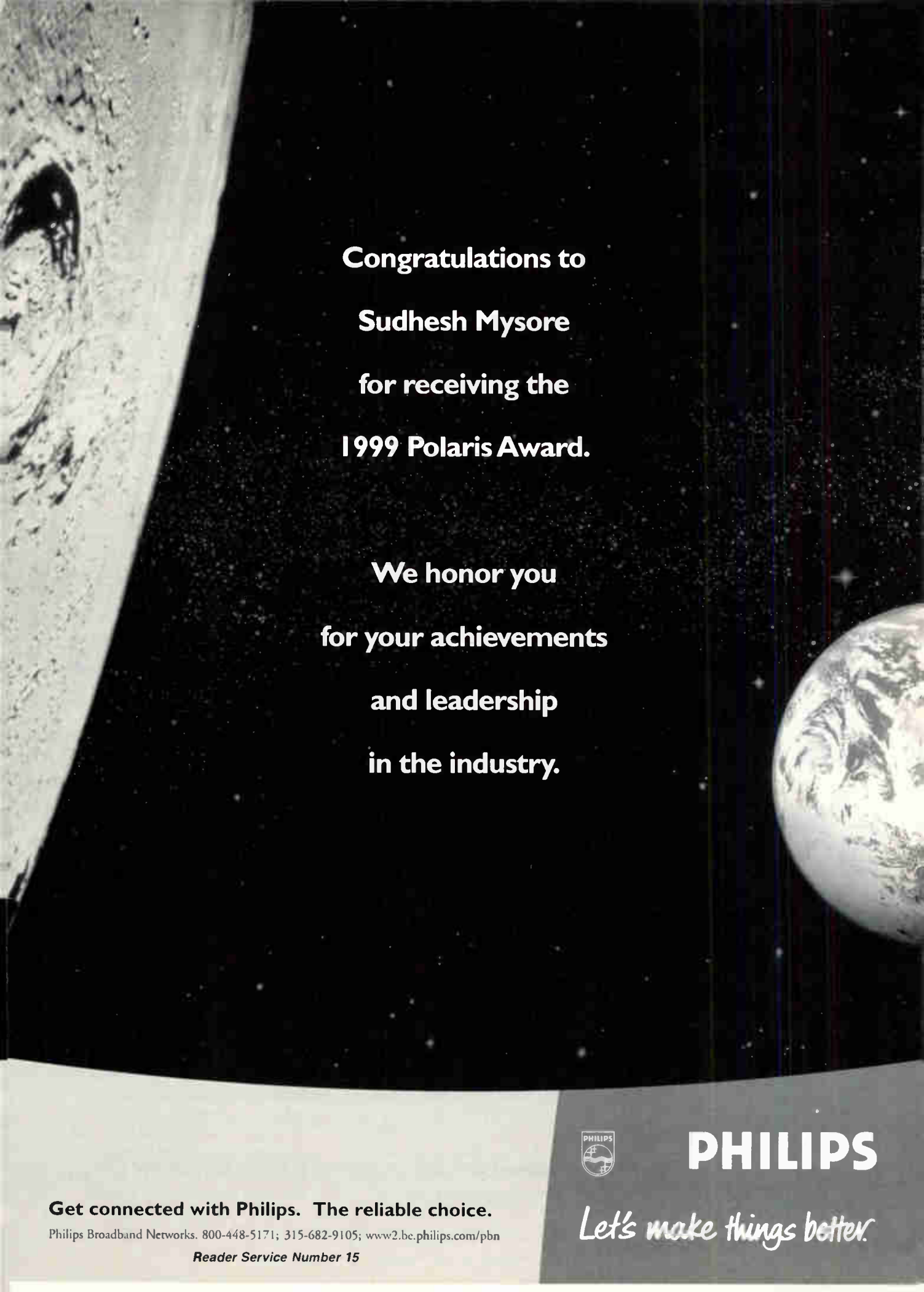
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Reader Service Number 15

Ted Woo told me recently that the SCTE Standards Department had celebrated three new standards in one day. And this has never before been achieved by any industry in history. How do we show the total value of the SCTE?

John Clark: I think this illustrates that we have a communications challenge that really includes two fronts.

> "The role of the engineering and technology community in our business overall probably has never been more important."

First of all, we are fortunate that the SCTE has a lot of very beneficial and powerful programs that are already in place and are occurring. So we do have the story to tell. So the first front is reinforcing the SCTE's position among the engineering and technology group in our business. Overall, I think this is solid, and a very good job has been done in the past to achieve this.

I think the second front is new opportunity to gain the recognition from people beyond our members about the positive contribution the SCTE makes to the industry.

With this message, we want to reach the people who manage and approve the participation of SCTE members in such things as regional seminars, Vendor Days, chapter meetings, Emerging Technologies, and the Expo.

One of our goals is to build support among the industry overall among operations people, financial people and chief executive officers to recognize what we are doing to make it easier for our members and their organizations to take full advantage of what SCTE offers.

Communications Technology: *So, in the past while training, education and certification might have been recognized as fundamental to career growth, that message has not gotten out to the people who control the time available to those engineers.*

Does that mean you are going to be spending a great portion of your time educating the CEOs and company owners about how important it is that their technicians and engineers keep up with the changes in technology?

John Clark: That's exactly what we are attempting to do. Some people have referred to it as "engineering empowerment." Fortunately, I think the timing is right.

Probably the biggest issues facing cable people in the operations, executive and financial arenas are: How do we deploy and in what form do we deploy new technology?

The role of the engineering and technology community in our business overall probably has never been more important. And the decisions we're being faced with have never been larger.

Expanding the SCTE mission and contributing to a broader audience is an extremely important objective and one which I would describe our feelings about as "evangelical."

Communications Technology: *So we'll have the opportunity to follow your success through your messages to the SCTE in your "President's Message" column each month in "Communications Technology" magazine right on into the new century.*

John Clark: Right. I'm thrilled to have the resources of *Communications Technology* and the editorial opportunities to communicate with our members. It's a very valuable tool that we plan to fully utilize.

In looking at the SCTE, I've always been struck by one of its strengths, and that's that the SCTE has a clear mission, and our role at SCTE now is to update that mission as we enter a changing future.

While the mission will remain the same, our methods of serving our members will change. CT

Rex Porter is editor-in-chief of "Communications Technology." He can be reached via e-mail at tvrex@earthlink.net.

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Reader Service Number 19

By Ron Hranac

The World of RFI

Mere mention of the acronym "RFI" can cause many of us to cringe. Why? The three letters stand for radio frequency interference, a phenomenon often associated with signal leakage, ingress, public relations and even equipment technical specifications.

With regard to the latter, the term RFI occasionally is misused when describing network and drop component shielding effectiveness. For instance, you've probably seen drop splitters labeled "100 dB RFI" or something similar, when they should have said "100 dB SE" to be technically correct. But I digress.

So, just what is RFI? As its name implies, it's a form of interference, objectionable or otherwise. The "RF" in RFI suggests the interference occurs to, from, or by signals in the radio frequency spectrum. Signal leakage from our cable networks probably is the most well-known type of RFI in our industry, followed closely by ingress. I suppose one also could define active device-generated noise and distortions as forms of RFI, especially if they become visible in the pictures.

FCC rules

Let's look at the most obvious form of RFI: signal leakage. Most of us are intimately familiar with the Federal Communications Commission's signal leakage requirements. They can be found in Part 76, Subpart K of the FCC's rules and regulations.

In a nutshell, the FCC says signal leakage must not exceed the following: For frequencies less than and including 54 MHz and over 216 MHz, the signal leakage limit is 15 µV/m at a distance of 30 meters. For frequencies over 54 MHz and up to and including 216 MHz, the signal leakage limit is 20 µV/m at a distance of three meters.

Almost all leakage measurements are performed in the VHF midband, so we use the 20 µV/m signal leakage limit. This means that leakage from any part of the system—headend, network and drops—must not exceed 20 µV/m at a three-meter measurement distance.

If you use a resonant half-wave dipole and a signal level meter (SLM) or equivalent for leakage measurements, the maximum dipole level (that is, the signal level at the dipole antenna's terminals before balun, downlead and filter loss, and any preamplifier gain) must not exceed about -41 dBmV to -44 dBmV. This assumes your measurement frequencies are between 108 MHz and 150 MHz.

> "Signal leakage from our cable networks probably is the most well-known type of RFI in our industry, followed closely by ingress."

In general, most systems do a pretty good job of complying with the FCC's leakage requirements. It's an ongoing battle, though, because of a variety of factors that seemingly conspire to keep us on our toes. You know the drill: installation workmanship problems, rodent damage to feeder cables, illegal connections, poorly shielded TV sets and videocassette recorders (VCRs), and so on. Still, did you know that in some cases your system can be in full compliance with the 20 µV/m limit and at the same time be in violation of Part 76?

Yes, RFI can rear its ugly head when leaks are below 20 µV/m. This problem falls under the harmful interference clause of §76.613(a): "Harmful interference is any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety service or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with this chapter."

§76.613(b) continues, "The operator of a cable television system that causes harmful interference shall promptly take appropriate measures to eliminate the harmful interference." So, even a lowly 5 µV/m leak that causes "harmful interference" can get you in trouble, despite the fact that it's some 12 dB below the 20 µV/m leakage limit.

For instance...

Let me give you an example. I'm a ham radio operator and have a high-gain VHF/UHF Yagi antenna array on the roof of my house. I can turn the rotator to point the antennas in a northerly direction and receive an interfering signal on 145.25 MHz.

This most likely is a leak from a neighbor's cable-compatible TV set or VCR, and I assume it's well below 20 µV/m at three meters. (It registers only about S2 or S3 on my radio's signal strength meter.) If I point the antennas any other direction, the signal in most cases falls below the radio's noise floor.

There happens to be a two-meter ham repeater in the Denver area with its output on 145.25 MHz. At my house, the repeater's received signal strength usually is S9 or greater, no matter which way

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Reader Service Number 20

I point the directional antennas, so the repeater is at least 30 dB stronger than the interfering signal.

When the repeater transmits, its signal is much stronger than the interference. That, combined with what is known as "FM capture effect," means the local interference is receivable only when my antenna points in a certain direction and when the repeater isn't transmitting.

In this example, even though I can receive an interfering signal on 145.25 MHz, and it may break squelch on a scanning-type receiver, it does not constitute "harmful interference" because it does not disrupt or prevent communications. In fact, I would venture a guess that most cable TV signal leakage detection equipment probably couldn't even hear it.

However, if the leak happened to be strong enough to prevent me from receiving the repeater, it could be defined as harmful interference even if the leak were below 20 µV/m.

RFI and ingress

Now let's look at ingress from an RFI perspective. Any place a leak exists represents a potential ingress point. After all, if a problem exists that allows signals to leak out of a cable TV system, then it's highly likely that over-the-air signals can leak in at the same location.

Our subscribers are pretty good about letting us know when ingress exists. A common complaint is interference on one or more midband channels. Ch. 18 interference usually comes from radio transmissions in the two-meter ham band, and interference on Chs. 19, 20 and 21 is caused by pager transmitters, police, taxi and other VHF two-way radios.

When this type of RFI exists, it's unfair to point fingers at the ham down the street or the pager transmitter on a nearby tower. Simply blaming the signal source for causing interference is irresponsible. Over-the-air users are licensed to use those frequencies and have every right to do so.

You need to determine if the ingress is getting into the system because of a system problem or direct pickup in the subscriber's equipment. We are responsible for the integrity of our networks, but not the performance of subscribers' TV sets or VCRs. If you find leakage near the complaining subscriber's residence and fix it, and if the ingress interference goes away, you've just solved a problem.

However, if you find the system has no leaks or ingress and can demonstrate with a different TV set or maybe with a converter connected to the subscriber's so-called cable-ready set that the interference is a consumer equipment problem, you've just entered the public relations world.

Technicians and PR

The keys to resolving these types of problems are good troubleshooting skills, cooperation and communication. If you determine the problem is with the subscriber's equipment, you must carefully explain how the interference is getting inside the device without making the subscriber feel like he or she bought an RFI-susceptible piece of junk. That may indeed be the case, but saying so does no good for anyone involved.

Offering a potential solution such as a converter in front of the affected device at least shows good faith on your part, even though your system is functioning properly and you have no liability to resolve a nonsystem problem.

Under no circumstances should you attempt to fix the set yourself. Not only is it likely against your company's policy, but you also may be in violation of various local or state laws. Laws and policies aside, the minute you take the back off the TV is the same instant the TV set "just doesn't work the same anymore." Buying the subscriber a new TV set may not go over well with system management.

If you'd like to learn more about the world of RFI, I suggest you pick up a copy of *The ARRL RFI Book* (ISBN 0-87259-683-4, American Radio Relay League, Newington, CT, 1998). It sells for $20 and is available directly from ARRL, most ham radio stores, or can be ordered at your local bookstore. CT

Ron Hranac is senior vice president of engineering for the Denver-based consulting firm Coaxial International. He also is senior technical editor for "Communications Technology" magazine. He can be reached via e-mail at rhranac@aol.com.

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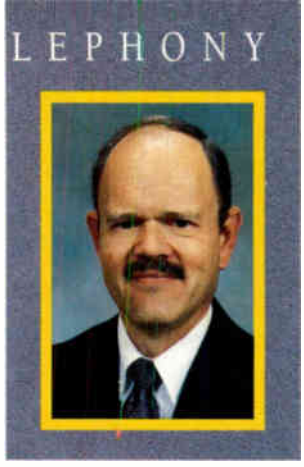
Reader Service Number 22

By Justin J. Junkus



Make the Connection: The Telephony Switch Interface

If you believe, as I do, that switched technology will be the near-term delivery mode for telephony in cable, you need to understand the way a cable company subscriber's coax plant gets connected to a switch built for telephony's "last mile" of twisted-pair.

It's important to examine the evolution of telephony's loop carriers into host digital terminals (HDTs). Also critical are the two major specifications for digital switch loop systems—TR-008 and TR-303.

The telco system

To begin, it helps to understand the electrical characteristics of the telephone company's local loop and how that enables the telephony switch to recognize that a subscriber has picked up the telephone receiver and is requesting service.

When the phone is on-hook, the circuit between the telephone office and the subscriber is open. When the phone is off-hook, a switch in the telephone set connects one of the wires in the subscriber's pair to the other wire in that same pair.

By connecting the wires, the telephone establishes a closed electrical circuit to the telephony switch, which enables current to flow. This flow of current is how the switch knows a subscriber is requesting service. Because the two wires to the subscriber form a loop to and from the switch when the circuit is closed, this method of requesting service is called "loop start."

The amount of current that flows depends on the resistance of the circuit. Resistance is directly proportional to the length of wire for a given wire gauge (diameter). In order for the current flow to be adequate to enable the switching equipment to recognize that the subscriber has gone off-hook, the resistance limit for the loop is 1,300 ohms maximum.

Given the range of wire gauges in the field, most telephony loop engineers equate this to a distance limit of approximately 18,000 feet of wire for station equipment to be connected directly to the switch. On a map, the point-to-point distance usually is shorter because the wire route is not a straight line to the switch.

> "As population moved away from urban environments, it became increasingly difficult to meet the distance limitations of twisted copper pair."

As population moved away from urban environments, it became increasingly difficult to meet the distance limitations of twisted copper pair. To overcome this limitation and to provide a way to save on cabling, telcos introduced loop carrier systems.

Loop carrier systems multiplex several individual subscriber lines onto a carrier between a remote terminal and a central office terminal (COT). The line side loop carrier system is connected to the twisted-pair going to the subscriber. The opposite side (the one that looks toward the telephony switch) is connected to one or more multiplexed lines to the central office housing the telephony switch.

The multiplexed lines may be analog or digital technology. Today, the predominant technology is digital time division multiplexing (TDM). Typically, the digital line is a T-1 or DS-1 connection, consisting of 24 time slots. Each of 24 subscriber lines, therefore, gets to use the multiplexed connection 1/24th of the time.

Several analog lines thus share one digital high-speed line from the remote terminal to the telephone office. Standard methods of regenerating a digital signal provide a way to increase the distance between the telephone company switch and the subscriber beyond the 18,000-foot limitation of a direct loop connection.

In systems introduced before the early 1980s, a COT at the switch location converts the digital input from the remote terminal back to individual analog lines. The switch receives the output of the COT as though it were a direct connection to a subscriber line. The switch can be analog or digital technology.

Bellcore standards

In the mid-1980s, Bellcore issued specification TR-008, which was the first specification to describe a digital interface between a remote digital terminal (RDT) and a local digital switch. Because a digital switch by definition processes digital signals, it is no longer necessary to have a COT to convert back to analog. ➤

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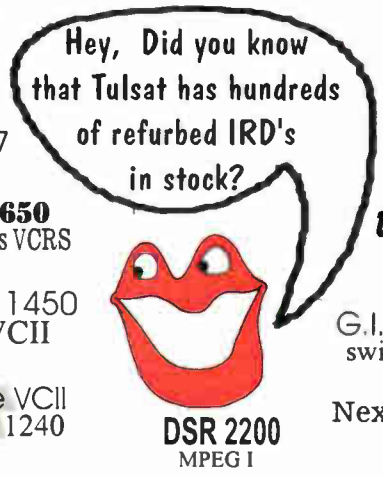

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Instead, a telco can add a special interface unit to the switch itself to provide a connection point for a digital line from the RDT and to manage any incompatibilities in the digital signal formats used by the digital line and the switch.

TR-008 also provides for a concentrated mode of operation, where there can be more inputs to the RDT than available paths to the switch. (Concentration is a full topic by itself, and I will discuss it in a future column.) The TR-008 specification supports up to 96 subscriber lines per RDT in either a concentrated or nonconcentrated mode.

The late 1980s saw the introduction of more sophisticated loop carrier systems called next-generation digital loop carriers (NGDLCs). These NGDLCs added enhanced maintenance monitoring, multiple paths between the switch and the RDT for reliability and improved concentration. The new technology greatly increased the number of possible DS-1 lines between the RDT and the local switch that could be served by the RDT. In addition, NGDLCs have a time slot interchanger (TSI).

One of the capabilities made possible by a TSI is integrated network access (INA). This is the ability to accept high-rate digital lines, such as a DS-1, as a subscriber side input and to complete a direct connection for these lines to digital networks beyond the switch, without intermediate analog-to-digital conversion steps. The TSI also provides the ability to add and drop individual voice circuits from the subscriber side digital line at the NGDLC.

> "Although cable's switch access architecture evolved from the telephone company's loop access, it is different."

Bellcore formalized most of these NGDLC capabilities in its TR-303 interface specification (also known as GR-303). In particular, TR-303 has become the current standard for interconnecting an integrated digital loop carrier (DLC) system to a digital switch. With a standard for the interconnection, it became possible to mix and match switches from one vendor with NGDLCs from another vendor. This opened the door for cable telephony's subscriber connection to a digital switch.

Where cable comes in

Although cable's switch access architecture evolved from the telephone company's loop access, it is different. Instead of a loop carrier system in the path between the switch and the subscriber, cable's switched telephony systems contain an

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HDT. The HDT consists of an RF modem system connected to an internal NGDLC.

On the switch side of the HDT, TR-303 provides a way to present signals from the HDT to the digital switch in a format the switch will recognize and process. As long as the NGDLC part of the HDT meets the specifications of TR-303, it can interconnect with any vendor's switch that is TR-303 compliant. Most digital switches on the market today are TR-303 compliant.

The RF modems in the HDT are very similar to the RF modems used in high-speed data cable modem termination systems (CMTSs). The RF modem system is the interface between the HDT and network interface units (NIUs) at the subscriber's premises. In general, the RF modems function similarly to RF cable modems found in CMTSs for high-speed data applications.

Although these modems are frequency agile, cable engineers generally assign the operating frequency when the system is installed. You can either assign specific frequencies or designate an acceptable frequency band and allow the system to assign a frequency within that band to a particular modem.

There is an initialization process between the corresponding modems in the NIUs and the RF modems in the HDT to establish communication between the modems in the HDT and the modems in the NIUs. This process varies among vendors, but typically it includes adjusting amplitude levels and measuring round-trip delays.

The number of modems required at the HDT varies depending on the vendor, the modulation method used by the vendor and the way subscriber calls are assigned to frequencies.

Different methods

One type of system assigns calls to multiple time slots riding on one carrier, while another assigns each call to a unique pair of frequencies within a 6-MHz channel. For a time slot-oriented system, one modem at the HDT can receive as many calls as there are timeslots. The signals in the time slots that are the output of the RF modem system can be processed by the NGDLC similarly to the way an NGDLC handles INA.

Unlike its loop carrier system cousin, an HDT is not necessarily located remotely from the telephony switch. HDTs may be located in a headend or at hubs. When they are located in hubs, the path back to the digital switch may be totally separate from the path used for other cable services and may use synchronous optical network (SONET) as the digital transport technology.

As a final note on this topic, when evaluating a hybrid fiber/coax (HFC) switched telephony solution, it is important to verify whether the HDT-to-switch interface is TR-303 or TR-008. Both are available, and many NGDLC features are provided in systems with only a TR-008 interface.

The key benefit of the TR-303 interface is the improved concentration in the HDT, which conserves switch resources. This can be especially important when the cable operator does not own the switch. CT

Justin J. Junkus is president of KnowledgeLink, a consulting and training firm specializing in the cable telecommunications industry. To discuss this topic further, or to find out more about KnowledgeLink, you may e-mail him at jjunkus@aol.com.

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By Jennifer Whalen

"ET" Phones Home

Telephony grabbed the spotlight at the Society of Cable Telecommunications Engineers' 1999 Emerging Technologies Conference in Dallas. Cable engineers will have to solve critical reliability and network management challenges to compete with traditional telcos.

Mention residential telephony to your chief financial officer, and you may see the proverbial dollar bills flash before his eyes. While your system's executives might view residential phone service as the next lucrative revenue source, it's up to you, the engineer, to make it both reliable and manageable. Some of the best engineering minds in the industry outlined pitfalls and solutions to making this happen at SCTE's recent Emerging Technologies Conference.

According to Jim Yatsko, district manager of Internet protocol (IP) access technology for AT&T, the current plain old telephone service (POTS) delivers end-to-end phone call availability of 99.93% or about 365 minutes of downtime per year. If you want to capture more than orders for second lines, you'll have to tackle the reliability issue.

Yatsko reported that 66% of hybrid fiber/coax (HFC) telephony network outages can be attributed to customer premise equipment (CPE) powering. You currently have two choices to solve this problem—network power or battery backup. "One of these solutions needs to be deployed if HFC telephony is to be competitive with what local exchange carriers (LECs) offer today," Yatsko said.

The advantages of network power are its high reliability and the ability to install the system just once, which over the long run saves money. However, the costs of installing network power are high, with only low initial take rates of the new services being offered. Also, we don't yet know the power consumption requirements of emerging devices that will integrate telephony and high-speed data, and neither do we know the future service mix. Both factors add uncertainty to any network power solution.

You also can turn to battery backup to solve CPE powering. Battery solutions offer low initial costs, and they can be deployed quickly. However, because CPE batteries run out of power, they offer only limited backup capabilities. You'll also need a system of routine battery replacement to ensure that the CPE battery is not dead when the power fails, added Yatsko.

Other solutions are available for increasing the reliability of your HFC telephony network, although these don't deliver as much "bang for the buck," said Yatsko, as solving the CPE powering problem. Things to consider include:

- Reducing the number of actives in cascade through deeper fiber deployment
- Reducing the number of homes per node from around 2,000 to 600
- Adding backup power to each node
- Selecting hardware (such as amps, line extenders, connectors and such) with a high mean time between failure (MTBF)
- Requiring vendors to provide cost-effective equipment with high MTBF
- Implementing network management and alarm correlation to reduce mean time to repair (MTTR)

Proactive network management

Before launching telephony and high-speed data services, you'll need to add robust operation support systems (OSS) for network monitoring, fault management, service provisioning and billing. The proliferation of intelligent customer terminals such as telephony network interface units (NIUs), cable modems and advanced set-top boxes can drastically change how you manage your network, said Esteban Sandino, manager of advanced network technologies for TCI.

"We must move from a reactive to a proactive mode of operation," Sandino said. "Through the collection of statistics, we'll know way in advance if there is signal degradation in the return path....We'll be able to identify problems before they become real for the end user."

TCI's network operations center (NOC) uses data collected from its telephony NIUs to reduce customer-noticed faults, Sandino reported. The NOC collects various statics and alarms generated by network elements or terminals. Engineers then analyze the data to drive improvements across the entire HFC service network. Improvements can include network upgrades or preventive maintenance.

Once the network achieves a higher performance threshold, the engineers use that as the new baseline against which to compare future measurements. Using this method, TCI's engineers reduced the rate of reported network problems in one of its systems by more than 80% over an 18-month period, Sandino said.

