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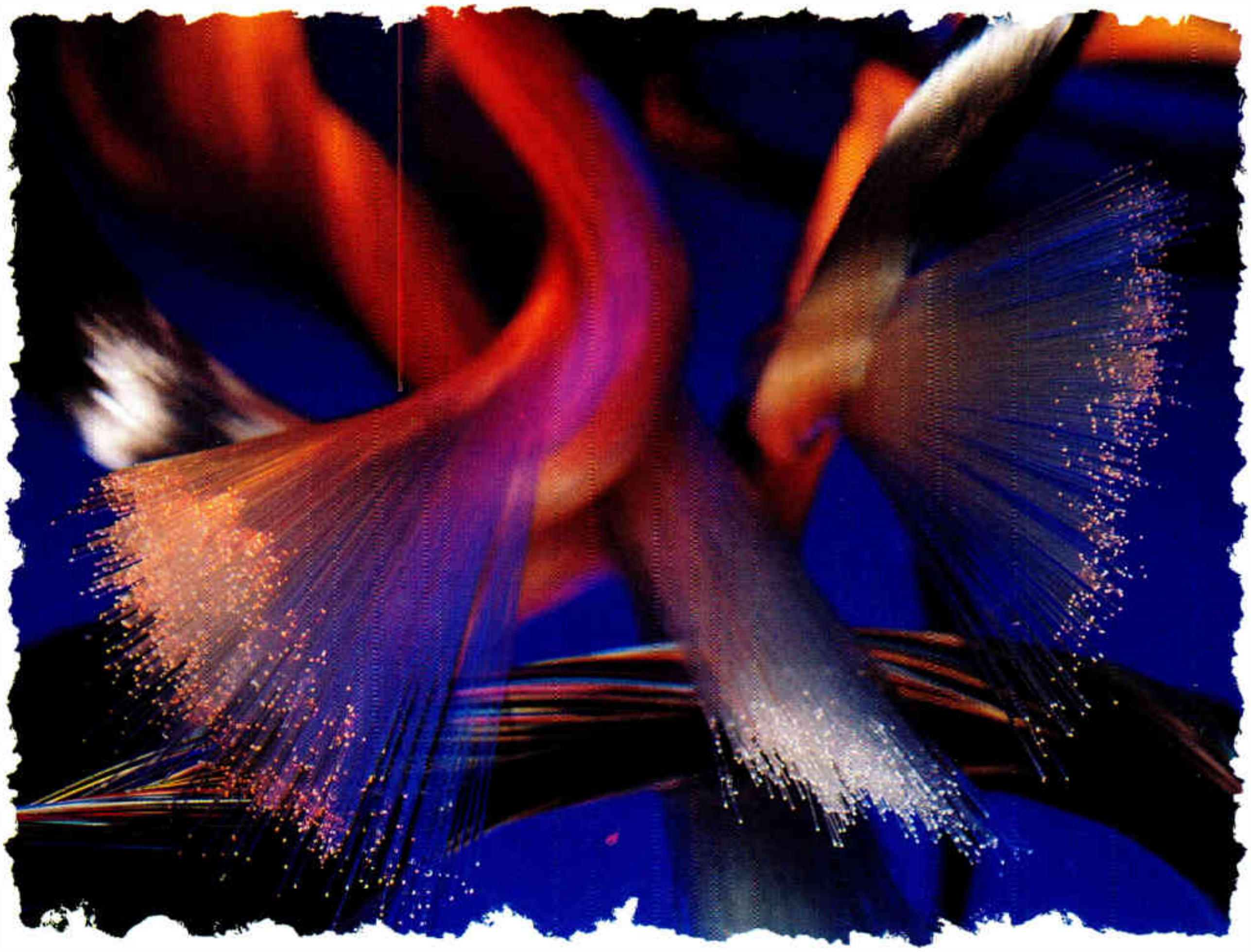
Official trade journal of the Society of Cable Telecommunications Engineers