Keep the customer happy

Lucent Technology's Richard Baughman agreed that trouble management and fault correlation are key to maintaining reliable service for customers. "You don't want customers to call you with an outage unless it's something on their premise," Baughman said. "You want to be able to say, yes, you know about the problem and tell them how long it will take to repair. This will make customers feel better and think that you are taking care of the problem, so the cable company doesn't lose the primary line to the telco." CT

Jennifer Whalen is editor of "Communications Technology." She can be reached at (301) 340-7788, ext. 2057 or via e-mail at jwhalen@phillips.com.

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Reader Service Number 28

By David Devereaux-Weber

An Idea Blossoms on the List: DC for Standby Power

An SCTE-List subscriber gets an idea for how to improve something and passes it along to the List. As usual, this has been edited to fit.

From: Max Morales
Date: Wednesday, Dec. 16, 1998
Subject: Powering question/idea

Dear colleagues,

I just came up with an idea that either shows the benefits of getting some rest, cleaning the office and organizing thoughts, or is one of the most stupid things I've come up with! Those of you who have known me for some time surely know that I've come up with more than one stupid idea, but out of so many, every once in a while one of them is something that works.

This thought is related to power. We use AC in cable systems because of the detrimental effects of running DC through the plant and its dissimilar metals. And we use quasi-square waves to obtain as much power as possible out of that AC.

However, I just started wondering what would happen if we were to use DC from the power supplies during stand-by time only. I guess a three-battery unit would be able to provide 36 VDC, and a six-battery unit would be able to provide 72 VDC. It seems that running on DC during standby times would allow for extended battery operation since the inefficiency of the DC-AC conversion process would be eliminated. Also, the amplifiers may be able to work longer, even at lower voltages, since there wouldn't be a need to convert the AC back to DC to power up the hybrids and other components.

It would seem that the corrosion problems would not be much of an issue, since the DC would be used only during standby times, which could be as long as five to 10 hours, more than enough time even for major power outages.

I guess the questions here are:

1) Do the power-passing and power-extracting components of cable systems work just as well at DC as they do at 50 Hz or 60 Hz? It seems to me that they should, since we can measure through them with DC ohm meters.

2) How does a conventional switching AC-DC power pack react to being fed DC instead of AC? Does it pass it and regulate it down to the voltage required by the amps, or does it chop off during every 8-10 msec, which is the equivalent switching rate of twice per cycle at 60 Hz or 50 Hz? On this note, it also seems that hum would not be an issue with low voltage, since the hum often is caused as a byproduct of the regulating and filtering associated with the AC-DC conversion process.

3) If the two technical questions above are nonissues, then are there any other technical or legal obstacles to doing this?

If this appears to be feasible, is there anybody out there who has access to a simulation system where it can be tried?

I'm looking forward to hearing your comments. If this is totally ridiculous, don't beat upon me too badly—my upconverter and my magic combiner worked.

[Here followed several comments, some serious, some rather less so.]

From: Max Morales
Date: Thursday, Dec. 17, 1998
Subject: Re: Powering Thought

Hey guys, I was serious.

I can't test it because I don't have access to a system right now, and I was not talking about adding more power supplies at each amplifier or anything like that, but rather eliminating the DC-AC inverters from the existing standby power supplies. Also, the issue is not only powering amplifiers, but also telephony gear, whether circuit-switched or Internet protocol (IP), at the residence.

From: Karl Poirier
Date: Friday, Dec. 18, 1998
Subject: RE: DC Powering

Most direct (transformerless) amplifier power packs work just fine on positive DC voltage; the incoming AC is first rectified and then chopped again into "pseudo AC" to drive the switching supply. While 36 V might be low, 72 V certainly would work. It's an interesting idea that might just take off more than you expect.

I would agree that the corrosion and subsequent development of semiconductor type deposits would be minimal because of the time duration.

Good idea, Max. This is where the List really works. CT

Dave Devereaux-Weber, P.E., is a network engineer at the University of Wisconsin-Madison. He is a senior member of the SCTE, and he can be reached via e-mail at djdevere@facstaff.wisc.edu.

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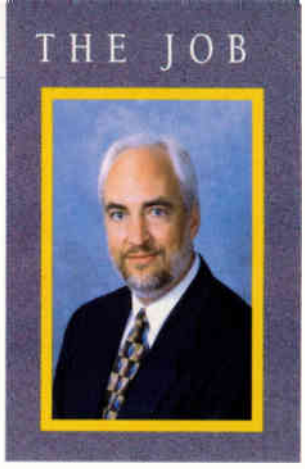
Reader Service Number 29

By Alan Babcock



SCTE Offers "Virtual" Training

A few months ago, I discussed various methods for providing training, including classroom instruction, videotape, interactive video disk (IVD), and even computer-based training (CBT). Each of these methods has an appropriate place in an overall training strategy (except perhaps IVD because the technology is outdated).

The Society of Cable Telecommunications Engineers traditionally has provided paper-based and videotape training programs, but the Society now is entering the era of electronic training delivery with two specific products.

Digital "DigiPoints"

You may have noticed that your 1999 *Interval*, SCTE's monthly newsletter for members, was significantly different from past *Interval* issues. One significant difference from the training perspective was the removal of the "DigiPoints" technical insert.

Through the past two years, "DigiPoints" has introduced concepts and applications of digital technology that were foreign to our industry just a few years ago. SCTE has provided "DigiPoints" as a source of training in digital technology, and many members appreciated the training provided through it. We haven't stopped producing "DigiPoints," but we have changed the delivery mechanism for this important member benefit.

In January, we began providing "DigiPoints" on our Web site. Check it out. The version on the Web still includes the level of training you expect, but now you can find it delivered in an

electronic medium. Using technology to train about technology—what a concept! Right now, "DigiPoints" is available to anyone accessing our Web site, but soon "DigiPoints" will be moved to an exclusive "Members Only" area being created on our site.

We have plans to further enhance our presence on the Internet by creating new training opportunities and providing additional member services via our Web site. To ensure that SCTE membership remains of value, we plan to restrict some of these services and benefits to members only.

The details still are being worked out, so watch for more information in the coming weeks on how you can access such exclusive and informative data. If you haven't visited the Web site lately, I suggest you take a look. Go to www.scte.org.

Virtual troubleshooting

Another application of technology in training is a CBT program that is soon to be released. SCTE has created a program that will help teach troubleshooting skills. The program can be loaded onto a computer (Windows 95 capable) and will help a technician learn the basic logic for finding and fixing common problems found in a cable network. Here is how the program works.

A problem description is presented at the opening of a scenario. The description explains a problem from the customer's perspective. The technician will be shown a graphic of the equipment found in the home and will need to choose an action from a list of options. Possible actions include: measure converter RF input, check TV channel selector and check videocassette recorder (VCR) output connection.

After selecting an action, the results of that action will be given. Results could include the measured RF signal levels, the channel selected by the tuner, or a description of the condition of a cable or connection.

Various screens are available depicting the customer equipment inside the home, the drop, bonding block and other devices between the tap and entry into the home, and a system map. Signal levels, AC and DC voltages, and other data are available at appropriate points in each screen.

Each screen has a unique set of possible action steps. For example, if you move to an amplifier location, possible actions would include RF input/output levels, AC and DC voltage readings, and so on. Each action taken provides some type of result. Users can refer to this data to determine the next action. Clues will be given along the way when users stray from the intended course of action.

The program will track the steps taken and award points for correct actions. Points also are subtracted for taking incorrect actions. In this way, each scenario has a maximum number of points that can be earned. This allows the program to judge the proper steps taken to fix a problem. ➤

Points also are earned for successful resolution, but the maximum score is possible only if users take the proper steps in finding and fixing the cause of the problem. Follow-up after repair also is critical to make sure the fix corrected the customer complaint. After all, more than one problem could exist.

Cooperation is key

The initial program will include three scenarios, and a "test" version of the program also will exist for use in the Broadband Service Technician Certification program. We will be working with local chapters to provide the software for certification testing purposes.

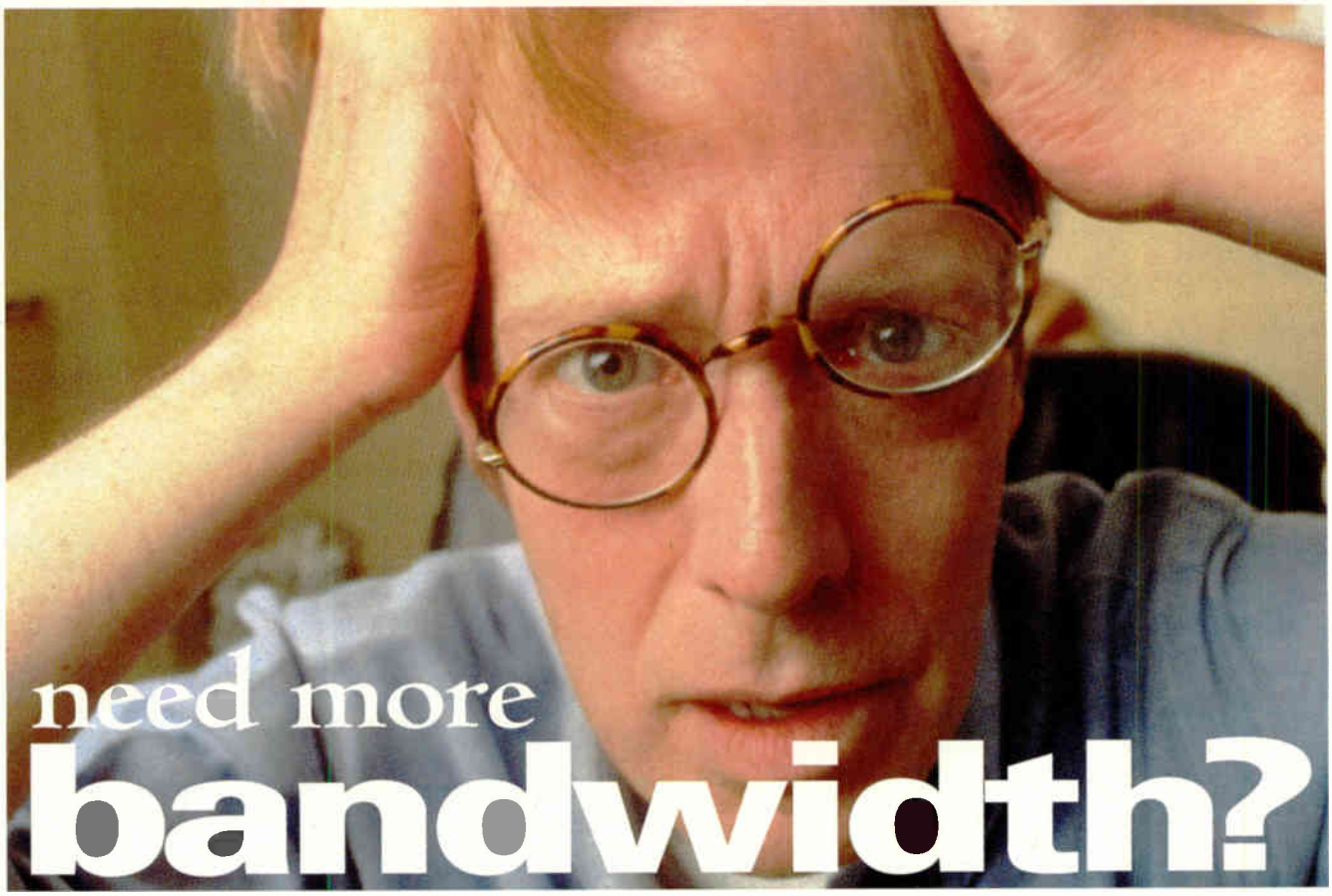
> "Now you can find ('DigiPoints') delivered in an electronic medium. Using technology to train about technology —what a concept!"

We have demonstrated the program at a few chapter meetings and have provided "beta" versions to various people for trial. A lot of people have provided input into the troubleshooting logic and problems depicted in the program.

I know that there probably are as many ways to troubleshoot a line problem as there are technicians, but I believe the program depicts the troubleshooting methods that are most commonly accepted and practiced by experienced field technicians. Look for the program to be available in the next few months.

Don't expect this to be as exciting as Doom or as graphically pleasing as Myst or Riven, but we are confident you will find it useful and even fun. CT

Alan Babcock is director of training development for the Society of Cable Telecommunications Engineers. He can be e-mailed at ababcock@scte.org.



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Reader Service Number 34

Launch A Telephony Winner

Gain Customers with Circuit-Switched Now; Migrate to IP Later

By Wade Carter

No doubt Internet protocol (IP) telephony over cable is a promising technology. It pledges to leverage the cable modem and digital set-top infrastructure to provide residential telephony service.

Advantages of this technology include:

- Lower customer premises equipment (CPE) costs through voice, data and video integration
- Lower backbone costs by leveraging existing data networks
- New revenue streams through novel applications that exploit voice, data and video integration

Unfortunately, specifications for voice over IP (VoIP) are not yet complete, so how can you take advantage of pent-up demand for competitive telephony services? You can deploy circuit-switched cable telephony today to capture customers and then move those customers to VoIP as the technology solidifies.

PacketCable

To get a sense of how ready VoIP is for deployment, we need to review the status of industry standards and to compare VoIP against consumer requirements for residential telephony. We can use existing

circuit-switched cable telephony as a benchmark.

PacketCable is an ambitious effort to develop specifications that will enable end-to-end VoIP over a hybrid fiber/coax (HFC) network with full interoperability with the public switched telephone network (PSTN). It builds on earlier versions of the Data Over Cable System Interface Specification (DOCSIS).

The PacketCable architecture (see Figure 1 on page 46) defines the major components required for a scalable, multivendor, interoperable VoIP network.

We envision that the embedded client will be a DOCSIS cable modem with integrated telephony interfaces. The call management server provides the intelligence to route calls and support residential telephony features such as call waiting, three-way calling, and calling name and number delivery.

The media gateway converts packetized voice streams into a time division multiplexing (TDM) format suitable for carriage over the circuit-switched PSTN. The signaling gateway provides a means for the call management server to signal across today's Signaling System 7 (SS7) network for purposes of 1-800 and 1-900 number database lookups, as well as for credit card calls.

The challenge for those writing PacketCable specs is to define all these interfaces. In turn, the vendor community must develop a new set of network elements for the distributed network and perform interoperability testing.

Circuit-switched cable telephony

MSOs that have launched circuit-switched cable telephony are competing with incumbent telephone operators for primary-line service. The MSOs, however, have reported penetration rates greater than 20%, thereby indicating that cable telephony is a viable product.

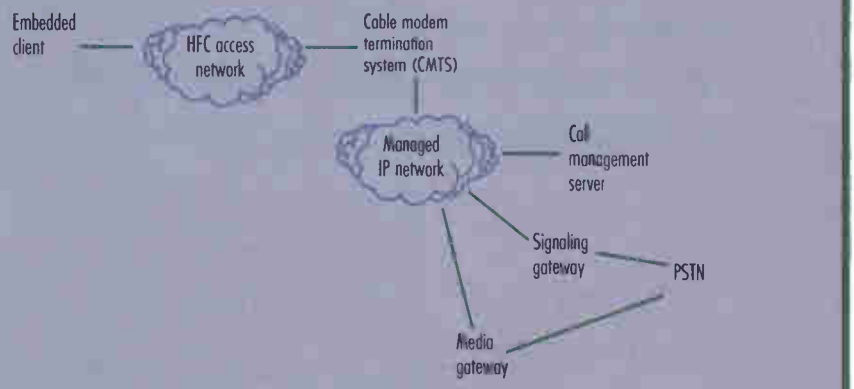
> "Consumers care less about the underlying technology than the service itself."

A cable telephony system consists of a host digital terminal (HDT) at the headend or hub and a network interface unit (NIU) at the subscriber's premise. (See Figure 2 on page 47.) Because the HDT is based on digital loop carrier (DLC) technology and protocols, cable telephony can access a host of services and infrastructures that have been developed for the circuit-switched network.

Cable telephony is based on low latency, constant bit rate (CBR) protocols over the HFC networks, so it can inherently meet the same quality standards as the PSTN. During the last three years, manufacturers have aggressively power-optimized cable telephony NIUs to make them viable and cost-effective to power networks with high penetration rates.

The attributes of existing circuit-switched cable telephony service provide a benchmark for IP telephony over cable. New VoIP services must have similar attributes and meet primary consumer requirements. ➤

Figure 1: PacketCable model



Consumers care less about the underlying technology than the service itself. Therefore, it's illustrative to review consumer requirements and compare how both VoIP and circuit-switched cable telephony stack up against those requirements.

Lifeline service

Consumers rely on their telephones for emergency service. Therefore, service must be available during a commercial power outage. For VoIP HFC access equipment, the embedded client device must be low-power (approximately 3 watts) so that it can be operated economically via the HFC plant (network power) or powered locally with battery backup in the event of a commercial power failure.

Today's cable modems typically draw 10-15 watts, and digital set-tops draw more than 20 watts; therefore, heavy power optimization is required. Cable telephony products provided by several vendors are much lower than 3 watts for two-line NIUs and support network power and local power with battery backup options.

Premium voice quality

IP telephony over cable must provide high-quality codecs, low delay and low packet loss. Ideally, a one-way delay across the network would be less than 50 msec to avoid the need for echo cancellation. Typically, echo cancellation is not required for circuit-switched cable telephony.

Also, bandwidth for circuit-switched telephony is nailed up. As a result, there is no jitter or latency of pulse code modulation (PCM) samples, thereby digitally delivering the highest voice quality possible all the way to the home.

For VoIP, the packetization delay for acceptable bandwidth utilization pushes end-to-end network delay to more than 50 msec, which means you generally need echo cancellation. Voice quality will be highly dependent on robust echo cancellation algorithms that can deal with background noise, which can throw off many echo cancellation algorithms. Backbone

delays must be less than 200 msec to avoid the perception of "talker overlap."

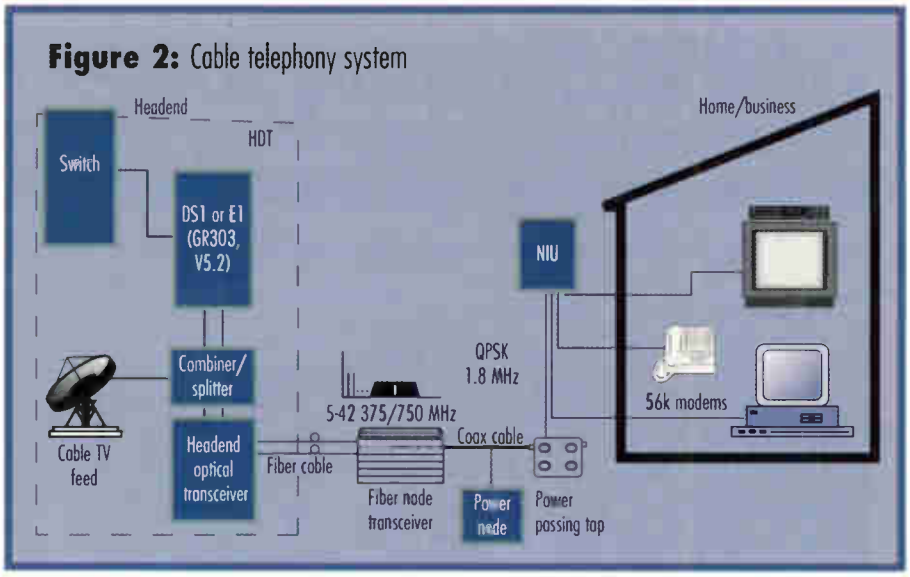
In addition to packetization delay, the voice quality of compression codecs degrades rapidly when packet loss exceeds 1%. Therefore, VoIP networks must be engineered carefully to avoid packet loss.

Compatibility with CPE

Consumers who switch from a telco service to IP telephony over cable will want to continue to use their analog fax machines and modems. Therefore, IP telephony over HFC must provide transparency for all analog modems and faxes. This is not a problem for circuit-switched cable telephony because the 64 kbps digital delivery to the side of the home provides superior performance over today's wireline service provider.

Standard G.711 encoding is the most direct method for IP telephony over cable to meet this requirement. However, excessive delay or packet loss will interfere with the reliability of analog modem connections. In addition, low-bit codecs that are optimized for voice typically destroy modem-type signals. To overcome this complication, you can monitor modem signals in-band, and if a modem signal is detected, switch to a G.711 codec.

Figure 2: Cable telephony system

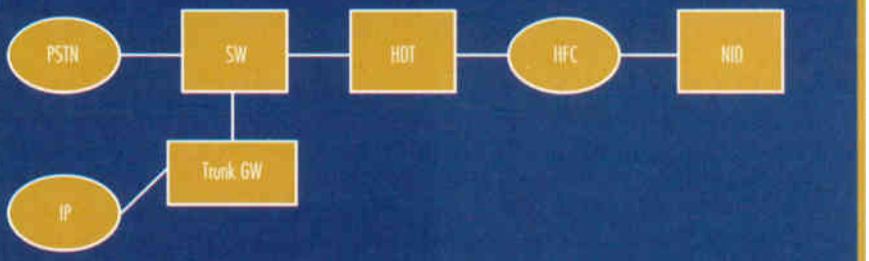


Residential calling features

Circuit-switched cable telephony products can provide residential calling features such as call waiting, three-way calling, call return, and calling name and number delivery because they are based on well-established DLC signaling standards and use existing digital switch features.

Perhaps one of the greatest challenges for IP telephony over cable is to provide better calling features than the incumbent telephone companies. Vendors of the call management server in the PacketCable model must attempt to recreate 20 years of digital switch feature development into a distributed IP-based environment, including more

Figure 1: Available IP telephony deployment coexisting with PSTN



The question, based on consumer requirements, is how do MSOs leverage investment in the existing network architecture to deliver this new variety of services as alternative technologies continue in their development?

While telephony and data can piggyback with video on the MSO's existing architecture, packet-based delivery offers the greatest opportunity to combine voice, video and data on hybrid fiber/coax (HFC) networks. MSOs that want to get into the game and increase playing time need to explore IP telephony to give the fans what they demand. (See Figure 1.)

What do they want? IP

Just as fans expect "Monday Night Football" at 8:00 p.m. EST, consumers expect to pick up the phone, get a dial tone, dial a number and get connected. Consumers don't know the difference between circuit-switched or packet-based networks; nor do they care.

They simply expect reliable service, which means having a dial tone even in cases of emergency (referred to as "lifeline" service). They also expect enhanced services such as call waiting, call forwarding and caller identification, all of which fall into the category of custom local area signaling services (CLASS) features.

Early IP telephony service and equipment required users to enter IP addresses and personal identification numbers (PINs), while undergoing various forms of preprogramming just to make the service work. Mainstream consumers simply will not tolerate this complexity—which is why IP telephony has not attracted a wide base of fan support and has ended up relegated to technologists and hobbyists.

Fourth and long

MSOs hoping to get fan support must demonstrate that IP-based service can make the play. This will require MSOs to prove they can deliver the same reliable service as the telcos, but at more cost-effective prices.

> "Continuing IP gateway development will allow the service provider to bypass the switch and still offer CLASS features."

Lifeline service/availability: IP-based service must mirror circuit phone service and be available even when electrical power is out. There are several methods of delivering lifeline service, including powering the equipment from the network, using battery power and local power with battery backup.

The business cases for these alternatives vary. Network power requires more upfront investment in infrastructure, while use of batteries virtually guarantees onsite technical service to the consumer within three years of installation. However, creative combinations of options can mitigate the investment cost, while providing optimum service. With this reliability, consumers are more likely to accept HFC-based telephony as their primary phone service.

Based on informal surveys, consumers will not tolerate an outage in excess of 15 minutes more frequently than once a month. Holding service outages to less than 15 minutes requires that the network automatically detect an outage and quickly switch over to a backup system.

MSOs must ensure that proper powering, backup routing and problem detection systems are included in their networks to deliver service at all times. Otherwise, the MSO will experience customer churn with each outage.

For MSOs planning to offer secondary-line telephony service only, lifeline service is not an issue. In this case, the MSO would concede primary line service to the local telco, while being content with second- and third-line sales. Service provider experience has shown, however, that foregoing sales of primary lifeline phone service will significantly reduce user uptake of the service, with a corresponding lengthening of return on investment.

Cost effectiveness: All consumers are looking for the best service at the best price. IP telephony can offer significant price savings, especially on international calls. Because IP telephony constitutes a "special service," it avoids tariffs. Eventually, the means to charge tariffs will be developed.

Even so, IP telephony will remain cost-effective because of its ability to use the network to its fullest capability. IP telephony does not transport silence, which is 60% of a conversation on circuit-switched telephony. In addition, a circuit-switched voice channel occupies 64 kbps, while packet voice occupies only 6-8 kpbs.

Compatibility and quality: Any service that requires users to replace their existing telephones, answering machines, fax machines and even dialup modems with new equipment will face substantial resistance. MSOs have the same concern for compatibility when it comes to the equipment required to deploy IP telephony services.

The center of this concern, for consumers and providers, is the desire to preserve the capital they've expended on existing equipment. Therefore, IP telephony solutions that are adopted must be compatible with both network and consumer equipment.

Also, the quality of the connection is paramount. Results from pioneering IP telephony providers indicate that although consumers were attracted initially by inexpensive service, they were dissatisfied

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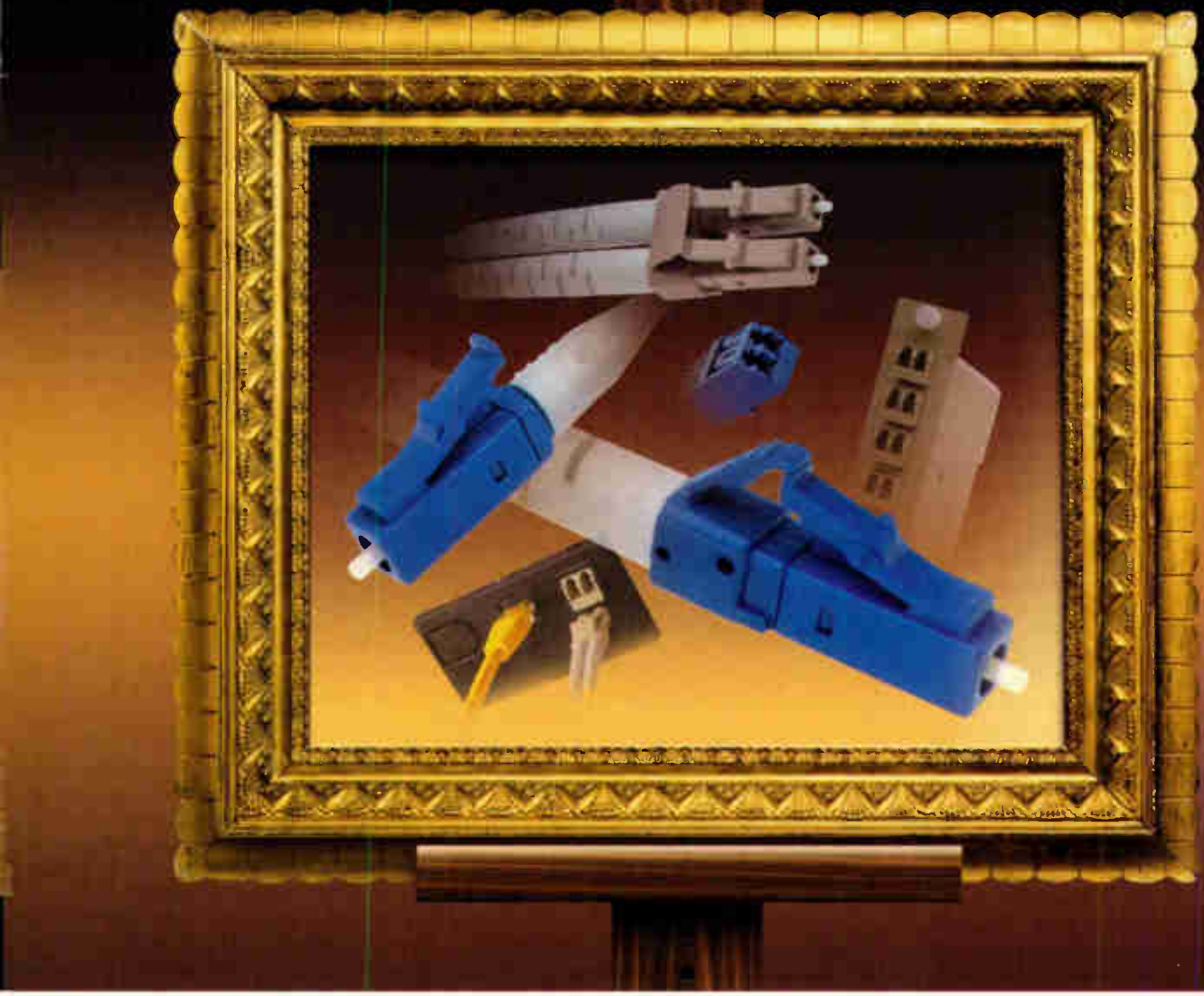

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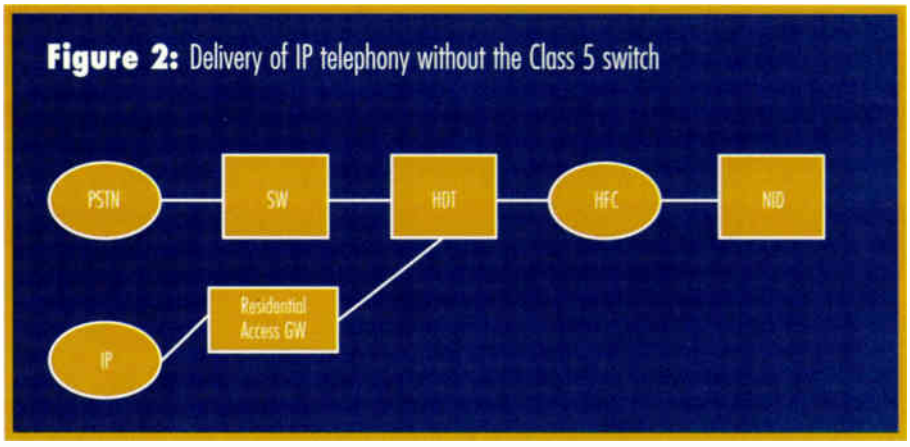
Figure 2: Delivery of IP telephony without the Class 5 switch



with the latency and echo problems of the early IP offerings. Today's IP routing equipment has eliminated most of the service quality issues of the early networks and can deliver the high-quality, competitive telephony that consumers demand.

Enhanced services: Consumers demand the same CLASS features that they receive with circuit alternatives. Examples include call waiting, caller identification and call forwarding. Today, CLASS features are available through the public switched telephone network (PSTN) Class 5 switch. These are the services that MSOs must continue to deliver to the consumer whether they use circuit- or packet-based networks.

Some form of switch interaction is required to deliver these services. Continuing IP gateway development will allow the service provider to bypass the switch and still offer CLASS features. CLASS features over a purely packet-based network are in development at this time. MSOs can provide CLASS features to the consumer today with the deployment of circuit-switched telephony and continue this functionality as IP gateway development continues.

Go for the goal: Migrate to IP

In order for MSOs to take full advantage of their position in the telephony game, the goal is to get to the IP network. Although circuit-switched telephony services provide many competitive opportunities, an IP solution provides maximum revenue and customer take potential.

So, an important consideration for MSOs is how to get from a circuit-switched service offering today to IP. Equipment upgrades are required in two locations.

For the headend, you'll need products that combine HFC modem and IP gateway functions to successfully bypass the PSTN switch. You'll need to replace cards that originally were designed to support orthogonal frequency division multiplexing (OFDM) or quadrature phase shift keying (QPSK) with hardware that is Multimedia Cable Network System (MCNS)-compliant.

Cards that supported circuit-switched service now need to support packet-based signal flow. Therefore, you'll need to consolidate IP gateway functionality that was provided by separate hardware into a single, enhanced platform to deliver the services once performed by the switch. Figure 2 shows this migration.

HFC-based telephony platforms are available today to minimize the financial and operational effects of upgrading to IP. Such a platform allows cable operators to provide circuit-switched telephony today, with a clear migration path to IP.

Challenges: There also are challenges involved in bringing IP telephony to the HFC arena. Billing systems, for example, are in early stages of development, but are critical to the commercial viability of IP telephony. Additionally, the automatic linking of operational systems to one another presents another set of issues.

Phone numbers are another important element in the service/feature mix. Consumers want to keep their phone numbers, even if equipment is swapped out or if they change service provider. Consumers also want to be listed in the local telephone directory. Many users dropped early IP telephony service because they weren't listed in the local phone book.

The final score

IP telephony will be in the game plan for many MSOs in the coming years. By considering the many consumer needs for telephony service and developing their own network migration playbooks, MSOs can garner a significant portion of the residential telephony market. This will enhance the operators' competitive positioning in the market against incumbent telcos and bolster the bottom line. CT

Ham Mathews is director of IP business development for ADC Telecommunications' Broadband Networks Division, and Glen Skrivseth is technical marketing engineer for ADC Telecommunications' Broadband Networks Division. Mathews can be reached at (612) 938-8080 or ham_mathews@adc.com; Skrivseth can be reached at (612) 938-2130 or glen_skrivseth@adc.com.

BOTTOM LINE

Make an IP Game Plan

IP telephony is an emerging technology that promises to offer low-cost, feature-rich telephone services over hybrid fiber/coax (HFC) networks. The question, based on consumer requirements, is how do MSOs leverage investment in the existing network architecture to deliver this new variety of services as alternative technologies continue in their development?

While telephony and data can piggyback with video on the MSO's existing architecture, packet-based delivery offers the greatest opportunity to combine voice, video and data on HFC networks. MSOs that want to get into the game will need to explore IP telephony to give the fans what they want.

End-users demand service that mirrors their landline phone service and is available even when electrical power is out. They want enhanced features, such as call waiting, caller identification and call forwarding, and they must be able to use their existing telephones and fax machines over the new network. IP telephony also must offer the same voice quality at a cost-effective price.

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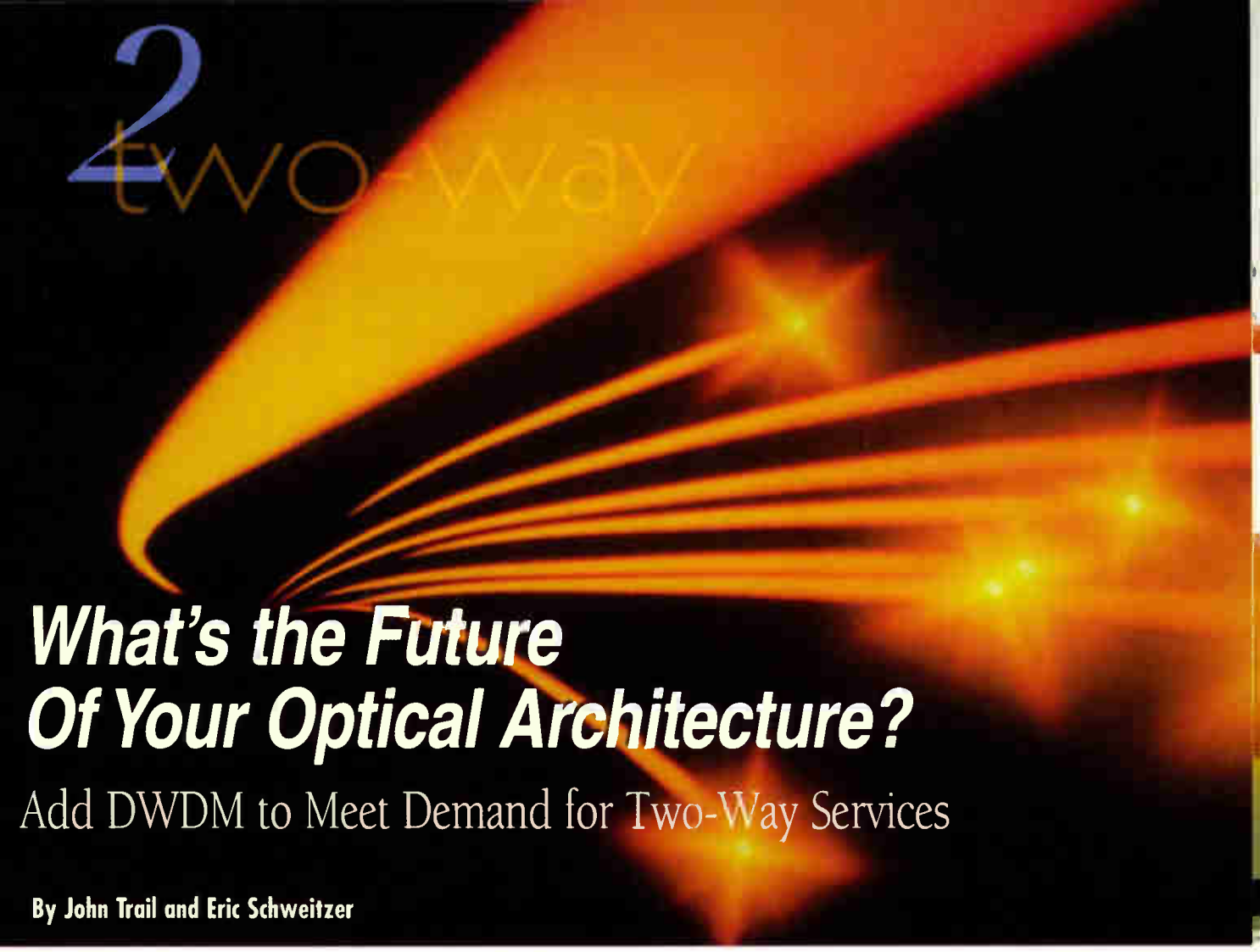


What's the Future Of Your Optical Architecture?

Add DWDM to Meet Demand for Two-Way Services

By John Trail and Eric Schweitzer

The rising demand for residential two-way service brings new opportunity to cable operators and with it a significant challenge: how to upgrade the plant to provide these services in the most cost-effective manner.

By implementing dense wavelength division multiplexing (DWDM), cable operators can increase the amount of bandwidth available to each home by increasing the geographic segmentation.

Although the optimal upgrade strategy will vary depending on the details of the existing plant, it is possible to outline the advantages and disadvantages of the main options.

Forward path

There are two dominant headend-to-node architectures for the forward path. The first, and historically the more common, architecture uses 1,550 nm or 1,310 nm trunking, followed by an optoelectronic repeat and then distribution with 1,310 nm distributed feedback (DFB) transmitters.

The second architecture uses 1,550 nm transmission from headend-to-node with no optoelectronic regeneration.

In both of these architectures, there are two main options for upgrades—adding 1,310 nm transmitters in the hub, or adding 1,550 nm transmitters in the headend with dense wavelength division multiplexing (DWDM).

For the 1,310 nm distribution architecture, typical current deployments use transmitters of greater than 10 mW output power with each feeding from four to eight nodes. This architecture already provides some geographic segmentation out of the hub for narrowcasting. The normal upgrade in this case is to add 1,310 nm transmitters and decrease the number of nodes fed by a single transmitter.

This approach to implementing two-way services requires that the information being narrowcast is available at the hub site. This may require the addition of significant equipment into the hub, such as data servers and perhaps a data transport network, such as a synchronous optical network (SONET) or synchronous digital hierarchy (SDH) link. If the upgrade necessitates building improvements or adding a data transport, then the cable operator may find it less expensive to upgrade using DWDM.

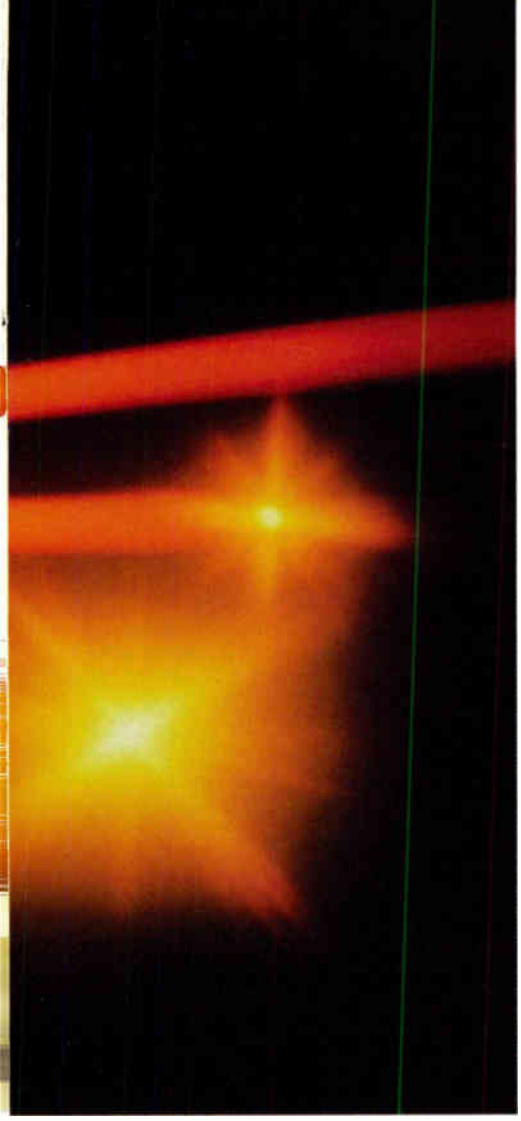
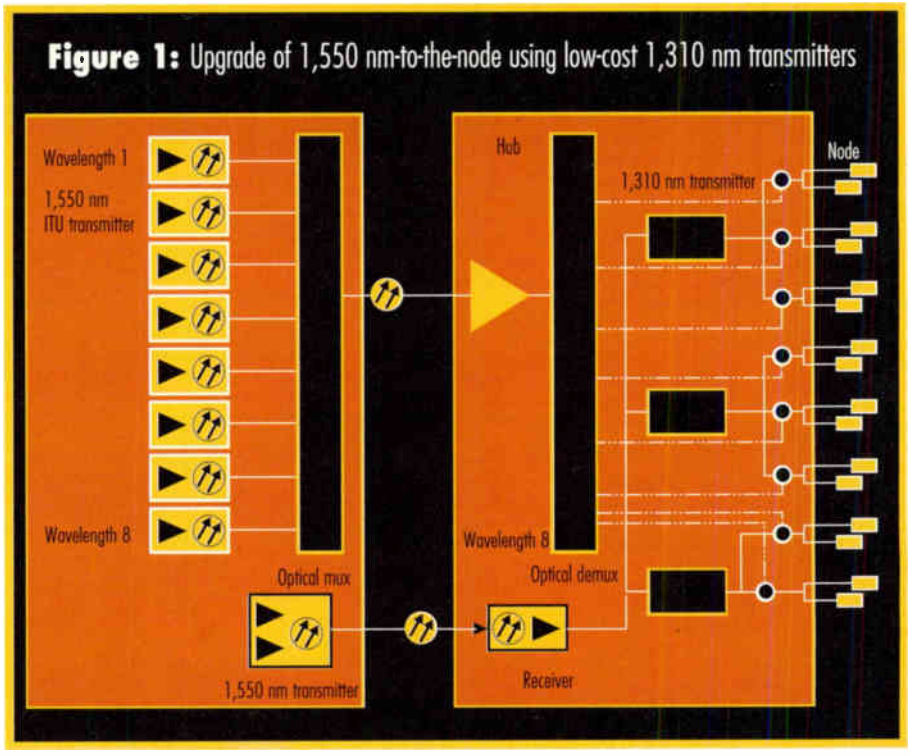


Figure 1: Upgrade of 1,550 nm-to-the-node using low-cost 1,310 nm transmitters



A DWDM system enables the operator to increase the geographic segmentation by adding equipment to the headend rather than the hub. In a DWDM upgrade, the forward narrowcast bandwidth is supplied using 1,550 nm transmitters located in the headend. These transmitters are at different wavelengths, with the outputs optically multiplexed for transport over a single fiber to the hub. (See Figure 1.)

In the hub, the narrowcast wavelengths are unbundled and then optically combined with the broadcast wavelength (1,310 nm in this case) before being routed to the node. You can add DWDM as a straightforward overlay on top of the existing plant with minimal impact on the existing broadcast system.

For a 1,550 nm-to-the-node architecture, the two main upgrade options are similar to those given above. The narrowcast bandwidth can be optically inserted at the hub using 1,310 nm transmitters and coarse wavelength division multiplexing (CWDM). (See Figure 2 on page 58.) These 1,310 transmitters can be very low in cost because they require minimal linearization and output power. Linearization is minimal because they will carry mainly quadrature amplitude modulated (QAM) digital channels in a restricted bandwidth. Output power is minimal because the optical power of the narrowcast wavelength required at the node is several dB below the 1,550 nm broadcast wavelength.

When a lack of available space in the hub or lack of a headend-to-hub data link become significant problems, one can consider DWDM as a method of providing the narrowcast service from the headend. (See Figure 3 on page 58.)

In the CWDM and DWDM upgrades described here, there is an additional benefit worth noting. By placing the narrowcast and broadcast bandwidths on different transmitters, the digital narrowcast signal is immune to any laser clipping that may occur from overdriving the broadcast transmitter.

The return path

Nearly all HFC systems allocate less bandwidth for the return path than for the forward. Therefore, to ensure acceptable service quality, the average and maximum return bandwidth-per-home required on each part of the HFC network must be defined and the network designed to accommodate the demand.

Because of the limited return spectrum, you need to consider techniques for increasing the available return bandwidth. The coaxial plant is a tree and branch structure, so it is difficult and expensive to divide this portion of the network.

It is much easier and less costly to divide the optical return from the nodes—keeping the returns from the multiple outputs of the optical node independent. This is a very cost-effective method for increasing the available bandwidth per home. For this technique to work, the returns must be kept independent of the location of the servers that support the information transmitted on the return path.

Upgrade options

There are three methods of keeping the return blocks from each port of the node independent:

- Use a separate fiber for each block.
- Use frequency stacking to block upconvert, and combine the returns onto a single fiber.
- Use a DWDM system with each block at a separate wavelength, and combine the wavelengths onto a single fiber. ➤

Figure 2: Upgrade of the 1,550 nm-to-the-node using low-cost 1,310 nm transmitters

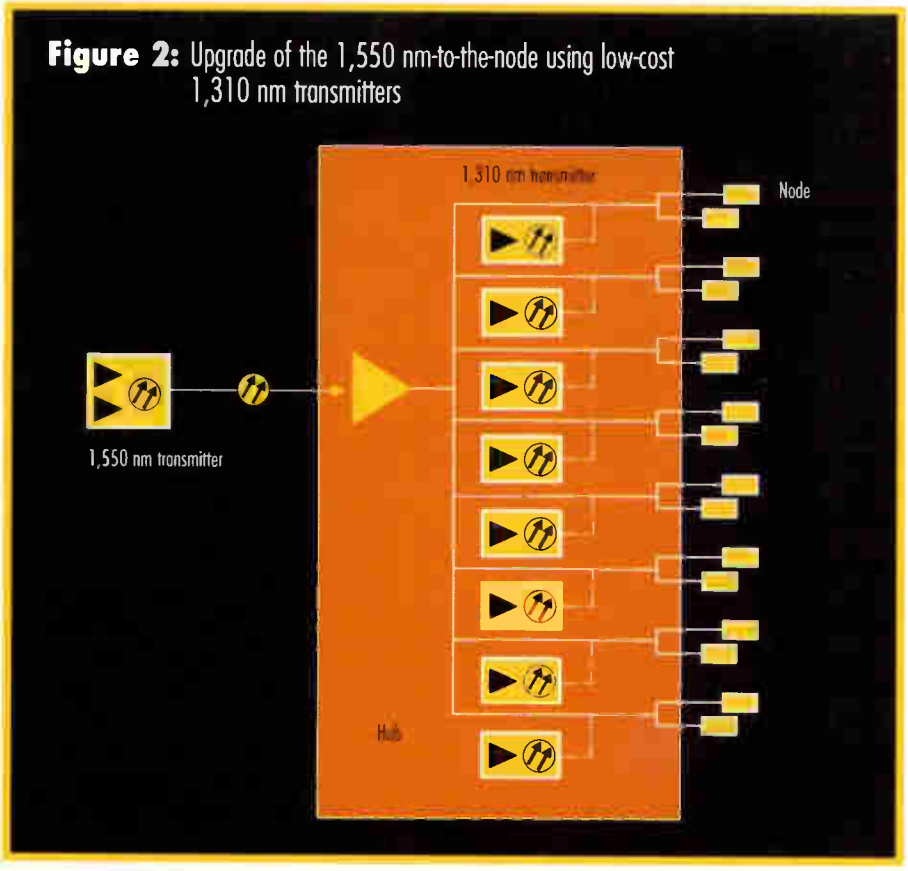
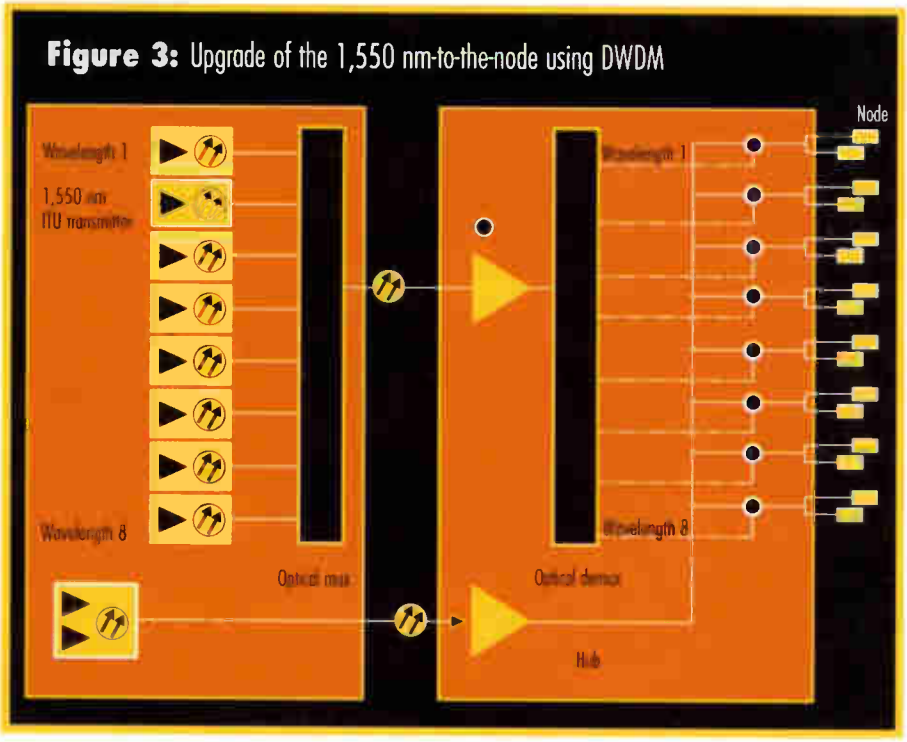


Figure 3: Upgrade of the 1,550 nm-to-the-node using DWDM



Separate fibers

Using a separate fiber for each return requires the minimum amount of equipment and, provided fibers are available, is likely to be the least expensive alternative. However, the following methods generally are less expensive if fibers must be installed.

Frequency stacking

Using block upconversion to stack multiple return blocks makes efficient use of the available bandwidth. Frequency stacking is very simple in concept: The return block from each port, or combination of ports, is upconverted in frequency to occupy a dedicated band. Multiple blocks then can be combined onto a single wideband optical return path. The blocks can be separated and downconverted at the receiving site.

Each block up- and downconverter contains an RF mixer and bandpass filter to isolate the desired output block. Designing these devices with acceptable dynamic range, frequency stability and phase noise is a significant challenge.

The block converters also must maintain this performance over the operating temperature of the node. You'll need to carefully select the locations of the blocks

BOTTOM LINE

DWDM Sheds Light On Two-Way Activation

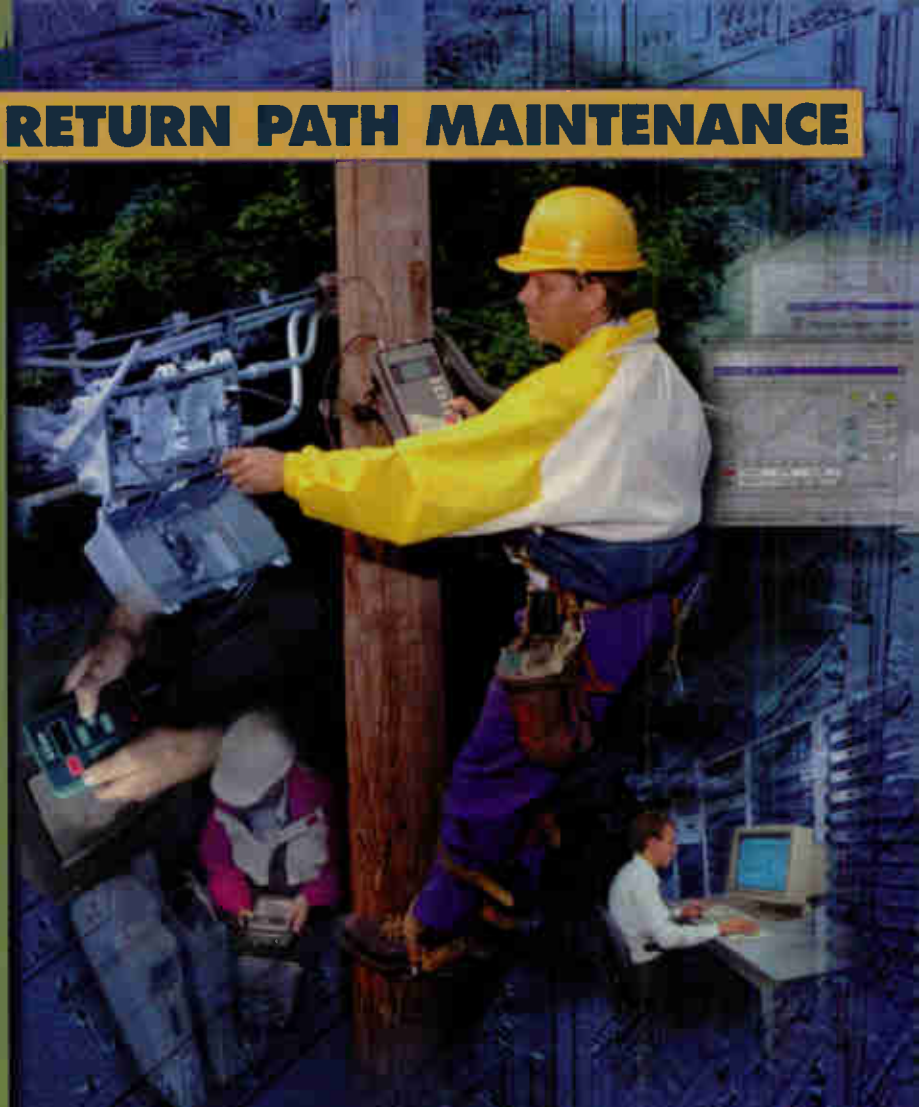
There are many ways to upgrade the optical section of the hybrid fiber/coax (HFC) network for the forward and the return paths. Dense wavelength division multiplexing (DWDM) is emerging as a viable alternative for many systems.

Before selecting how you'll upgrade the optical portions of two-way HFC systems, first determine the capability of your existing system, as well as the requirements for the upgraded system, including forward and return bandwidth per home.

It is easier to design a DWDM system than a frequency stacking system. Also, DWDM optical components are stable over temperature and are readily available on the International Telecommunications Union wavelength grid. DWDM components are costly right now, but prices are dropping rapidly.

While DWDM is somewhat complex in concept, it is simple in implementation. The network feeds the return from each port, or combination of ports, into an optical transmitter at a defined wavelength. A DWDM multiplexer then combines the optical outputs from multiple transmitters onto a single fiber. At the receiving site, an optical demultiplexer separates the wavelengths and detects each block independently.

WHEN IT COMES TO RETURN PATH MAINTENANCE



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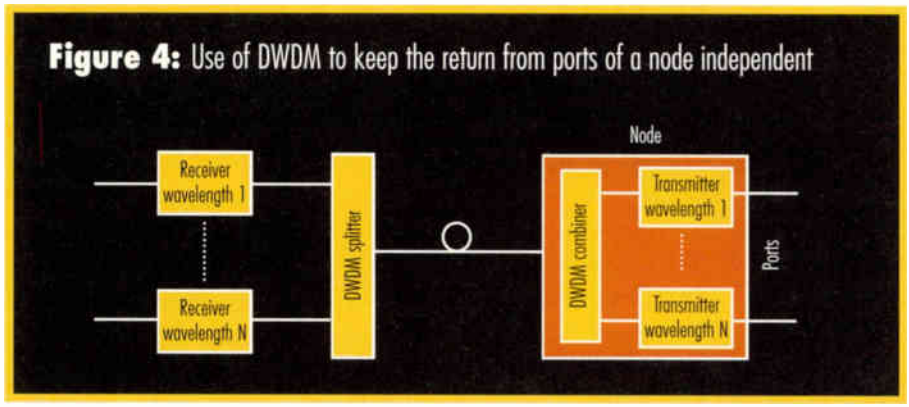

Figure 4: Use of DWDM to keep the return from ports of a node independent

within the total available bandwidth to allow the filters to be designed with acceptable group delay and spurious levels.

Provided block up- and downconverters with sufficient performance are available, frequency stacking probably is the lowest cost method of combining multiple returns onto a single fiber.

DWDM implementation

While DWDM is a bit more complex in concept, it is simple in implementation. The network feeds the return from each port, or combination of ports, into an optical transmitter at a defined wavelength. A DWDM multiplexer then combines the optical outputs from multiple transmitters onto a single fiber. At the receiving site, an optical demultiplexer separates the wavelengths and detects each block independently. (See Figure 4.)

It is easier to design a DWDM system than a frequency stacking system. Also, DWDM optical components are stable over temperature and are readily available on the International Telecommunication Union's wavelength grid. Though they're costly, prices are dropping rapidly.

How to proceed

Various options exist for upgrading the optical portions of two-way HFC systems. To determine the optimal upgrade strategy, you need to clearly define the following:

- What's the capability of the existing system—forward bandwidth, return bandwidth, age, expected lifetime, fiber counts and so on?
- What are the requirements for the upgraded system—forward and return bandwidth per home?

Once you understand these aspects of your system, you can explore the various options for the forward and return upgrades to determine the optimal strategy for your network. CT

Eric Schweitzer, Ph.D., is a manager for Receiver Systems, and John Trail, Ph.D., is a manager for Transmitter Systems, both at Harmonic Lightwaves. They may be reached via e-mail at Eric.Schweitzer@harmonic-lightwaves.com and John.Trail@harmonic-lightwaves.com.

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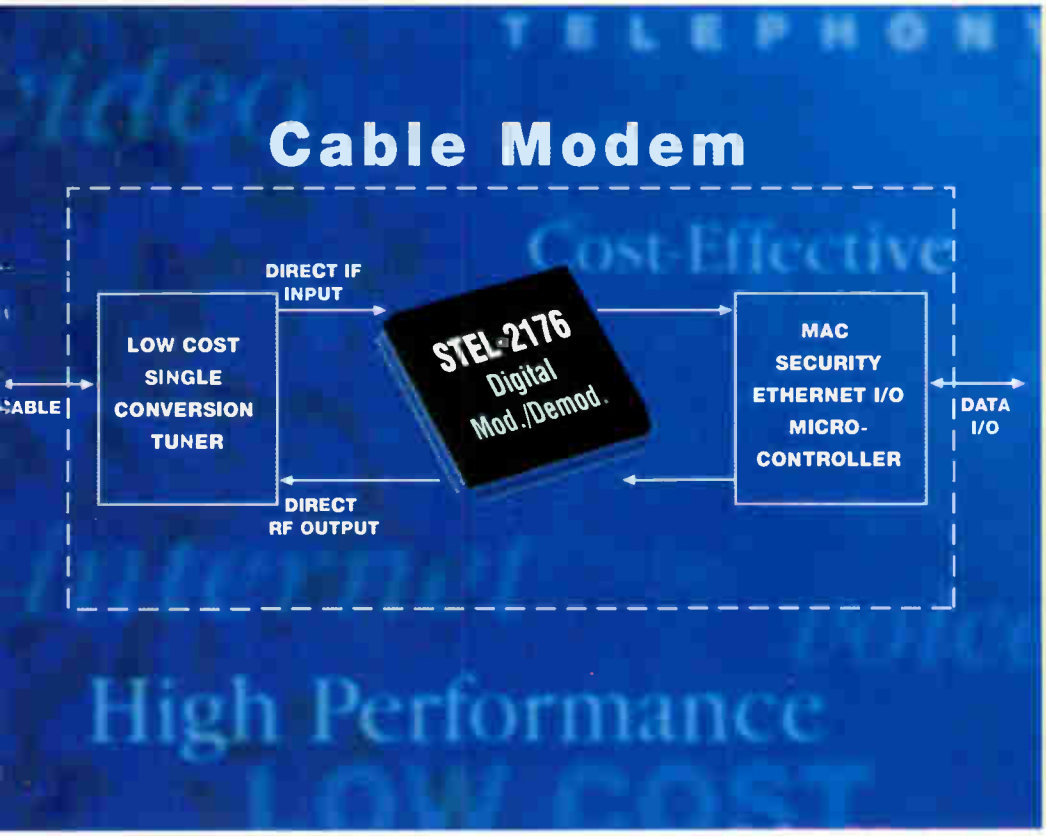

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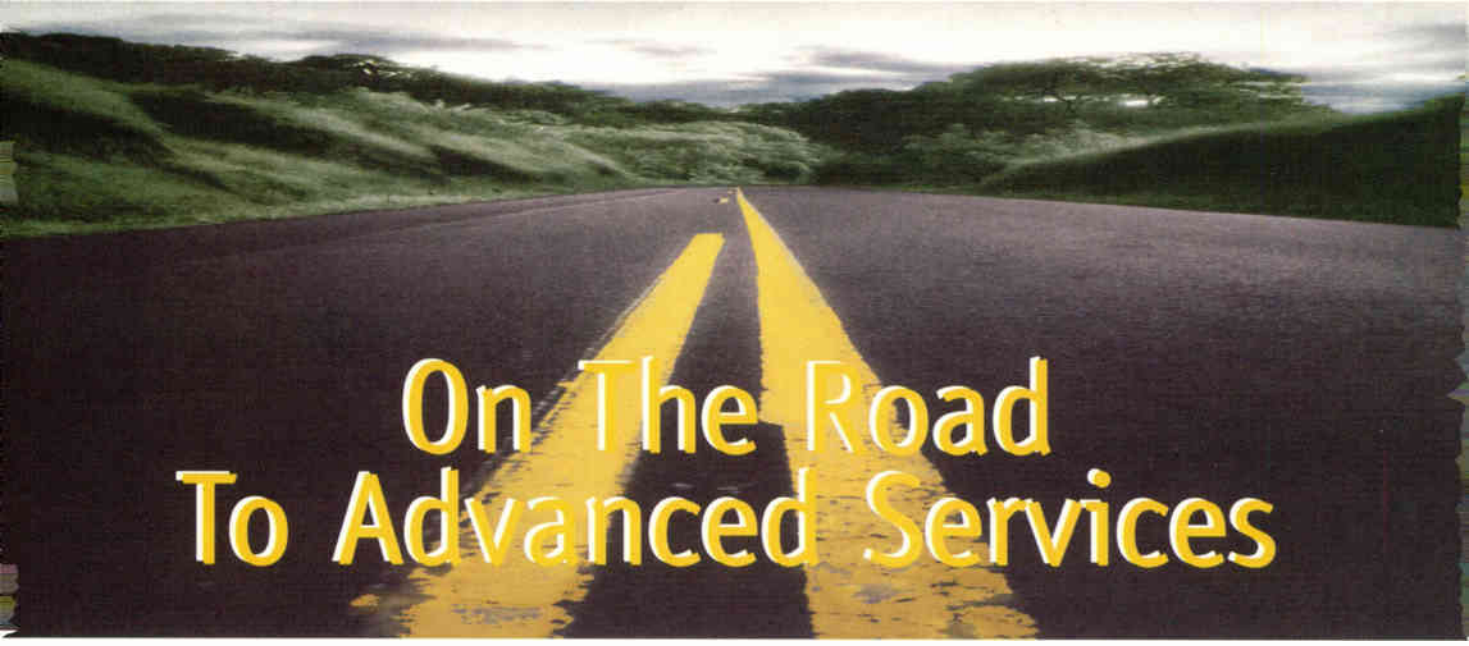


On The Road To Advanced Services

S-CDMA Makes Two-Way Go Your Way

By Adrian Jones

Synchronous code division multiple access (S-CDMA) technology enables your cable operation to deliver high-speed, two-way data services, while simultaneously increasing the data capacity of your networks. The technology's upstream capacity paves the way for advanced broadband services over cable.

The rollout of high-speed data services has been inhibited by the challenges of initiating two-way broadband access over the cable infrastructure. Cable is susceptible to a range of narrowband, wideband and burst noise in the upstream direction from a variety of sources. This fact makes it difficult for operators to make the transition from being one-way carriers of video to true two-way carriers of broadband services.

In response to this challenge, S-CDMA technology provides reliable, high-capacity communication, even in the most demanding cable plant conditions. This technology approach provides you with several advantages:

- Fast time-to-market for data services because you don't need to upgrade your plants prior to initiating data services
- Reduced operating and plant maintenance costs, based on the robust S-CDMA technology, over all-coaxial or fiber-upgraded plants
- Reliability and capacity to support more advanced services—from commercial data services to Internet protocol (IP) telephony

Benefit summary of cable efficiencies between S-CDMA and TDMA systems

Attribute	TDMA	S-CDMA	Benefit
Available upstream spectrum	20-42 MHz	5-42 MHz	160%
Allocated channel efficiency	1:2 - 3:5	1:1	160%
Channel availability ratio	70%	100%	140%
Channel capacity	Low to moderate	High	
S-CDMA efficiency gain			**>300%**

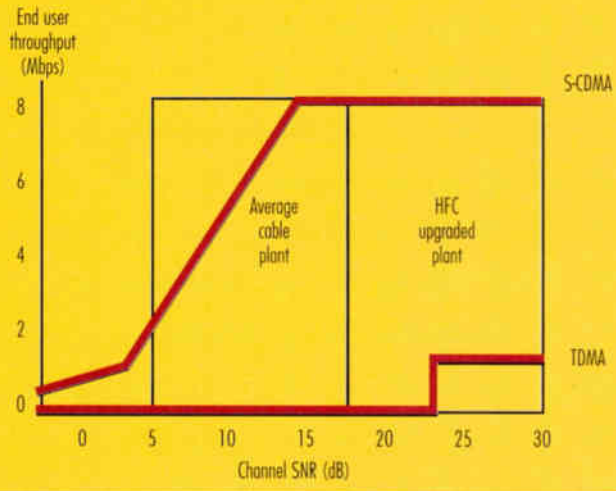
Many operators today either limit their data service deployment to a subset of their cable plants or simply cannot deploy data services because of performance limitations of the current proprietary time division multiple access (TDMA) upstream transport.

S-CDMA deployments (see related story in "Deployment Watch" on page 16) have demonstrated the ability to provide cable operators a highly reliable, high-capacity cable modem transmission system that can be launched quickly and ubiquitously across a broad range of cable plants.

The reliability factor

The cable industry has expended considerable effort over the years to improve the reliability and availability of its networks so they can support demanding new services. While much effort has gone into improving network architectures and increasing the reliability of system components, offering highly available services still heavily depends on the robustness of the RF modem transmission system under real-world plant conditions. ➤

Figure 1: Channel capacity of S-CDMA systems and typical TDMA systems with channel S/N



For any given set of noise conditions, an S-CDMA channel provides a more reliable upstream channel than a TDMA channel, which results in fewer interruptions in data transmission from excessive error rates. This higher channel reliability is a result of the inherent advantages that S-CDMA offers when confronted with dynamic narrowband interference and impulse noise.

S-CDMA's ability to handle the same noise level with fewer errors and outages increases service reliability. Better service results in lower customer care expenses and helps counter claims made by regional Bell operating companies (RBOCs) that cable operators deliver a less reliable form of Internet access. In addition, advanced services such as packet and circuit-mode telephony and video conferencing require a higher channel reliability than casual Internet browsing to ensure service competitiveness and customer satisfaction.

You also can run S-CDMA-based systems under higher noise conditions than those tolerated by TDMA-based systems, with equivalent channel reliability. This ability allows you to aggregate more homes passed for each upstream channel receiver and reduce the costs of headend RF channel receivers when building out the network.

By reducing expenses, you can maintain attractive margins for new two-way services in the initial years when subscriber penetration is low. Then, as demand increases, you have a cost-effective and modular approach to scaling the network to higher service penetration levels.

Expanding the pipe

Under any common channel reliability criteria, an S-CDMA channel provides higher net payload capacity than a TDMA channel. The higher payload allows you to add more residential Internet access customers per channel, which reduces the capital expenditure for upstream receiver cards when building out the headend infrastructure.

The higher channel capacity also supports premium services that provide minimum guaranteed upstream rates per subscriber that are substantially greater than those offered by integrated services digital network (ISDN) or asymmetrical digital subscriber line (ADSL) technologies.

ISDN is symmetric 128 kbps, while ADSL (depending on the standard) ranges from 64 kbps to 640 kbps upstream and 1 Mbps to 6 Mbps downstream.

The bulk of S-CDMA deployments occur around 2 Mbps downstream and 128 kbps upstream.

S-CDMA quality of service (QoS) controls for each modem allow unique bandwidth control independently in both upstream and downstream directions. Bandwidth can be allocated in increments of 64 kbps up to 8.192 Mbps with guaranteed or fair-based, best-effort delivery providing asymmetric, symmetric and

reverse-symmetric traffic profiles. This flexibility is immensely valuable in addressing the needs of different markets.

By offering higher speed services, cable operators can obtain lucrative high-margin business selling telecommuting services and commercial-grade data access services. Figure 1 (on page 64) compares the channel capacity of an S-CDMA system with that of a typical TDMA system with channel signal-to-noise ratio (S/N).

Generally speaking, a larger pool of resources will support greater traffic concentration. As the bandwidth of the channel increases, the number of users supported increases more rapidly. Thus, the higher the bandwidth, the more efficiently statistical multiplexing of bursty traffic can occur.

The higher capacity channels allow you to sustain much higher peak burst rates per subscriber, which is necessary for emerging applications such as high-speed Internet access. Support for high burst

BOTTOM LINE

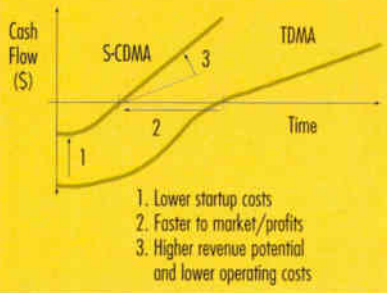
Save Money with S-CDMA

Synchronous code division multiple access (S-CDMA) is a technique for two-way data transmission that enables cable operators to share spectrum in a common RF channel among a group of users and provide each user with his or her own data stream.

S-CDMA-based systems can operate under higher noise conditions than those tolerated by time division multiple access (TDMA)-based systems, with equivalent channel reliability. Therefore, you can aggregate more homes passed for each upstream channel receiver and reduce the costs of headend RF channel receivers when building out the network.

By reducing expenses, you can maintain attractive margins for new two-way services in the initial years when subscriber penetration is low. Then, as demand increases, you have a cost-effective and modular approach to scaling the network to higher service penetration levels.

Figure 2: Expense, revenue and time benefits of S-CDMA over TDMA-based cable modems



rates creates a unique competitive advantage for cable-based broadband access. Finally, you'll need higher capacity channels to provide enough upstream bandwidth to handle voice and video conferencing services at reasonable penetrations.

More bang for your buck

In order to provide data services that build on and optimize your cable network investment, you need to make every effort to use those assets efficiently. Operators frequently decide to upgrade their plants based on the need to increase either forward or reverse capacity. By efficiently using reverse spectrum, you can defer or even avoid unnecessary plant upgrades.

I generally consider spectrum below the "glass floor" of 20 MHz too noisy to be used by most TDMA systems, leaving 30-50% of the return spectrum unused. Robust modem technologies such as S-CDMA allow you to use the entire return spectrum.

You can, therefore, support more users on a given system and may defer or even avoid upgrading or subdividing the plant. By reducing the immediate need to subdivide your system, you'll have more time to plan the upgrade, while offsetting the cost of that upgrade with greater service revenue.

S-CDMA-based modems also operate robustly and efficiently in the presence of severe noise levels, especially in the sub-20 MHz spectrum, providing cable operators with major economic advantages as they deploy data services.

The use of frequency hopping by TDMA systems to avoid noise interferers requires additional clean spectrum. So, for a single revenue-generating TDMA upstream channel, at least one additional channel width of spectrum lies dormant. In addition, TDMA systems require that operators avoid known interferers, such as continuous wave (CW) and ham radio bands. Thus, the amount of clean channel relative to the total spectrum available (channel availability ratio) decreases rapidly with the width of a TDMA carrier.

S-CDMA provides greater robustness in the face of such interferers. Figure 2 provides an estimate of the overall efficiency gains that S-CDMA technology provides over TDMA systems. S-CDMA's robustness allows the cable operator to efficiently use the limited return spectrum.

Make money sooner

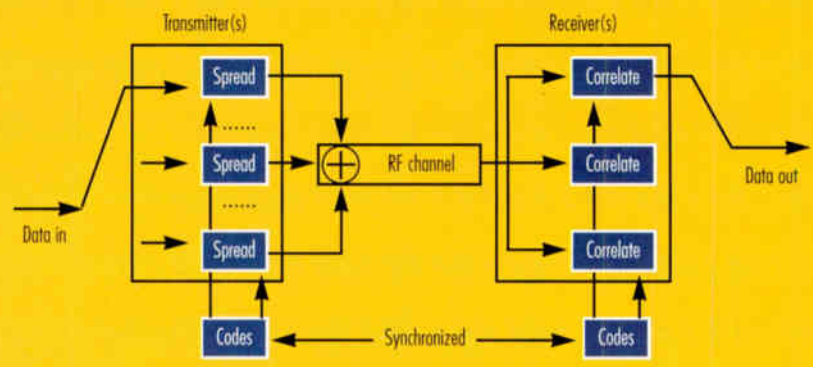
Operators have demonstrated that they can deploy S-CDMA cable modem systems more rapidly than is possible with

TDMA modems because of the reduced level of plant upgrading and cleanup. In addition, the ongoing maintenance costs are lower with S-CDMA. The resulting higher revenue slope, coupled with a lower maintenance expense line, leads to earlier and higher profits for the service. (See the accompanying table on page 62.)

Some cable plants are not likely to be upgraded to modern, cleaned-up hybrid fiber/coax (HFC) in the near future, including vintage all-coax systems. S-CDMA has had successful commercial deployments on plants that could not be served by TDMA-based modems in Belgium, Brazil, Canada and Japan.

S-CDMA allows an operator to provide broadband access services to customers on such plants now without requiring time-consuming and expensive rebuilds. The only other options available to operators of such plants are to use dial-return modems—with their recognized economic and marketing weaknesses—or to forgo offering service in those areas, at the risk of customer and regulatory disapproval.

Figure 3: How S-CDMA works

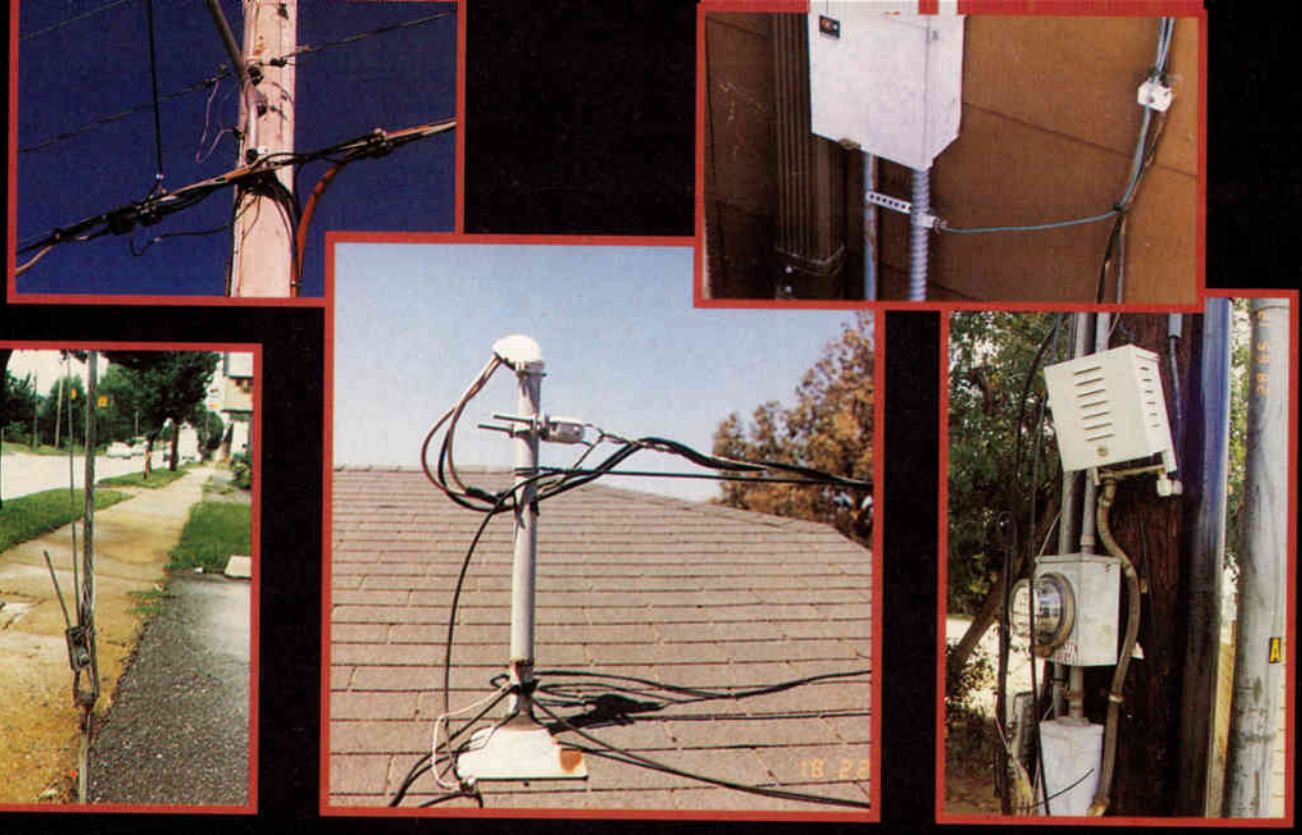


Why S-CDMA?

Feedback from commercial deployments has demonstrated the following key benefits of S-CDMA-based cable modems. For details about how S-CDMA works, see Figure 3.

- System-wide launches on all plants with lower up-front costs
- Reduced time to market
- Increased retained revenue through lower operating expenses
- The ability to serve a wide variety of markets, from residential Internet access to high-end data services CT

Adrian Jones is group director of product management for Terayon Communication Systems. He may be reached via e-mail at adjones@terayon.com.



Top left: The CATV system is just a few inches from street light power. Top right: The NEC does not permit grounding to a flexible conduit. Bottom left: A missing down guy guard presents a hazard to pedestrians. Bottom center: The CATV drop touches the power drop and should not be attached to the power riser. Bottom right: This CATV power supply is active, and energized terminals are within reach of pedestrians

Do You Know the Code?

How to Avoid Costly Violations

By Jonathan L. Kramer

"*Ignorantia legis neminem excusat.*" This may be the first Latin phrase you've ever read in *Communications Technology*, but as you'll discover, it's a phrase that governs your system's everyday broadband plant construction and maintenance activities. You need to understand clearly the laws (called "codes") that governments use to assess your broadband system.

Okay, let's start with a basic question: Why do governments exist? At the most basic level, governments exist to promote and protect the welfare and safety of their citizens. Those citizens include your subscribers, residents, visitors, and even you and your employees.

Governments promote the welfare of everyone through the adoption of safety-related codes, which are the body of local laws that everyone in the community must obey. You certainly are aware of some of these codes, at least by name. At the local level, we give these laws names such as municipal codes, government codes, safety codes, ordinances and so on.

Some of these safety codes govern our daily activities such as requiring us to stop at red lights, yield to emergency vehicles and build safe structures. Some specialized safety codes tell us how we must build and maintain broadband communications systems.

Anyone involved in plant construction eventually will have his or her work scrutinized by a government safety code inspector. The inspector may be an

NEC

Article 830C

"Primary electrical protection shall be provided on all network-powered broadband communications conductors ..."

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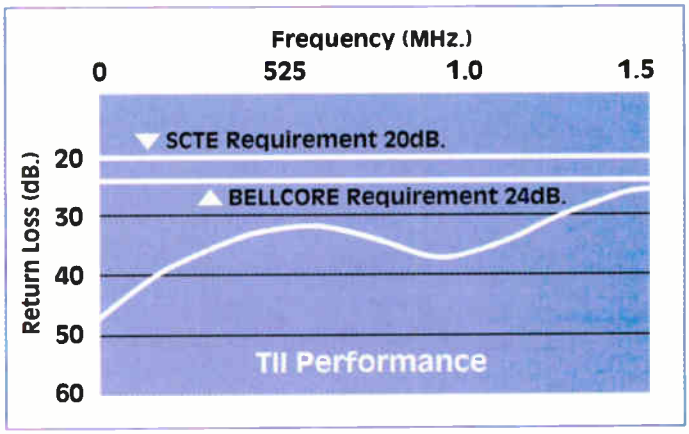

excellent fire protection as well. So shield your equipment with TII surge arresters.

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Now that you know about the codes, you're likely asking yourself where to get your own copies. If your corporate office doesn't provide them to you, you'll find print copies in most major city construction bookstores, or you can purchase them directly from their publishers. The NEC also may be purchased on disk or CD-ROM.

Additionally, the NEC and NESC have handbooks that provide explanations of many sections of the codes. There also are many useful Web sites providing nonauthoritative interpretations of the rules. Remember, though, that the codes defer to the local inspector for final rules interpretations within the adopting jurisdiction.

employee of the government's telecommunications franchise agency, the building and safety department, the city manager's office, the public works agency, or some other agency.

Because of the specialized nature of broadband system construction, you may find that the inspector is a highly experienced employee of an outside firm retained by one or more of the government agencies listed earlier.

Regardless of where the inspectors come from, you can be certain of one thing: The inspector's job is to determine whether you've met your legal (code-mandated) responsibilities to build a safe system. A failed inspection can cost your system hundreds of thousands of dollars in fines, upgrade costs and possibly even franchise revocation.

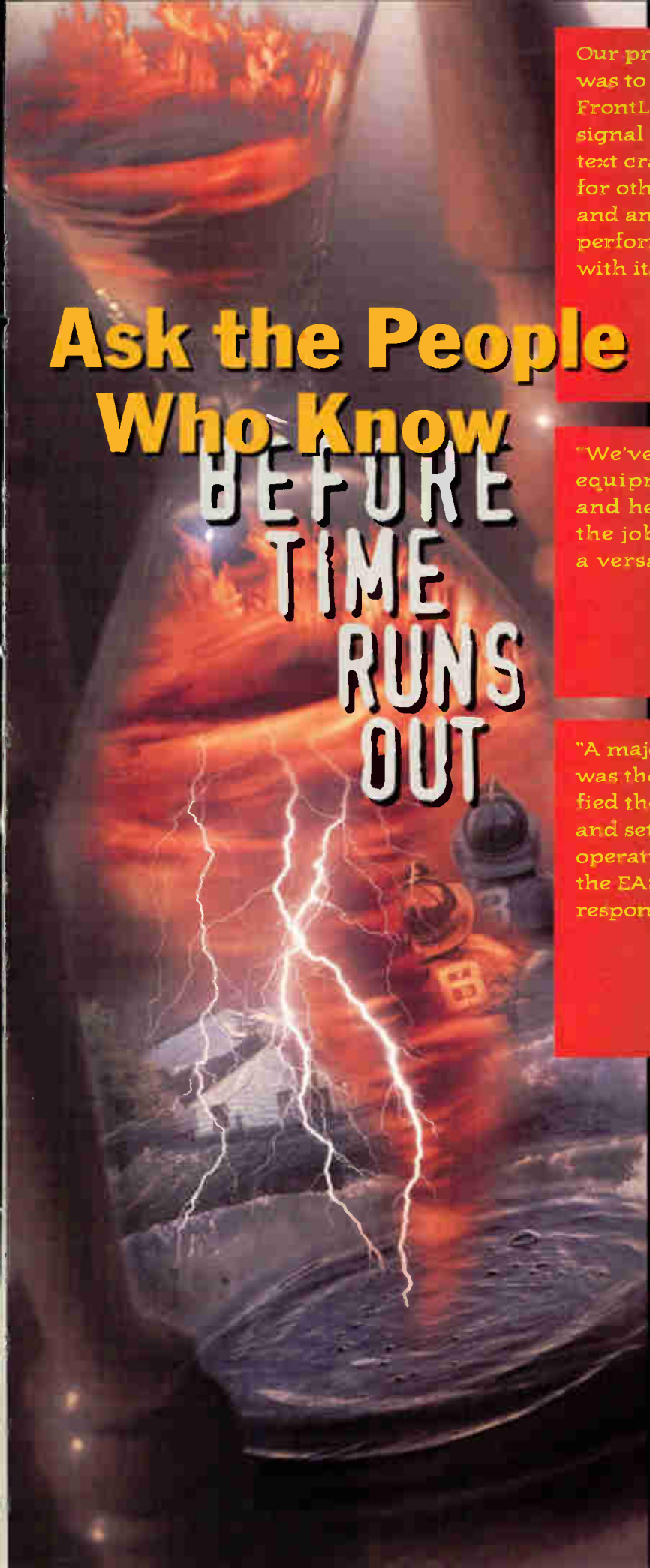
Know the codes

You may be wondering what codes govern your system and what they regulate. These are common questions, yet the answers may surprise you.

There are just a few nationwide codes that form the regulatory foundation of broadband system construction. They include the National Electrical Safety Code (NESC) published by the Institute of Electrical and Electronics Engineers; the National Electrical Code (NEC) published by the National Fire Protection Association; the BOCA Building Code (BOCA) published by BOCA International; and the Uniform Building Code (UBC) published by the International Conference of Building Officials.

The NESC code focuses on outside plant construction requirements and, to a lesser degree, plant construction at subscribers' buildings. The NEC, BOCA and UBC codes all focus on plant construction at the subscribers' buildings. Most states, counties and local governments have adopted the NESC and NEC as their own safety codes. The odds are high that your local or state government requires that you adhere to these codes.

In some states, such as California, a state agency has developed its own construction code effectively replacing the NESC with a tougher, statewide measure. In other states, such as Connecticut, a



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"We've actually been using FrontLine equipment for local emergency messaging and headend switching since 1993! It's done the job effectively, reliably, and provided a versatility that we did not expect."

Dick Snyder
Area Engineer
Comcast Cable Communications
Philadelphia, PA

"A major reason for our choice of FrontLine was the ease of installation. They've simplified the wiring issues, making installation and setup easy and helping to assure reliable operation down the road. FrontLine knows the EAS business and they've been very responsive to our needs."

Neil Fladeland
Assistant VP of Engineering
Insight
Nobleville, IN

As these industry veterans know, FrontLine EAS systems are proven in leading cable operations around the country. With more experience, the widest range of products, and proven quality and reliability, FrontLine is the leader in EAS.

Remember, if you have over 10,000 subscribers, the deadline for compliance is December 31, 1998. When you choose your system, take advantage of experience and listen to the people who know.

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state agency has enhanced the NESC or NEC by adding additional or different state-specific requirements.

A question of years

Virtually all of the national codes and some of the state and local codes are updated every few years. The fact that they are updated by the national organizations that control their development does not mean that those new codes are what you must follow.

Here's an important tip: Most governments are slow to adopt the most current code. For example, although the 1999 NEC code is now available, many governments only use the 1993 or 1996 versions.

Some governments still enforce earlier versions such as the 1987 NEC and 1990 NESC codes. Because the rules are slightly (or, in some rare cases, significantly) different between editions, you may be caught in the common trap of assuming that the most current code prevails. Newer is better, right?

In fact, the code you're actually responsible to obey may be several or many years old and different from the code book sitting on your shelf. Another tip: Some cable TV franchise documents require that you comply with the most current version of a particular code, even though the government hasn't yet formally adopted that version.

Unless you know your system's true code obligations, you may find yourself on the wrong end of a series of violation notices. Want an example? One of the most interesting code violations today is tied to one of our newest technologies: telephony over cable.

Broadband operators that are governed by any NEC code year prior to the 1999 code, and who are sending more than 60 V via coaxial cable to the customer's structure (usually 90 V to the network interface attached to the side of the building), are most likely to be in violation of the long-standing NEC code that limits the maximum voltage to 60 V.

Although the 1999 NEC now permits you to send 90 V to the home, it's unlikely that most governments will adopt the 1999 NEC for another three to six years. Imagine being given 500 separate violation notices and told to terminate telephony service to your paying subscribers because you didn't realize you'd have to secure a waiver to pump 90 V down a drop.

Here's another example: Many years ago, the NEC allowed the use of an independent cable TV ground rod where the structure already had its own power ground. Now, under the current NEC dating back to the 1980s, the use of independent cable TV ground rods in this situation is clearly prohibited. (As an inspector, this is one of the "biggies" I find in many systems I inspect.)

Clearly, it's important that you check the terms of your government franchise and ordinance, or ask the government inspector and your company's legal department for guidance as to which codes and code years apply to your system.

Outside plant and house-side plant

Because the "Big Two" codes are the NESC and the NEC, we'll take a short tour of each of them. Although literally thousands of rules and sub-rules are contained within the bodies of the NESC and NEC, we generally can categorize our involvement with the codes into two well-known areas of our business: outside plant and subscriber drops.

The NESC controls outside plant construction—generally, from

the headend to the attachment point at the subscriber's structure. Here's where we'll find the rules that, among other things, govern cable heights above railways, roadways, driveways, pedestrian walkways, structures and so on; cable separations from power, telephone, street lights, and others at and between poles and underground; riser requirements; plant bonding; guying requirements; climbing space minimums; and ongoing inspection requirements. (What, you didn't know the NESC has an ongoing system inspection requirement? Your government code inspector knows.)

Generally, your pole line and underground trunk and distribution construction crews are impacted most by the NESC. To a lesser degree, your installers will find that their greatest contacts with the NESC stem from tap-to-structure drop construction and burial depth of underground drops.

While NESC code has its greatest impact on the outside plant construction (from the headend up to the subscriber's structure, including the drop), NEC has its greatest impact once the drop touches the attachment point of the subscriber's structure.

The NEC governs how you attach your drop to the structure and run it on the outside. Here are some outside home "don'ts:"

- Don't use the power service mast
- Don't get too close to the phone company's drop attachment point
- Don't run your cable too close to power or telco on the side of the house
- Don't have too many bends in your ground lead

The NEC also controls how you run your cables inside the structure. Don't allow your cable to interfere with the removal of electrical panels such as breaker bays or suspended ceiling panels, and make sure you use properly rated coaxial cables, especially in air plenums.

As an aside, the NEC also sets out some very specific rules about headend electrical wiring, antenna tower and satellite grounding, headend grounding, and working space clearances around equipment racks. Also, the NEC prohibits the use of extension cords to extend power to AC power strips in fixed racks of equipment, a common "gig" during my headend inspections.

So, do you remember why governments exist? (No, it's not just to collect franchise fees!) Governments really do exist to promote public welfare and safety. Now you know how they do it. And, you understand why *Ignorantia legis neminem excusat* is Latin for "Ignorance of the law excuses no one." CT

Jonathan Kramer is a fellow of the Institute for the Advancement of Engineering, an SCTE senior member, an inspector-grade member of the International Association of Electrical Inspectors and a national director of National Association of Telecommunications Officers and Advisors. He may be reached via e-mail at kramer@cabletv.com.

BOTTOM LINE

Get Up to Speed on Code

It's becoming more common for franchising authorities to retain an expert inspector to investigate a cable system's compliance with the codes at the time of a transfer and again when renewal is looming. The reasons for the timing stem from certain legal obligations that franchisers must follow during these times.

You can easily land in trouble if you don't know what codes you're required to follow. It's equally easy to spend a just few hours doing the research to learn what codes to meet—before the inspector arrives.

Kramer's First Law states, "No one can effectively inspect their own system." It's human nature. As an example, take your morning drive to work: You instinctively drive around the potholes and bumps so often that they disappear from the front of your mind. However, when visitors come to town, they'll instantly notice every one of those potholes and bumps

Ask a trusted peer—perhaps a seasoned construction supervisor—to look over your system for code violations. By doing so, you'll gain a wealth of understanding about your system and its true condition before a government inspector visits your system.

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The Build

Training and Construction Strategies for Evolving Broadband Networks

Aggressive Upgrade Plans Spur Training Needs

The numbers are staggering. AT&T has so far committed to spending more than $40 billion to gain access to cable's broadband pipe. Why? The lure of direct access to millions of your customers.

With AT&T's marriage to TCI considered by most a *fait accompli* and last month's highly anticipated joint venture with Time Warner finally unmasked, AT&T will have access to more than 42 million homes, which encompass 40% of the local phone market. All that, and AT&T expected to add still other partners to its dance card.

What's it mean for you? The pressure to upgrade your cable systems to handle two-way advanced services such as Internet protocol (IP) telephony, digital video and high-speed data will increase. TCI and Time Warner alone plan to spend roughly $4 billion to upgrade their cable infrastructures, and both have aggressive rebuild schedules (80-85% complete by year-end '99). Even if you're not invited to AT&T's party, competitive pressures surely will intensify your upgrade pace.

Your engineering staffs, construction crews and installation technicians will have to work faster, smarter and more efficiently. And, they'll be assigned increasingly complex tasks. To help you tackle this challenge, *Communications Technology* is adding a new section to its pages. Dubbed "The Build," this section will deliver training and construction tips that you can immediately implement to improve your installation, construction and maintenance practices to save money in this competitive marketplace.

"The Build" also will deliver case studies and feature articles that highlight superior voice, video and data deployment practices so that broadband operators can learn the latest in best practices from their peers and potential competitors.

Why combine high-level engineering, construction training for new entrants and new build strategies under one roof? Because the rollout of advanced, interactive digital services is inextricably tied to the quality construction of today's infrastructure and the existence of a sophisticated, well trained work force at all levels.

TCI President Leo Hindery said it best when he cautioned everyone at the Western Cable show not to underestimate the difficulty of offering seamless voice, video and data services. Within five years, Hindery expects "50% of revenues will be driven by services that the company doesn't offer today." What does that mean from an engineering and infrastructure standpoint? "Tens of millions of man-hours of installations over the next five years," Hindery predicts.

Cable telecommunications providers will need a sophisticated work force, trained in the advanced technologies such as IP telephony, cable modems, digital TV, and network management that already are a staple of *Communications Technology*'s editorial coverage. By combining construction and training expertise with *Communications Technology*'s existing engineering solutions, we'll be able to provide you one information source to help you successfully deploy and launch advanced broadband services.

Jennifer Whalen
Editor

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[Case Study]

ROAD WARRI

By Bob Cherry and Mark Liggett

When Time Warner Cable began to upgrade its Dallas network, our construction division knew it needed a better method for organizing our daily splicing.

So we devised a plan to manage the splice contractor during the upgrade–a plan that not only improved our splicing personnel's efficiency and productivity, but also acted as a customer service tool during the upgrade process. As a result, we've seen less downtime, lower costs, improved contractor relations and a better-trained workforce.

On the road again

We call our new upgrade process "control van management" because we literally drive a van out to a central location, such as a node, and monitor each day's upgrade splicing and activation. We man the van with a technical general foreman and a contractor representative, who together route the field work, track its progress and improve the quality of the work.

Inside the van, we keep work maps from the previous day, the current day and the next day, along with walk-out maps of the system itself. The van also may contain an alternative power source that drives an on-board personal computer (PC) for reporting production, a plug strip for maintaining meter batteries and a mini-stock of frequently required materials, such

Time Warner's Mobile Managers Streamline Texas Upgrade

as amplifiers, taps, pads, equalizers and so on. (See Figure 1 on page 78.)

As the day progresses, our work team routes the splicers and activators from one area to the next. Those crews then relay detailed information about what they have accomplished back to the control van, where our managers transfer the information to the master prints. This process lets the supervising force know how the field activity is progressing in a much more detailed manner than before.

Efficient routing

Our control van team first routes each node planned for upgrade splicing by area or pocket. A typical 5-mile node may have four areas. We usually identify the area with the highest density of penetration as the first area to visit in the work day, then move on to subsequent areas in order of lower population.

This process is key to minimizing the customers' downtime during an activation. Many customers aren't aware of the presence of splicing technicians, each of whom is assigned an average of five device locations in a row to splice. This process ensures continuity and improves efficiency. As the splicers complete the routes, they send their updates to the control van personnel, who then assign the next route.

The activation

Each day, our staff first splices and activates the node and trunk. Once they

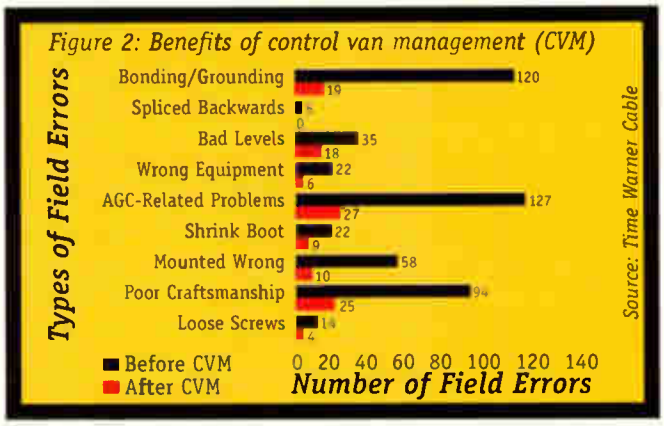
The Bottom Line

Time Warner Hits the Road

To improve splicing and activation practices during its Dallas upgrade, Time Warner Cable's construction division is implementing "control van management."

Each day, project leaders drive the control van out to a central location, such as a node. From the van, Time Warner staff and contractors route splicing and activation work, track progress and improve the quality of work in the field. Field crews relay detailed information about what they have accomplished back to the control van, where project managers transfer the information to the master prints.

Using a control van to coordinate its field work brings Time Warner Cable's upgrade projects a higher level of accuracy and efficiency. Since implementing this method, the company's Dallas-based construction division has reduced its cost per foot for in-house personnel and equipment by 26%. The company hopes to implement control van management at other projects.



Better, faster, cheaper

Once we implemented control van management in Dallas, our "discrepancy lists"—which track field errors found by our quality control team—decreased dramatically. (See Figure 2.) Prior to our "launch" date in August, we received multiple pages of discrepancies per node. After August, we found that we had reduced discrepancies by an average of 47.3% per node. We believe this factor greatly contributed to the reduced costs and higher efficiency levels of our personnel and the contracted forces in Dallas.

The number of miles we upgraded as a result of this program also increased. Before the program, we maintained an average daily production of 2.1 miles. Now we can splice and activate a minimum of 5 miles per day—an increase of 138%.

We evaluated the requirements of our method from a financial aspect as well and found we needed to invest $4,600 per month to furnish the van, equipment and manpower to operate it. On a typical 1,200-mile-per-year project, this investment impacted our financial integrity by $0.0087 per foot.

On this particular 1,200-mile project, we've logged 272 miles so far and discovered some interesting results.

For the first 113 miles prior to control van implementation, our in-house cost-per-foot averaged $0.363. Since August, when we started using the control van, we've decreased our cost-per-foot average to $0.257 for the remaining 159 miles.

With the additional costs for the van, we saved an average of $0.098 per foot on those last 159 miles—a 26% decrease in our costs.

By hitting the road with our van, we've improved productivity, empowered our crews, better served the customer and saved money.

Bob Cherry is technical supervisor and Mark Liggett is project manager, both for Time Warner Cable's construction division in Dallas. They can be reached at (972) 245-7662.

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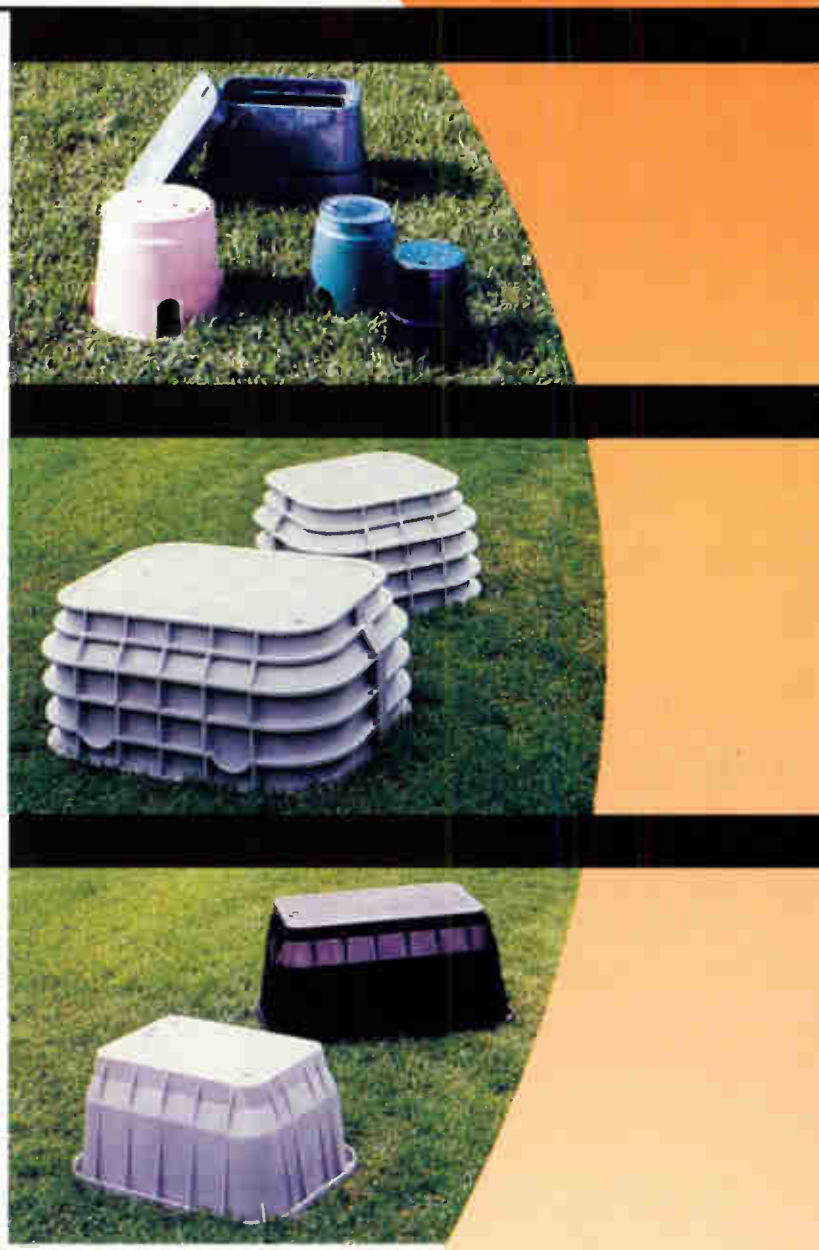

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Reader Service Number 58

[Case Study]

THE Build

Terra Firma? Not Really

Don't Let Ground Heaving Uproot Your System

By Elisa Modugno

You've engineered the perfect two-way system. Your preactivation tests prove the hybrid fiber/coax (HFC) network is finely tuned. Then, after six months of flawless operation, the ever-capricious March pounces like a lion. Temperatures drop drastically, and suddenly your system fails. Angry customer complaints flood your call center.

What have you done wrong? Nothing, really, but your system may have fallen victim to ground heaving. As you begin your design cycle for this summer's new builds and upgrades, you need to plan to protect your system from this menace.

Master of disguises, the phenomena generically known as ground heaving is one of the most enigmatic scourges that afflict cable networks. It is so wily, in fact, that many cable operators have a difficult time deciding whether ground heaving is the culprit when signal quality suddenly goes berserk.

Because ground heaving can be a menace in vastly disparate regions of the country, it often is caused by different geological and soil-related conditions. Ground heaving in Alaska, for example, will not be triggered by the same events that cause ground heaving in New Mexico. However, the net effect is the same: Cables are crushed, exposed or otherwise rendered useless.

But never fear; there are ways to control ground heaving before it ravages buried cables. The following tips illustrate preventive measures that you can use in specific geographic regions, as well as tried-and-true tactics that cable constructors use in all kinds of terrestrial jobs, all over the world.

Fortify your trenches

Whether you're laying cable west of the Mississippi or north of the Mason-Dixon line, taking simple steps to create a more hospitable, protective trench environment is well worth the extra money it might require up front.

"Once the cable is in the ground, there's not a lot that you can do from that perspective to protect it," says Jeff Michaud, vice president of marketing at Iron Mountain, MI-based Cable Constructors. In Michaud's experience, which mainly has

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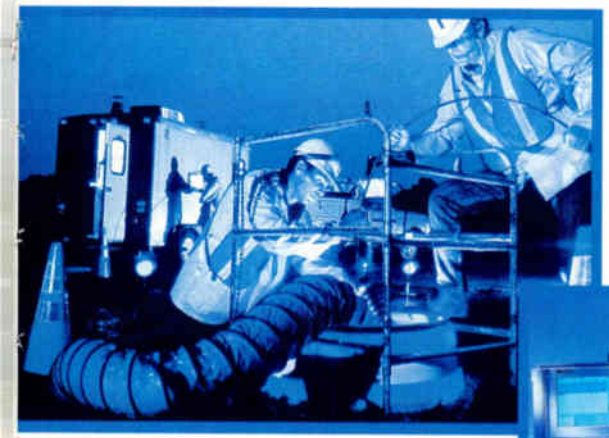

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Expanding Possibilities

involved systems located in eastern states, ground heaving or "frost heave" has not caused much concern among customers.

"The biggest problem with buried plant is nearby excavation activity," Michaud says, adding that squirrel-chew damage is a close runner-up. But Michaud recognizes the often covert mischief caused by ground heaving.

"During the winter, you may experience degradation of a signal," he says. "A rock could have been pushed up by ground heave, or it could be something else." That's why, regardless of the cause, reinforcing trenches can be a cable operator's first line of defense.

When backfilling a trench, start out by ensuring there are no rocks or sticks strewn about that could be pushed up against the cable should the ground heave during a heavy frost or even when construction activity is going on nearby. Next, lay a 6-inch to 12-inch deep layer of sand both underneath and on top of the cable. This will provide a "cushion" of protection from debris.

"Obviously, that's very expensive," Michaud says of the sand cushion tactic. But the extra money spent up front buying sand and hauling rocks away can translate into dollars saved later.

Dig deep, avoid frost

Frost is a major cause of ground heaving. For those working in very cold climates, cable damage associated with frost is a serious issue that requires a lot of extra planning to overcome. ➤

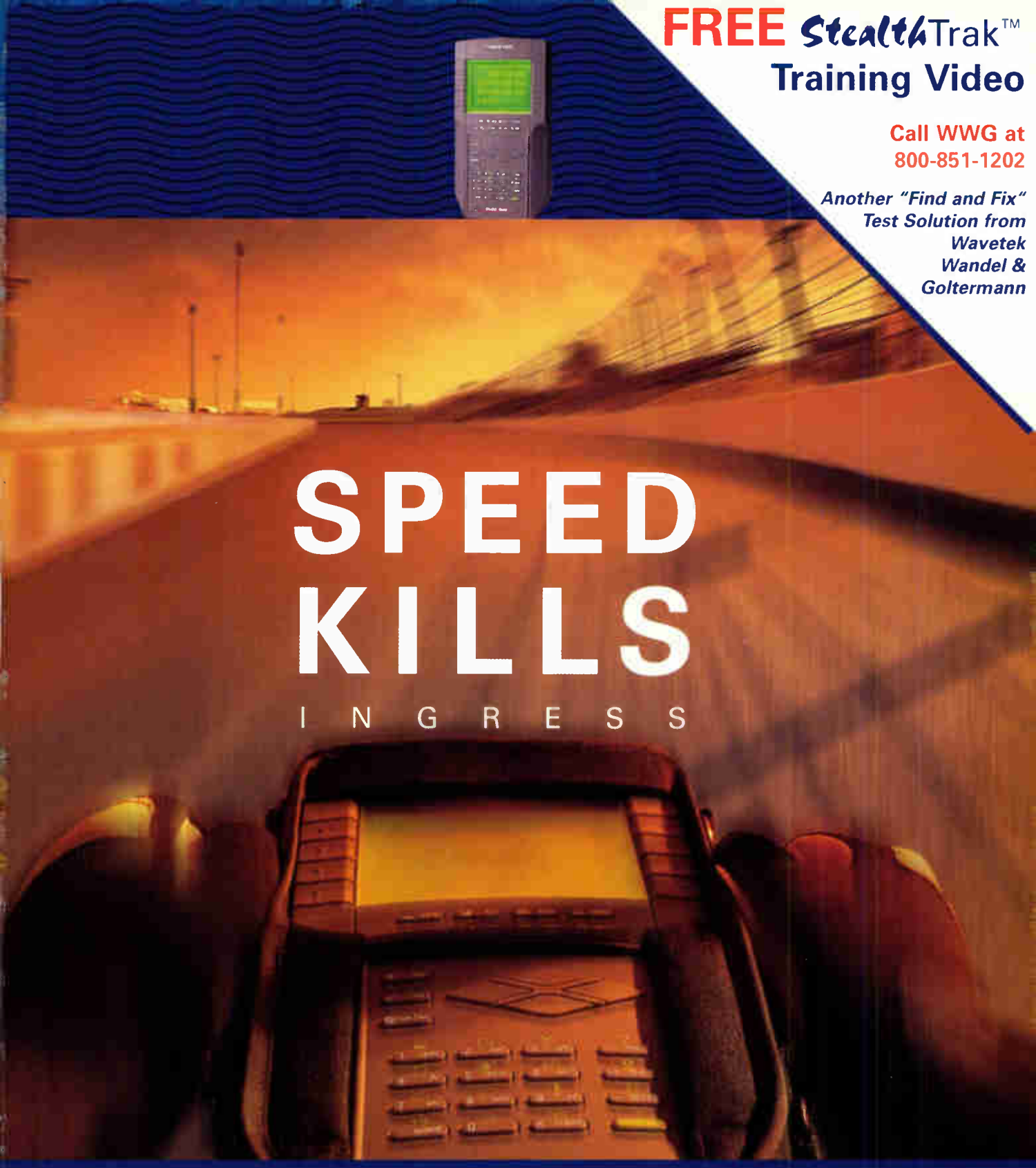
The Bottom Line

Beat Ground Heaving

Fortify trenches: Trench space is becoming a more complicated matter. Whether cable is sharing life in the trenches with utility lines or just going solo, a good way to protect it from ground heaving is to pour between 6 inches and 12 inches of sand both below the cable and above it. This cushion protects the cable from debris that could be pushed against it if the ground begins to heave.

Dig deep to avoid frost: Whatever else, always lay cable below the frost line. Frost may or may not cause ground heaving, but if ground heaving occurs, it can tear open or crush cables. This, in turn, allows moisture to saturate the cable. And when that happens, a signal is sure to degrade. So bury deep, and bury well.

Take conduit seriously: Conduit comes in many shapes and forms. Whether laying cable in the desert or across Alaska's frozen tundra, the appropriate conduit can prevent having to go back to an area to make repairs. And if repairs are needed, the presence of conduit can prevent a mishap from getting worse.



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OUT

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Reader Service Number 61

"The frost gets pretty deep," says Scott Ducott, vice president of engineering at Time Warner Cable's Green Bay, WI, division, which oversees about 2,800 miles of plant in northeastern Wisconsin. Ducott suggests putting standard feeder cable 24 inches to 30 inches beneath the ground and putting any cable that will share a common trench with other utilities 30 inches to 40 inches beneath the ground.

Recently, protecting fiber-optic cable has become more of an issue for Time Warner, he says.

"We are putting a significant amount of fiber-optic cable in the ground," says Ducott. This past year, the company installed between 250 and 350 route miles of fiber. Based on his experience, Ducott recommends putting fiber-optic cable 42 inches beneath the ground "for protection (from ground heaving) as well as trying to get it out of everyone's way."

Wrap it up

Just as popular wisdom dictates that no one should swim across the English Channel in December without first donning a wet suit, industry leaders are beginning to suspect that it's a little foolish to send cable to its final resting place without the right attire.

> "As you begin your design cycle for this summer's new builds and upgrades, you need to plan to protect your system from this menace."

Different climates and soil conditions call for different types of conduit. The main point, from a protection standpoint, is to consider investing in conduit rather than allowing nature to take its course on direct-buried cables.

A 15-year veteran of Austin, TX-based Prime Cable who has overseen system upgrades in Alaska, Alex Gold is a staunch believer in the power of conduit.

"You'll have moisture underground. As the water freezes, it causes the ground to separate, which causes cable conductor to pull apart, elongate," Gold explains. "Typically, we would have to dig it up and effect a temporary repair (until summer)."

Because of a proliferation of such costly incidents, conduit has become synonymous with protection on jobs supervised by Gold.

"We now install our conductors in conduit. It's an investment well worthwhile," Gold says. For the Alaskan terrain, Gold uses a Schedule 40 polyvinyl chloride (PVC) conduit. He prefers PVC over steel because freezing water will destroy a steel conduit if it gets inside. And, inevitably, water does.

Michaud also extends a warm welcome to conduit as a preventive measure. Maintaining conduit integrity is extremely

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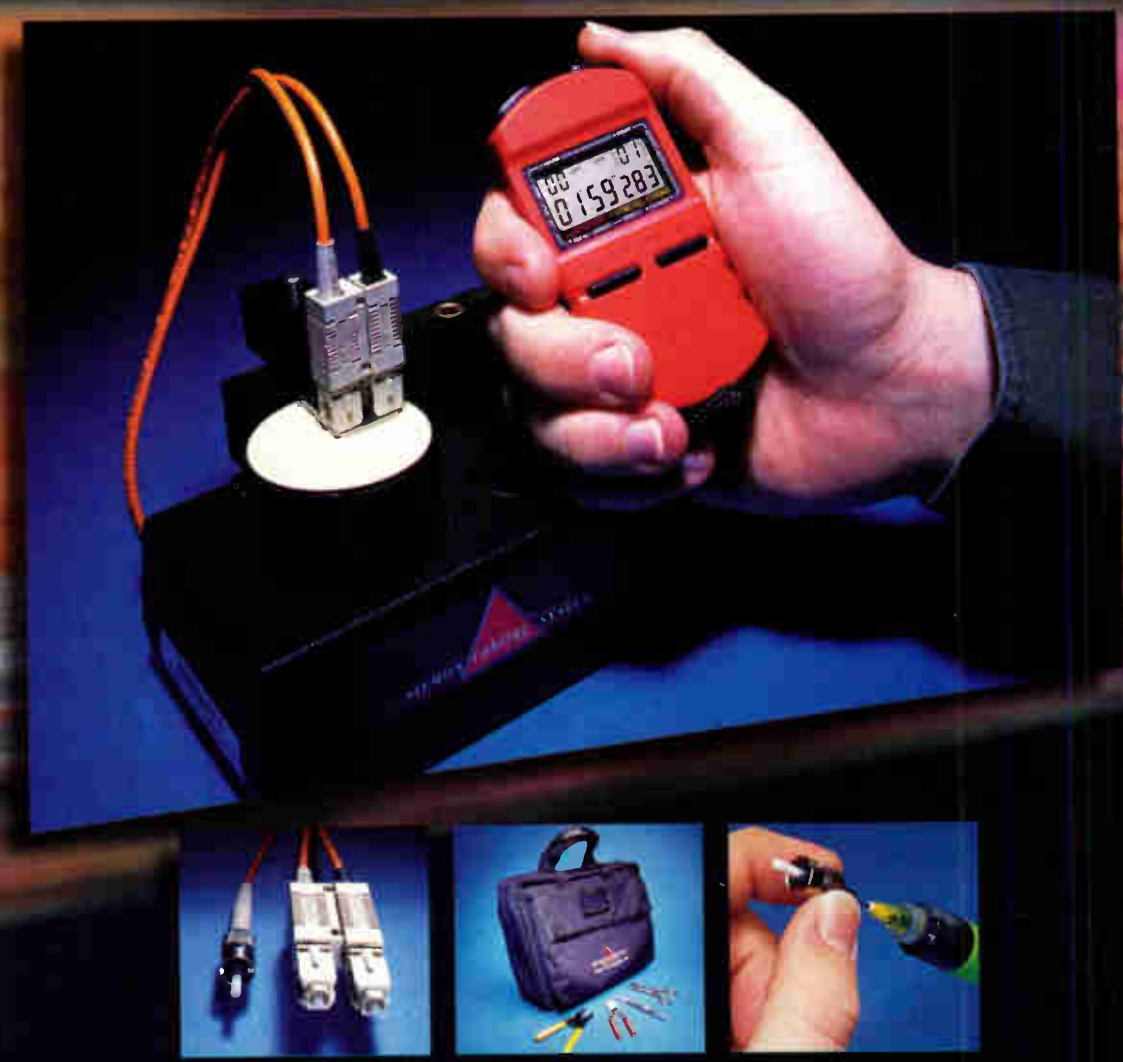

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important, he cautions. For avoiding frost damage, he recommends rolled conduit made from high density polyethylene (HDPE) instead of "stick pipe" conduit because rolled conduit is continuous rather than composed of segments.

"In some extreme cases, people put steel in," Michaud notes, adding that steel works well to protect fiber lines that have been earmarked to route a lot of 911 traffic—particularly if that line has to travel through a rocky area. "Working with steel is a lot more costly," he says.

Across the map

In the southwestern United States, conduit also plays an essential role, but for much different reasons. Skeeter Cope, upgrade project manager for Cable TV Arlington, which is operated by Prime Cable, has spent most of his professional career—beginning in 1966—on jobs in the Southwest.

"The ground heaving out there comes in two parts," Cope says. The first is a result of the many earthquake fault zones scattered across the region.

In these areas, Cope likes to install a soft-walled conduit, such as a DB-120, because it breaks easily in one place without breaking too far back and disturbing lock boxes on the ends. Where fault zones are concerned, however, the best preventive measure is to isolate the damage to a narrow area, Cope advises.

Flash floods and earth wash are the second part of the ground heaving problems Cope has faced in the Southwest. There are sand wash areas between rural towns where cable must be laid that are subject to frequent flash floods.

"The best way to go through these wash areas is with armored jacketed cable," Cope says, adding that it must be buried 36 to 48 inches deep. The armored conduit protects the cable, even if it should become exposed to the elements after a flash flood. "The cable is still intact," Cope says. "All you have to do is go rebury your cable."

Whether it's frost or floods, spending the time and money to protect your cable today will help you prevent future repairs and expenses.

Elisa Modugno is the editor of sister publication "Broadband Networking News." She can be reached at (301) 340-7788, ext. 2017.

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Troubleshooting Hum Modulation, Part 6

This month's installment is the last in a series on troubleshooting hum modulation. The material is adapted from a lesson in NCTI's Installer Technician Course. © NCTI.

Last installment covered measuring hum percentage or checking picture quality at the tap port and tap input port, and replacing a defective tap face plate. This installment finishes the troubleshooting process at the tap where last month's left off and then moves to the ground block/grounded splitter and house amplifier.

Because an electrical shock hazard may exist when troubleshooting a hum modulation problem, always carefully observe all appropriate safety precautions.

- *Monitoring hum percentage or picture quality at tap port while disconnecting other drop cables.* To determine if one customer drop system is backfeeding the unacceptable hum modulation to another customer drop, reinstall the tap face plate (if it was removed) and connect a signal level meter (SLM) or TV test set to the original customer's tap port. Monitor the hum percentage/picture quality as you disconnect each drop cable connected to the tap, one at a time (Figure 1), until the percentage of hum modulation is less than 2% (Figure 2), or until there are no hum bars on the TV test set. If the hum is still greater than 2% or if hum bars are visible on the TV test set when all other customer drop cables are disconnected from the tap, the problem is generated by the feeder system or by another source upstream from there.

When disconnecting one of the drop cables causes the percentage of hum modulation to drop to 2% or less, the disconnected drop system is causing the hum modulation. That drop system may have a hot chassis condition, a defective house amp or a TV set with an internal problem. Whatever the cause, identify it and repair it.

- *Measuring hum percentage or checking picture quality at ground block/grounded splitter input.* Check the picture quality or the hum percentage at the input to the ground block/grounded splitter when there are hum bars on all cable-installed TV sets or excessive hum at the wall plate of the only cable-installed TV set. Measuring hum modulation or checking picture quality at the input to the ground block helps to determine if the abnormal hum modulation is caused before or after the ground block.

  Picture quality can be checked by either connecting a test drop to the input cable of the ground block and connecting the other end of the test drop to the TV test set in the truck or by connecting the input cable to the TV test set at the ground block. Acceptable hum modulation at the input of the ground block/grounded splitter indicates that the excessive hum is generated between the ground block/grounded splitter and the wall plate location. Excessive hum may be caused by poor grounding, bad bonding wire connections, a defective house amp, defective house electrical wiring or a defective household electrical appliance. Unacceptable hum at the ground block's or grounded splitter's input indicates that the service drop, tap or feeder system is causing the problem.
- *Measuring hum percentage or checking picture quality at house amplifier.* If there is a house amp between the output of the ground block/grounded splitter and the input of the cable wall plate, measure the hum percentage or check the picture quality at the input and output of the house amp. An acceptable hum modulation reading on the SLM at the input to the house amp and an excessive reading at its output indicates a defective house amp. Replace the amp (if company-owned) and remeasure the hum modulation. If the amp is owned by the customer, tell the customer that it is causing the problem and needs replacement or repair. TB

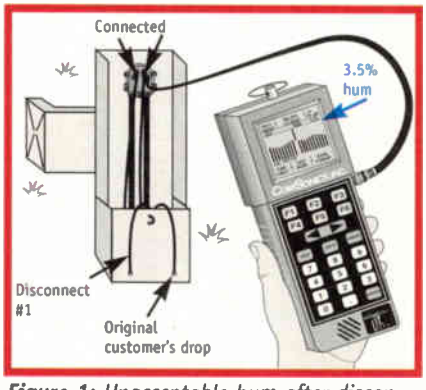

Figure 1: Unacceptable hum after disconnecting the first drop indicates one of the two drops still connected or feeder system is causing the problem

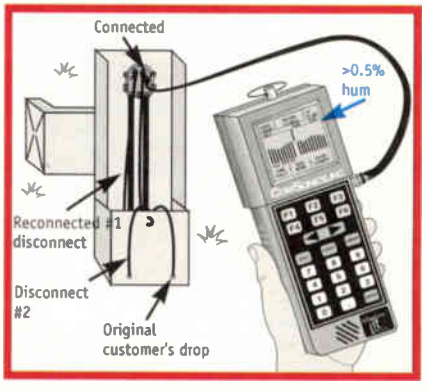

Figure 2: Hum modulation less than 2% after disconnecting second drop indicates that drop is causing the problem

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INSTRUMENTS

Test Module

Aimed at service providers with long fiber runs, GN Nettest has introduced a new module allowing users to test for end-of-fiber at 200 km to 300 km.

The 46 dB optical module for the CMA4000 optical time domain reflectometer (OTDR) uses very high dynamic range (VHDR) technology and maintains compatibility with existing CMA4000 OTDRs. According to the company, the module allows users to achieve a higher dynamic range while reducing the time it takes to perform testing on fiber of any length. Because VHDR reduces testing time, optical modules require less averaging time; test results are ready faster, and productivity is increased.

Reader Service #311

Power Light

Identify networking cables without a tone generator or extra labeling. The DataLite from Jensen Tools is designed to locate cable. Setup time is reduced by injecting an electrical pulse into the cable and illuminating an RJ-45 module on the patch panel.

The DataLite is intended for installs, moves, additions and changes. According to the company, the DataLite works with numerous wiring schemes and on punch-down blocks with an RJ-45 adapter. The adapter lights red if the line's polarity is reversed and flashes green if it's correct.

Reader Service #312

Modulator Family

Barco has launched a line of headend products for analog and digital cable systems. The products come in a vertical mount with modular housing.

The line includes two modulators. Barco's Galaxy multistandard digital modulator supports OpenCable standard requirements. The company's Orion analog modulator complies with transmission standards. Both products combine functionality with performance while saving rack space.

Barco's Pyxis is a DVB/ATSC-compliant, single-channel Moving Pictures Experts Group (MPEG-2) encoder with a modular compact design. The Pyxis encoder was designed for distribution applications, such as local advertisement and program insertion or pay-per-view (PPV) channels in the cable TV headend.

The Pyxis encoder is custom-configurable and upgradable as the operator's system grows or goes digital.

Reader Service #307

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Inside the technically advanced Lectro CPR battery is a pure lead-tin electrochemistry, thin plate technology and sophisticated grid material used to ensure maximum performance in the harshest environments. The high purity lead (99.99% pure) results in low self-discharge rates (longer shelf life), higher power densities, faster recharge and much less corrosion. The presence of tin creates a superior battery with higher tolerance for frequent cycling without shortening its life in standby applications. Two sizes are offered - a 40 Amp-hour designed for ZTT/Plus cabinet retrofit applications as well as a 70 Amp-hour for new CPR installations.

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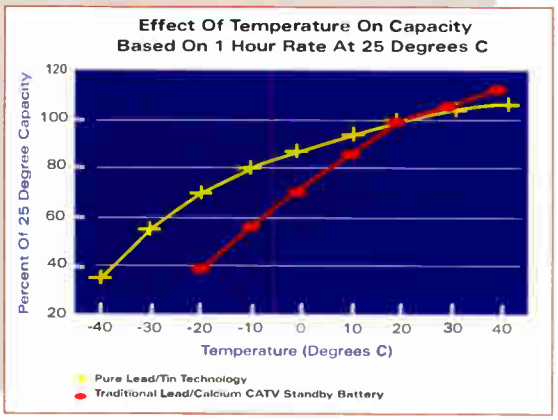

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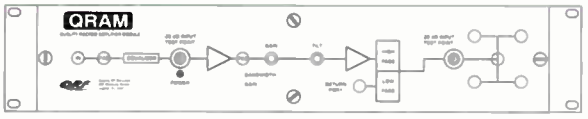
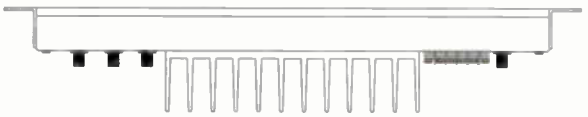


QRAM Front View

QRAM Rear View



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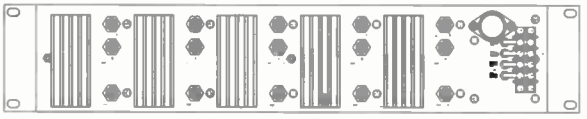

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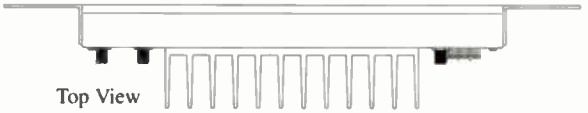

Top View

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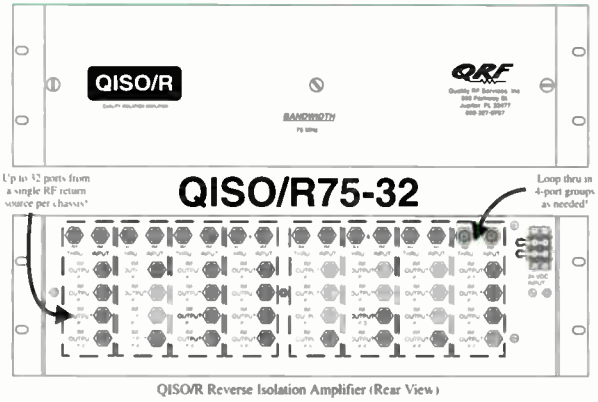

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Reader Service Number 69

SAP Generator

Leaming Industries has developed a new MTS-2S BTSC stereo and secondary audio program (SAP) generator. It provides cable systems with a means to transmit stereo and SAP TV audio from one space-saving unit.

The generator's features include stereo frequency response to 14.5 kHz, built-in stereo and SAP, dbx-licensed baseband, and 4.5 MHz outputs. The SAP generator is built into the unit, so setup time is reduced. The unit mounts easily in one standard rack space (1.75 inches high, 19 inches wide).

Reader Service #309

Modulator Line

Standard Communications has added the 860 MHz AVM860 modulator to its product line. The AVM860 includes features from the TVM series and has several new additions, including fault-over on loss of video and remote network control.

Reader Service #308

Return Path Improvements

Hewlett-Packard has rolled out several new products for 1999. AccessCable is an intelligent return path monitoring and measurement solution for automated ingress detection and identification. The Service Advisor Tablet platform contains asynchronous transfer mode (ATM) test and optical carrier (OC) 3c/synchronous transfer mode-1 (STM-1) line interface modules for transmission testing of fiber backbones. CableBERT (bit error rate testing) over coax cable remains in beta testing. It uses the company's T1 Test Advisor to operate with a high-speed, frequency agile quadrature phase shift keying (QPSK) cable modem made by RF Networks. The test was used to qualify a T1 signal and rate on coax cable for telephone transmission.

Reader Service #310

Connection System

Molex Fiber Optics hasreleased its new OptoClipII connection system. The system offers mechanical splice quality performance with the flexibility of a connector package.

Featuring push-pull operation with a positive locking system, it also has a unique system to align fibers to tolerances comparable to the best-performing ferrules.

When the end plugs are in the disconnected position, a shutter swings into place to protect fiber from contamination and to provide eye protection from laser radiation. Designed to fit any standard mounting location, the OptoClipII adapter secures to the panel with screws or metal clips.

Reader Service #306

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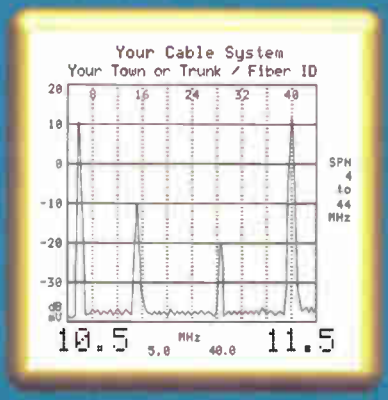

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❑ 23. Educational TV Stations, Schools and Libraries
❑ 24. Other (please specify)

C. Please check the category that best describes your job title:
❑ 25. Corporate Management (Chairman, Owner, President, Partner, Executive/Senior Vice President, Treasurer)
❑ 26. Management (Vice President, General Manager, System Manager and Director)
❑ 27. Programming (Vice President, Director, Manager, Producer)
❑ 28. Engineering Management (Vice President, Director, Manager)
❑ 29. Engineer
❑ 30. Technician (Technical Director, Manager, Supervisor, Technician)
❑ 31. Installer (Installation Director, Manager, Supervisor, Installer)
❑ 32. Sales (Vice President, Director, Manager, Sales Representative)
❑ 33. Marketing (Marketing Vice President, Director, Manager)
❑ 34. Other (please specify)

D. In the next 12 months, what cable equipment do you plan to buy?
❑ 35. Amplifiers
❑ 36. Antennas
❑ 37. CATV Passive Equipment including Coaxial Cable
❑ 38. Cable Tools
❑ 39. CAD Software, Mapping
❑ 40. Commercial Insertion/Character Generator
❑ 41. Compression/Digital Equip.
❑ 42. Computer Equipment
❑ 43. Connectors/Splitters
❑ 44. Fleet Management
❑ 45. Headend Equipment
❑ 46. Transmission/Switching Equipment
❑ 47. Networking Equipment
❑ 48. Vaults/Pedestals
❑ 49. MMDS Transmission Equipment
❑ 50. Microwave Equipment
❑ 51. Receivers and Modulators
❑ 52. Cable Modems
❑ 53. Subscriber/Addressable Security Equipment/ Converters/Remotes
❑ 54. Telephone/PCS Equipment
❑ 55. Power Supply. (Batteries, etc.)
❑ 56. Video Servers

E. What is your annual cable equipment expenditure?
❑ 57 up to $50,000
❑ 58 $50,001 to $100,000
❑ 59 $100,001 to $250,000
❑ 60. over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?
❑ 61. Fiber-Optic Amplifiers
❑ 62. Fiber-Optic Connectors
❑ 63. Fiber-Optic Couplers/Splitters
❑ 64. Fiber-Optic Splicers
❑ 65. Fiber-Optic Transmitter/Receiver
❑ 66 Fiber-Optic Patchcords/Pigtails
❑ 67 Fiber-Optic Components
❑ 68 Fiber-Optic Cable
❑ 69. Fiber-Optic Closures & Cabinets

G. What is your annual fiber-optic equipment expenditure?
❑ 70 up to $50,000
❑ 71. $50,001 to $100,000
❑ 72. $100,001 to $250,000
❑ 73. over $250,000

H. In the next 12 months, what cable test & measurement equipment do you plan to buy?
❑ 74. Audio Test Equipment
❑ 75. Cable Fault Locators
❑ 76 Fiber Optics Test Equipment
❑ 77. Leakage Detection
❑ 78 OTDRs
❑ 79 Power Meters
❑ 80. Signal Level Meters
❑ 81 Spectrum Analyzers
❑ 82. Status Monitoring
❑ 83. TDRs

I. What is your annual cable test and measurement equipment expenditure?
❑ 84. up to $50,000
❑ 85 $50,001 to $100,000
❑ 86. $100,001 to $250,000
❑ 87. over $250,000

J. In the next 12 months, what cable services do you plan to buy?
❑ 88. Contracting Services (Construction/Installation)
❑ 89 Repair Services
❑ 90. Technical Services/ Eng. Design

K. What is your annual cable services expenditure?
❑ 91 up to $50,000
❑ 92. $50,001 to $100,000
❑ 93. $100,001 to $250,000
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L. Do you plan to rebuild/upgrade your system in:
❑ 95. 1 year
❑ 96. more than 2 years

M. How many miles of plant are you upgrading/ rebuilding?
❑ 97 up to10 miles
❑ 98 11-30 miles
❑ 99 31 miles or more

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2	26	50	74	98	122	146	170	194	218	242	266	290
3	27	51	75	99	123	147	171	195	219	243	267	291
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7	31	55	79	103	127	151	175	199	223	247	271	295
8	32	56	80	104	128	152	176	200	224	248	272	296
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18	42	66	90	114	138	162	186	210	234	258	282	306
19	43	67	91	115	139	163	187	211	235	259	283	307
20	44	68	92	116	140	164	188	212	236	260	284	308
21	45	69	93	117	141	165	189	213	237	261	285	309
22	46	70	94	118	142	166	190	214	238	262	286	310
23	47	71	95	119	143	167	191	125	239	263	287	311
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A. Are you a member of the SCTE (Society of Cable Telecommunications Engineers)?
❑ 01. yes ❑ 02 no

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

Cable TV Systems Operations
❑ 03. Independent Cable TV Syst.
❑ 04. MSO (two or more Cable TV Systems)
❑ 05. Cable TV Contractor
❑ 06. Cable TV Program Network
❑ 07 SMATV or DBS Operator
❑ 08. MMDS, STV or LPTV Operator
❑ 09. Microwave
❑ 10. Telecommunications Carrier
❑ 11. Electric Utility
❑ 12. Satellite Manufacturer
❑ 13. Satellite Distributor/Dealer
❑ 14. Fiber Optic Manufacturer
❑ 15. Data Network
❑ 16. Commercial TV Broadcaster
❑ 17. Cable TV Component Manufacturer
❑ 18. Cable TV Investor
❑ 19. Financial Institution, Broker,Consultant
❑ 20. Law Firm and Gov't. Agencies
❑ 21 Program Producers or Distributors and Syndicators
❑ 22. Advertising Agencies
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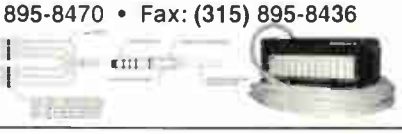

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REGISTRATION
Complete and return the official Attendee Registration Form. Use a separate form for each attendee. Photocopies are accepted. SCTE will not accept registrations by phone. **Payment must accompany**

forms in order to be processed. SCTE will accept registrations by fax ONLY when paid by credit card. If forms are faxed, registrants should not mail the original to SCTE. Non-members wishing to join SCTE may complete the membership application enclosed with this registration packet and submit it with the registration form. Individuals submitting a completed membership application with payment are eligible for SCTE member registration rates. Annual member dues are $40 within North America, and $60 for International membership.

REGISTRATION TYPES

Full Registration: Includes Preconference Sessions, Engineering Conference, Technical Workshops, Exhibits and Annual Awards Luncheon.
Expo Only: Admittance to Technical Workshops and Exhibits.
Spouse Registration: Includes Preconference Sessions, Engineering Conference, Technical Workshops, Exhibits and Annual Awards Luncheon.

PRE-REGISTRATION

DEADLINE: APRIL 16, 1999
Registration forms with payment must be received at SCTE on or before April 16. Forms received after that date will not be processed and individuals must register on-site in Orlando at the on-site rate.

CANCELLATIONS/SUBSTITUTIONS

DEADLINE: APRIL 23, 1999
All requests for cancellation must be received in writing on or before April 23. All requests for cancellation will be subject to a $75 cancellation fee. **No refunds will be given after April 23.** All requests for substitutions must be received in writing prior to April 23. After this date, substitutions must be processed on-site at the Registration Assistance Booth. Written company authorization and a $5 processing fee are required.

DRESS CODE

Since the primary purpose of Cable-Tec Expo® is education, we urge attendees to dress in a manner that is comfortable and conducive to getting the most out of the program (slacks, jeans, short sleeve shirts – NO shorts or tank tops).

REGISTRATION FEES

	PRE-REG Until 4/16/99 Member/Non	ON-SITE** After 4/16/99 Member/Non
Engineering Conference and Expo*	$295/$395	$360/$460
EXPO only	$250/$350	$310/$410
Spouse Registration*	$95/$95	$95/$95

* Includes ticket to the Awards Luncheon on May 25. Additional luncheon tickets are available for $40 each.
** Admittance to the Awards Luncheon is not guaranteed, but will be made available as seating permits.

ADMISSION

Admission to all events will be through color coded badges. Badges are to be picked up at the registration desk upon arrival.

TRANSPORTATION

SCTE has made special arrangements for you to get to Expo for less when you call Conventions in America (CIA) at 800-929-4242 and ask for Group #661. You will receive 5-10% off the lowest applicable fares on Delta Air Lines, United Airlines and US Airways, or the lowest available fare on any other carrier. Take an additional 5% off official carriers if you purchase at least 60 days prior to departure. Travel between May 22-31, 1999. All customers of CIA also receive free flight insurance of $100,000. Avis and Budget are offering special low rates with unlimited free mileage. Remember to book early into Orlando – flights fill up fast!

For all airlines, call CIA at 800-929-4242 and ask for Group #661. Outside the 800 area, call 619-232-4298 or fax to 619-232-6497. Reservation hours are Monday through Friday from 6:30 a.m.-5:30 p.m. (Pacific time). Refer to CIA's website at www.scitravel.com (use #661). If you call direct or use your own agency, refer to these codes:

United	800-521-4041, ID #522AZ
Delta	800-241-6760, File #123718A
US Airways	800-334-8644, Goldfile #58650910
Avis	800-331-1600, AWD #B504899
Budget	800-772-3773, ID #U054636

ENTERTAINMENT

The Orlando County Visitors Bureau will maintain a booth in the Convention Center and can make reservations for area attractions, dining, nightlife and sightseeing activities.

ATTRACTIONS

• Animal Kingdom • Magic Kingdom • Epcot Center • Disney/MGM Studios • Universal Studios • Sea World • Wet 'N' Wild • Church Street Station • Blizzard Beach • Typhoon Lagoon • Cypress Gardens • Kennedy Space Center • Busch Gardens • Beltz Factory Outlets • Pleasure Island • Disney Village

HOTEL RESERVATIONS

Hotel reservations will be accepted only with paid attendee registration forms. No reservations will be accepted by phone. Hotels are assigned first come, first served based on availability. Every effort will be made to honor hotel requests. However, SCTE reserves the right to place reservations where rooms are available. **Housing reservation forms must be received at SCTE Headquarters by April 16, 1999.**

HOTEL DEPOSITS AND GUARANTEES

Hotels require a $100 credit card deposit in order to guarantee rooms. **Therefore, SCTE will accept housing reservations by credit card ONLY.** Credit card information must be filled out completely. Failure to complete all information will delay the processing of reservations. SCTE Headquarters and the SCTE Housing Bureau are not responsible for the cancellation of reservations due to failure to follow hotel deposit procedures.

HOTEL CONFIRMATIONS

Attendees will receive written acknowledgement of their Expo hotel reservations from the SCTE Housing Bureau. Confirmation of hotel reservations will be sent to attendees directly from the assigned hotel after April 28. Attendees should not call SCTE Headquarters for hotel confirmation numbers.

CANCELLATIONS AND CHANGES

Hotel cancellations or changes must be received in writing by SCTE Headquarters prior to April 16. After April 16, changes or cancellations must be made directly through the SCTE Housing Bureau by calling 877-288-3437.

Written hotel cancellations received prior to March 31, will be eligible for a full refund. Written hotel cancellations received after March 31 will be assessed a $15 processing fee and refunded $85.

Broadband Systems and Techniques for the New Millennium

Preconference Tutorials
Monday, May 24

The Basics of Dense Wave Division Multiplexing (DWDM)

This tutorial defines terms and explains how DWDM works within the cable telecommunications industry. The session features several network configuration examples, and presents models for examining the cost impact of various DWDM scenarios as they relate to headend interconnection.

Internet Protocol and its Applications in Data, Video and Telephony

Internet Protocol, or IP, is increasingly becoming a fact of life in cable. Currently it is a critical aspect of cable modem technology. In the future, it promises to play more of a role as cable carries IP telephony and streaming video. This tutorial covers the basics of IP as well as Transmission Control Protocol (TCP). Attendees walk through a brief history of IP networking as well as some of the fundamental and more advanced topics that will become important for cable technicians, engineers and managers.

Annual Engineering Conference
Tuesday, May 25

Session A - Future Perspectives: CEOs Outline the Plan

This panel discussion highlights where the CEOs of several MSOs believe the future of broadband communications is heading. Hear their views of the changing role of broadband telecommunications beyond that of an entertainment provider; the influences of telephone companies on the business and the services offered; the impact of competition; and how the cable industry will face these challenges.

Moderator: To Be Announced

Session B - Promising Technologies: CTOs Discuss Risks and Benefits

After hearing the plans and strategies laid out by the top business minds in the industry, this panel of Chief Technical Officers explains how technology can help realize the business opportunities the CEOs expect to pursue. The panel members — each tasked with building the networks and developing the infrastructures that hold the promise for the future of broadband telecommunications – offer their solutions and approaches.

Moderator: To Be Announced

Workshops
Wednesday, May 26 and Thursday, May 27

DOCSIS Demystified

Leave Expo with a complete understanding of the technical and operational issues surrounding the industry's migration from proprietary high-speed data platforms to DOCSIS standards-based platforms.

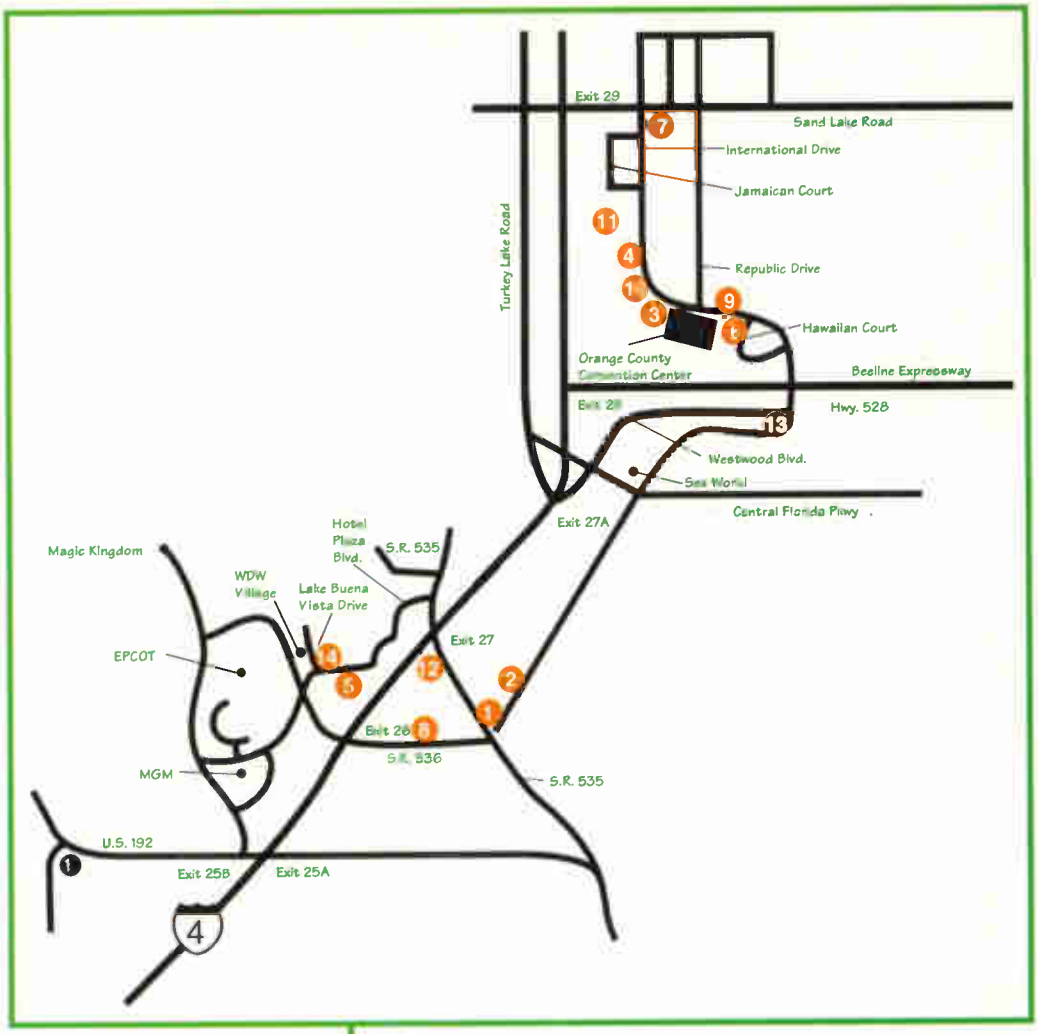
- Technically and operationally, what does the migration to DOCSIS and the retail availability of modems mean to the field engineer or technician?
- How will migration impact field and customer service on a daily basis?

The workshop also includes an in-depth review of the DOCSIS technical specification and strategies for traffic-engineering networks, addressing tradeoffs between the number of users supported and the quality of service (QoS).

Forward and Reverse Plant Maintenance

Explore methods of non-intrusive return path testing using both statistical analysis and common sense methods. Presentations focus on the use of various testing techniques to resolve return path interference with

EXPO HOTELS



1. **Buena Vista Suites** (Single/Double: $129, Triple: $139, King Deluxe: $149) Restaurant, lounge, heated pool/whirlpool, game room, lighted tennis courts, exercise room & game room, complimentary breakfast buffet, microwave. Located 10 minutes from convention center.

2. **Caribe Royale Resort Suites** (Single/Double/Triple: $155, King Deluxe: $175) Restaurant, lounge, cafe, pool, 75' waterslide, video arcade & game room, lighted tennis courts, two exercise facilities, complimentary full breakfast buffet, refrigerator, data ports, microwave. Located 10 minutes from convention center.

3. **Clarion Plaza Hotel** (Single/Double: $128, Triple: $143) Three restaurants (Backstage is popular nightclub), lounge, 24-hr. deli, heated pool/jacuzzi with waterfall. Walking distance to convention center.

4. **Embassy Suites Hotel** (Single/Double: $159, Triple: $169) Restaurant, lounge, indoor/outdoor pools, whirlpool, sauna, steam room, video arcade/billiards, fitness room, complimentary breakfast buffet, nightly two hour beverage reception, data port, microwave. Located less than 5 minutes from convention center.

5. **Hilton at Walt Disney World** (Single/Double: $171, Triple: $191) Seven restaurants, two lounges, two outdoor heated pools, volleyball court, video arcade & game room, health club, data port systems. Located 10-15 minutes from convention center.

6. **Omni Rosen Hotel** (Single/Double: $145, Triple: $165) Two restaurants, two lounges, 24-hr. deli, heated pool/jacuzzi, lighted tennis courts, game room, spa, health club. Walking distance to convention center.

7. **Orlando Marriott International Drive** (Single/Double/ Triple: $111) Restaurant, lounge, three heated pools, four lighted tennis courts, health club. Located five minutes from convention center.

8. **Orlando World Center Marriott** (Single/Double/ Triple: $169) Nine restaurants and piano lounge, 24-hr. room service, four pools (one indoor), water slide, saunas, spa, 18-hole Joe Lee designed golf course, miniature golf, eight lighted tennis courts, two sand volleyball courts, basketball court, game room, health/exercise facility. Located 10-15 minutes from convention center.

9. **Peabody Hotel** (Single/Double: $185, Triple: $200) Four Star, Four Diamond Luxury hotel with three restaurants (B-Line Diner open 24-hours) and 24-hr. room service, heated outdoor pool, four lighted tennis courts, athletic club. Located directly across the street from convention center.

10. **Quality Inn Plaza** (Single/Double/Triple: $61) Restaurant, lounge, pool. Walking distance to convention center.

11. **Radisson Barcelo Hotel Orlando** (Single/Double: $79, Triple: $89) Restaurant, lounge, heated outdoor pool/jacuzzi, tennis court, health club, oversized room with refrigerator, data port, and on-command movie/Nintendo. Located five minutes from convention center.

12. **Residence Inn Suites LBV** (Single/Double/Triple: $134) Deli and groceries, three pools, two whirlpools, lighted tennis courts, sports court, sand volleyball court, video game room, complimentary breakfast, fully equipped kitchen with microwave. Located 10-15 minutes from convention center.

13. **Sheraton World Resort Orlando** (Single/Double/ Triple: $91) Restaurant, lounge, three heated pools/whirlpool, five lighted tennis courts, volleyball/basketball courts, miniature golf, table tennis, fitness center, refrigerator, data ports. Located five minutes from convention center.

14. **Wyndham Palace Resort & Spa** (Single/Double: $165, Triple: $180) *Formerly known as Buena Vista Palace Resort & Spa.* Two restaurants, three lounges, and pastry shop, three pools/jacuzzi, sauna, marina with boat rentals, sand volleyball court, spa, fitness center and lap pool. Located 10-15 minutes from convention center.

cable-tec expo® '99 attendee registration form

registration instructions

- SCTE will accept registrations by fax *only* when paid by credit card. Please *do not* mail original if already faxed.
- Registrations received after April 16 will not be processed. After April 16, attendees must register on-site at the on-site rate.
- Name substitutions must be received in writing at SCTE prior to April 23. After that date, substitutions must be processed on-site at the Registration Assistance Booth accompanied by a $5 processing fee and written company authorization.
- Registration forms accompanied by a completed SCTE membership application and dues payment are eligible for the member rate.
- Sustaining membership qualifies only the individual named on the membership to register at the member rate.
- SCTE will send written confirmation of your attendee registration.
- No refunds will be given after April 23. All cancellations must be received in writing on or before April 23 and are subject to a $75 cancellation fee.

badge information

Complete a separate form for each registrant. Photocopies are accepted. Do not use this form to register exhibitor personnel.

Please TYPE.

Name: _____ Nickname: _____

Title: _____ Company: _____

Address: _____
Street/P.O. Box *City* *State* *Zip*

Phone: ( ) _____ Fax: ( ) _____

E-mail (PLEASE TYPE): _____

SCTE Member # _____ Amateur Radio Code: _____

registration fees

	Pre-Registration Until April 16, 1999		On-Site After April 16, 1999		
	Member	Non-Member	Member	Non-Member	
Engineering Conference and Expo	$295	$395	$360	$460	$_____
Expo Only	$250	$350	$310	$410	$_____
Spouse Registration	$95	$95	$95	$95	$_____

Spouses Name (First, Last): _____

Additional Luncheon Tickets @ $40 each $_____

TOTOAL ENCLOSED $_____

method of payment

Fees are payable to SCTE by check (in U.S. dollars), Visa, MasterCard, or American Express. Registration fees or credit card information must accompany this form in order to process registration. Please do not include hotel deposit with payment.

❑ Check ❑ Visa ❑ MasterCard ❑ American Express

Credit Card Number: _____ Exp. Date: _____

Cardholder Signature: _____ PRINT Cardholder Name: _____

for SCTE use only

Date Received: _____ Date Processed: _____ Amount Received: _____

SCTE Member: ❑ Yes ❑ No Membership fee included: ❑ Yes ❑ No

Batch #: _____ Check #: _____ ❑ Visa ❑ MC ❑ AmEx

cable-tec expo® '99 attendee housing form

housing instructions

- Housing reservations are accepted only with paid Expo registrations. Registration forms with payment and hotel reservation requests must be received by SCTE Headquarters by April 16, 1999. Hotels are assigned first come, first served based on availability.
- A credit card deposit of $100 must accompany reservation requests. Rooms must be guaranteed by credit card ONLY. Please fill out complete credit card information below.
- Housing acknowledgements will be sent by the SCTE Housing Bureau.
- Hotel cancellations or changes must be received in writing by SCTE Headquarters prior to April 16. After April 16, changes or cancellations must be made directly through the SCTE Housing Bureau by calling 877-288-3437. Written hotel cancellations received prior to March 31, will be eligible for a full refund. Written hotel cancellations received after March 31 will be assessed a $15 processing fee and refunded $85.

attendee information

Complete a separate form for each reservation. Photocopies are accepted. Do not use this form to request an exhibitor room block. Housing acknowledgements will be sent to you from the SCTE Housing Bureau.
Please TYPE.

Name: _____ Nickname: _____

Title: _____ Company: _____

Address: _____
Street/P.O. Box *City* *State* *Zip*

Phone: ( ) _____ Fax: ( ) _____

E-mail (PLEASE TYPE): _____ SCTE Member # _____

hotel options

Please rank your hotel preferences from 1-14

_____ Buena Vista Suites
_____ Caribe Royale Resort Suites
_____ Clarion Plaza Hotel
_____ Embassy Suites Hotel
_____ Hilton at Walt Disney World
_____ Omni Rosen Hotel
_____ Orlando Marriott International Drive
_____ Orlando World Center Marriott
_____ Peabody Hotel
_____ Quality Inn Plaza
_____ Radisson Barcelo Hotel Orlando
_____ Residence Inn Suites LBV
_____ Sheraton World Resort Orlando
_____ Wyndham Palace Resort and Spa

attendee accommodation information

Arrival Day:_____ Date:_____ Time:_____ Departure Day:_____ Date:_____ Time: _____

Room Type Requested: ❑ Two Double Beds ❑ King Size Bed ❑ Smoking ❑ Non-Smoking

Number of Persons Sharing Room: _____ Name(s): _____

Special Requests (honored when possible):_____

payment instructions

You must guarantee your room reservation by providing credit card information and signature below.

❑ Visa ❑ MasterCard ❑ American Express

Credit Card Number: _____ Exp. Date: _____

Cardholder Signature: _____ PRINT Cardholder Name: _____

Return completed registration and housing forms with appropriate fees to:
SCTE • 140 Philips Road • Exton, PA 19341-1318 • Or fax to: 610-363-5834
Expo Hotline: 610-363-3822

Molex Network Solutions

Provide *Picture Perfect* Performance

Being a cable operator today means more than offering entertainment packages to *customers*. Telephone, internet access and interactive services are just a few of your new network requirements.

With all this at stake, can you afford to *trust* your fiber network to just anyone?

Molex Fiber Optics, Inc. designs products which impact the heart of your system. We offer a full line of passive optical products for fiber management which include SC, SC/APC, FC, and FC/APC cable assemblies, coupler and WDM modules, fiber drop cables, pre-terminated cabinets and complete frame administration systems.

Digital or analog network – Molex selects the right *interconnect management system* to give you piece of mind.

Your connectivity specialist.

molex Fiber Optics, Inc.

5224 Katrine Avenue • Downers Grove, IL • 60515-4070 • (800) A1-FIBER • Fax: 630-512-8777
http://www.molex.com

Reader Service Number 73

BOOKSHELF

The following listing covers several resources currently available by mail order through the Society of Cable Telecommunications Engineers. The prices listed are for SCTE members only. Nonmembers must add 20% when ordering.

- *AC Power Systems Handbook* (2nd Edition)—Because sensitive equipment requires attention to transient disturbances, grounding practices and standby power needs, this book focuses on the engineering technology essential to the design, maintenance and operation of alternating current (AC) power systems. It examines the design and maintenance of AC power systems in critical-use applications for engineering personnel concerned with the specification, installation and maintenance of electronic equipment.

  The work illuminates the trend towards microelectronic equipment and microprocessor-based systems. It examines how to thwart potentially destructive power disturbances and maximize AC power quality in commercial and residential environments. Topics covered include power system operations, AC energy generation and distribution, as well as common fault conditions. Order TR-41, $70.
- *Regulation and the Cable Industry*—This video features Steve Ross, John Wong and Alan Stilwell from the Federal Communications Commission, as well as Dave Large and Wendell Bailey.

  This program covers substantive and diverse topics including regulations for compatibility between cable and subscriber-owned equipment, short- and long-term compatibility requirements, single-channel vs. simultaneous access and decoder interfaces.

  It goes on to explore alternatives and disagreements negotiated with the consumer electronics industry, how regulations can be carried out, must-carry, rate regulation rules and broadcasters' petition for second channel. (90 min.) Order T-1150, $45. CT

Note: The videotapes are in color and available in the NTSC 1/2-inch VHS format only. They are available in stock and will be delivered approximately three weeks after receipt of order with full payment.

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

To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Orders without full and proper payment will be returned. Send orders to: SCTE, 140 Philips Rd., Exton, PA 19341-1318 or fax with credit card information to (610) 363-5898.

SCTE MEMBERSHIP APPLICATION

NAME:_____ PHONE:_____

MSO:_____ FAX:_____

COMPANY:_____ TITLE:_____

ADDRESS:_____

CITY:_____ STATE:_____ ZIP:_____

ON-LINE ADDRESS:_____ HAM RADIO CALL SIGN:_____

Affiliation: ☐ Cable ☐ Telephone ☐ Other:_____

Job Description: ☐ Manager/Administrator ☐ Operations ☐ Financial ☐ Installer ☐ Sales ☐ Construction ☐ Engineer ☐ Technician ☐ Other:_____

Membership Type: ☐ Individual @ $40 ☐ International @ $60* ☐ Sustaining Member Co. @ $250
**Applicants from outside the U.S. include an additional $20 for mailing expenses.*

Make checks payable to SCTE, or include MasterCard or Visa information below. Please make payments in U.S. funds, drawn on a U.S. bank. SCTE is a 501 (c) (6) non-profit professional membership organization. Your dues may be tax deductible. Consult your local IRS office or tax advisor. Additional member material will be mailed within 30 days. Dues are billed annually.

An Individual SCTE member will receive all standard benefits of membership. A Sustaining member is listed under the company name and has one contact person who is afforded all benefits of an individual membership. Sustaining member companies are given discounts while exhibiting at the SCTE Cable-Tec Expo.

Type of Card: ☐ MasterCard ☐ Visa Card#:_____

Exp. Date:_____ Signature:_____

Sponsoring Chapter or Meeting Group:_____

Sponsoring Member:_____

Send Completed Application to: SCTE, 140 Philips Road, Exton, PA 19341-1318 or Fax to: (610) 363-5898

Complimentary Subscription Application

☐ YES! I want to receive/continue to receive a **FREE** subscription to *Communications Technology*, SCTE's Official Trade Journal. ☐ NO

Signature_____ Date_____
(Signature and date required by U.S. Postal Service.)

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

Cable TV Systems Operations combined
03. ☐ Independent Cable TV Systems
04. ☐ MSO (two or more Cable TV Systems)
05. ☐ Cable TV Contractors
06. ☐ Cable TV Program Networks
07. ☐ SMATV, DBS Operator
08. ☐ MMDS, STV or LPTV Operations
9A. ☐ Microwave
9B. ☐ Telecommunications Carrier
9C. ☐ Electric Utility
9D. ☐ Satellite Manufacturer
9E. ☐ Satellite Distributor/Dealer
9F. ☐ Fiber-Optic Manufacturer
10. ☐ Commercial TV Broadcasters
11. ☐ Cable TV Component Manufacturers
12. ☐ Cable TV Investors
13. ☐ Financial Institutions, Brokers & Consultants
14. ☐ Law Firm or Govt. Agencies
15. ☐ Program Producers, Distributors and Syndicators
16. ☐ Advertising Agencies
17. ☐ Educational TV Stations, Schools and Libraries
18. ☐ Other (please specify)

_____

C. Please check the category that best describes your job title: (check only one)
19. ☐ Corporate Management
20. ☐ Management
21. ☐ Programming

Technical/Engineering
22. ☐ Vice President
23. ☐ Director
24. ☐ Manager
25. ☐ Engineer
26. ☐ Technician
27. ☐ Installer
28. ☐ Sales
29. ☐ Marketing
30. ☐ Other (please specify)

_____

D. Which one of the following best describes your involvement in the decision to purchase a product/service? (check only one)
31. ☐ Recommend
32. ☐ Specify
33. ☐ Evaluate
34. ☐ Approve
35. ☐ Not involved

CALENDAR

March

3-5: CTAM Digital and Pay Per View Conference, New Orleans Marriott Hotel, New Orleans. Call (703) 549-4200.

4: Penn-Ohio SCTE Chapter technical seminar and testing session, Sheraton North Inn, Pittsburgh. Topic: "Digital Services." Broadband Communications Technician/Engineer certification examinations to be administered. Contact Marianne McClain, (412) 531-5710.

6: Penn-Ohio SCTE Chapter testing session, Butler, PA. BCT/E certification examinations to be administered. Contact Michael Giobbi, (724) 283-0925.

10-12: Northern California Vendor Show and Golf Outing, Hilton Hotel, Concord, CA. Contact Steve Allen, (916) 786-4353.

11: Ohio Valley SCTE Chapter vendor show, Holiday Inn East, Columbus, OH. Contact Gia Phelps, (606) 299-6288.

12: SCTE Satellite Tele-Seminar Program, Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Topic: "Introduction to Digital Technology (Part Two)." Contact SCTE national headquarters, Janene Martin, (610) 363-6888, ext. 220.

15-16: North Central Cable Television Association Convention and Trade Show, Hyatt Regency Hotel, Minneapolis. Contact Karen Stamos, (651) 641-0268.

17: Old Dominion SCTE Chapter annual Vendor Show and Cable-Tec Games, Richmond Hotel and Conference Center, Richmond, VA. Contact Maggie Fitzgerald, (540) 248-3400.

18: Dakota Territory SCTE Chapter technical seminar, Pierre, SD. Topic: "Category V Terminal Devices." Contact Tony Gauer, (605) 426-6140.

19: Piedmont SCTE Chapter technical seminar, Hickory, NC. Contact Mark Eagle, (919) 573-7083.

23-24: Digital Engineering Conference: The Consumer Electronics Future, Hasbrouck Heights, NJ. Call (703) 907-7660. CT

Planning Ahead

May 3-6: Women in Cable Telecommunications' National Management Conference, San Francisco Hilton Hotel and Towers, San Francisco. Call (888) 275-9428.

May 4: New York State Cable Show, Lake George, NY. BCT/E, Installer, Telephony and Service Technician certification examinations to be administered. Contact Steve Townsend at SCTE headquarters, (610) 363-6888.

May 25-28: SCTE Cable-Tec Expo '99, Orlando, FL. Call (610) 363-6888.

June 13-16: Cable '99, the National Cable Television Association's Annual Convention and International Exposition, Chicago. Contact the NCTA at (202) 775-3669.

June 22-24: International Conference on Consumer Electronics, Los Angeles. Contact Diane Williams, (716) 392-3862.

July 18–21: CTAM Marketing Summit '99, San Francisco Marriott Hotel, San Francisco. Call (703) 549-4200.

By John Clark

SCTE Standards: A Growing Mission for Cable

The wide deployment of new and exciting technologies holds great promise for both our industry and the consumer. Simplicity, ease of adoption and breadth of potential use will directly impact the successful introduction of these technologies.

The Society of Cable Telecommunications Engineers' role in the proposal, adoption and approval of cable industry standards is pivotal to advancing these opportunities. Members and staff involved in the standards development process are committed to hardware, software, and network reliability and interoperability.

Accreditation and due process

SCTE has been an American National Standards Institute accredited standards development organization (SDO) since Aug. 7, 1995. All standards development procedures conducted within SCTE are in compliance with the ANSI due process. In addition, SCTE standards have been approved as international standards by the International Telecommunications Union-Telecommunications.

SCTE publishes standards action announcements in its monthly magazine, *Interval*, as well as in other major trade journals in the telecommunications industries. The SCTE Standards Department maintains an open, fair and balanced process in all of its standards development meetings and continuously communicates with other standards developers under ANSI.

In the SCTE standards development process, all engineering committees concentrate on:

- Identifying and implementing plans
- Investigating the transition of network architecture, products and services from proprietary to public status
- Determining the types of activities for industry forums in the planning of products and services and exploring the need for new evaluations
- Evaluating the impact and timing relative to market availability
- Balloting and recommending coordinated practices for domestic and international applications

> "Special attention will be devoted to standards in the exploding realm of digital video and related areas."

Support leadership

The SCTE Engineering Committee is the Society's Standards Board, presently headed by Dan Pike, senior vice president of engineering at Prime Cable. Dr. Ted S. Woo, SCTE director of standards, coordinates the Society's standards development activities. The number of SDOs within SCTE has increased 200% compared to a year ago.

Latest standards activities

The SCTE Standards Board approved the following digital video standards for the cable industry at the end of last year:

- Home Digital Network Interface With Copyright Protection (DVS194) is designed to support cable services for high definition TV (HDTV) sets that interconnect audio or video devices on a common bus or network. The copyright protection is for network security.
- Home Digital Network Interface Without Copyright Protection (DVS195) is similar to the previous document except that the copyright protection is left out for organizations that prefer not to adopt it.
- Point-of-Deployment (POD) Module for Set-Top Boxes (DVS131 revision 8) is in compliance with the Federal Communications Commission's set of rules for commercial availability of navigation devices that was issued in July.

Future outlook

This year looks to be an even busier year in the Society's standards development area. Special attention will be devoted to standards in the exploding realm of digital video and related areas. We welcome your involvement and participation in this expansion.

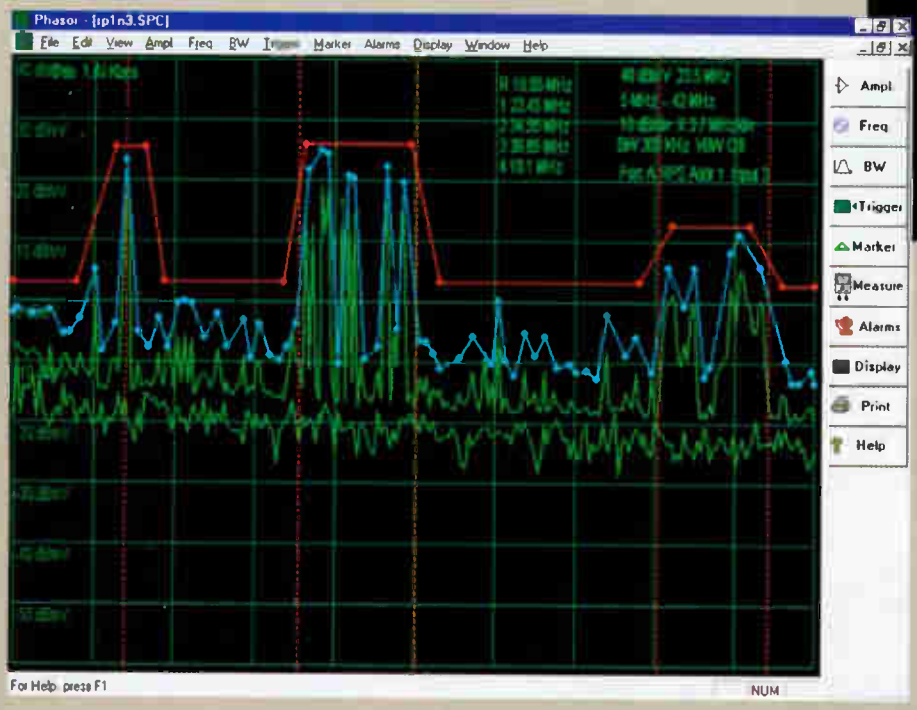
Delivering the promise

Our industry faces a unique opportunity to improve the lives of consumers through the introduction of valuable new technologies. An active and thorough standards development process will help ensure the speed, effectiveness and overall success of these efforts. CT

John Clark is president of the Society of Cable Telecommunications Engineers.

A MICROSECOND IMPULSE JUST INTERRUPTED YOUR RETURN PATH.

DID YOU CATCH IT?



...CHEETAH'S® NEW PHASOR™ SYSTEM DID.

Effective return path management starts with speed. Accordingly, Cheetah Technologies is proud to introduce the premier member of its Phasor System, the Phasor DSP-565™.

The Phasor DSP-565's detectors are fast enough to catch impulses other systems overlook entirely – events as short as 1 microsecond in duration. You'll never miss another meaningful event.

The Phasor System can analyze more than 500 spectral data points on a single node – from 5 to 42 MHz – in a 20 millisecond sweep. That's three times the resolution of competing systems, in similar sweep times.

As a result, the Phasor System can scan every node in your network more than three times per second. That's performance that puts Phasor in a class of its own.

This speed, combined with Cheetah's unique new DSP-IF™ technology opens previously unexplored worlds of digital signal processing flexibility. The Phasor System is the finest return path solution available.

For more information, call Cheetah Technologies at 941-756-6000, or e-mail phasor@cheetahtech.com

Reader Service Number 76

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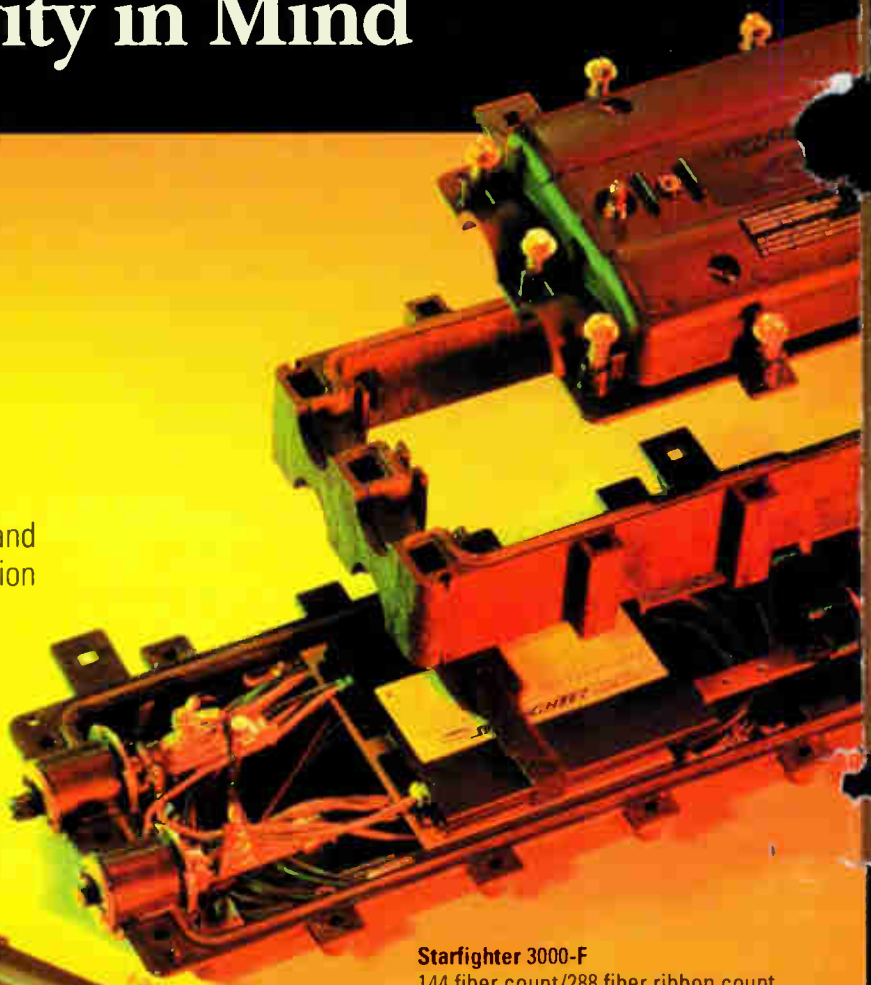
CHEETAH™ TECHNOLOGIES

Fiber Optic Splice Cases Designed with Productivity in Mind

STARFIGHTER™
Fiber Optic Splice Cases

- Easy assembly.
- Built to last the life of your network.
- Above ground aerial applications.
- All components included for assembly.
- The Starfighter family allows you to expand your system with minimal cost or disruption to existing fibers.
- All Starfighter splice case products meet or exceed Bellcore testing requirements.



Starfighter 3000-F
144 fiber count/288 fiber ribbon count
Starfighter 3000-CAK
288 fiber count/576 fiber ribbon count

Starfighter 2000-F
72 fiber count/144 fiber ribbon count

Starfighter 1120-F Minibutt™
24 fiber count/48 fiber ribbon count

For more Information contact:

Multilink™
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