High-speed data: Testing network capabilities

February 1997



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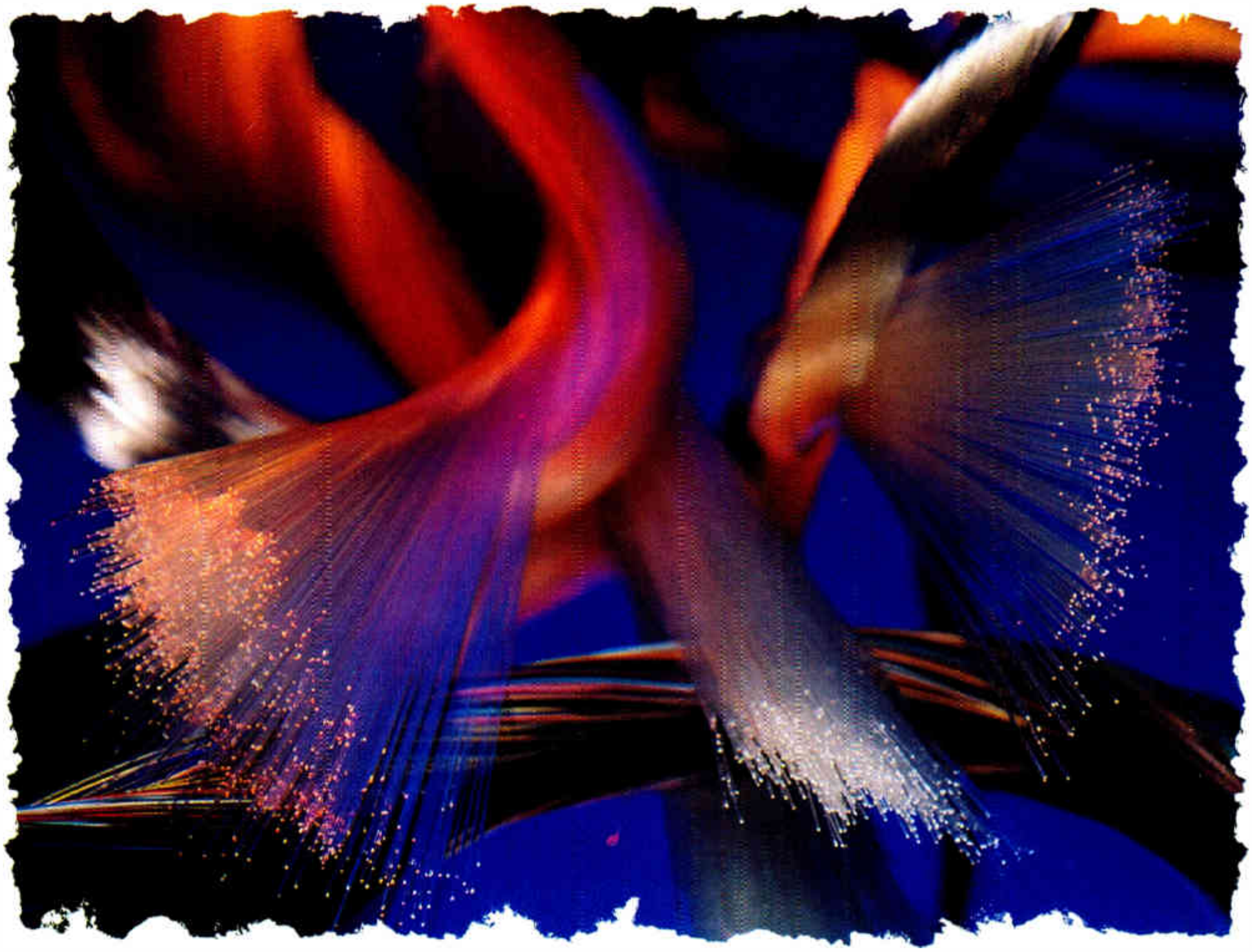

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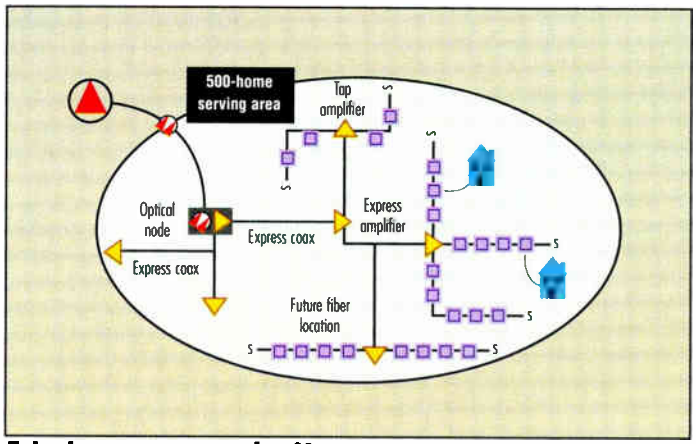
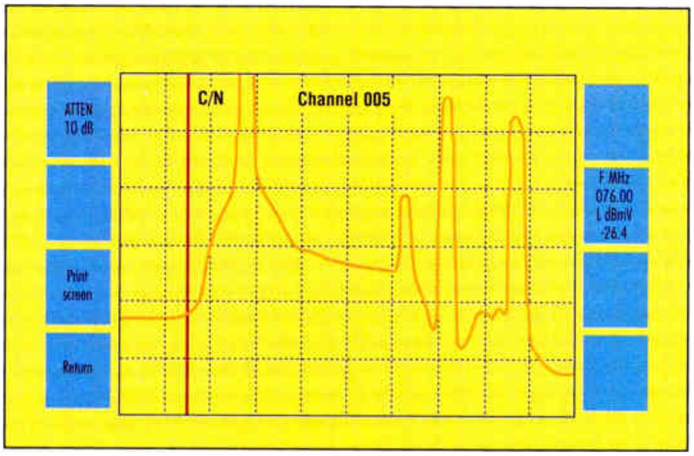
DEPARTMENTS





FEATURES

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Emerging Technologies

Talk about starting the new year with a bang! Last month we enjoyed the Society of Cable Telecommunications Engineers' best Conference on Emerging Technologies ever. The program subcommittee of Chiddix, Farmer, Langenberg, Pike, Riker, Semon, Smith and Werner presented an outstanding schedule of sessions. (For more details on ET '97, see page 42.)

Every session was of vital interest to communications engineers but I looked forward to "Empirical Data and Field Experiences," moderated by Pete Smith. I am now working out of an office at my home in Phoenix, AZ, so I was especially interested in papers presented on business experiences in residential data networks, integrated voice and data and the network operation and field experiences. By the way, while I'm talking about my new location, this would be a good opportunity to let you all know my new business phone number is (602) 807-8299 and my new fax number is (602) 807-8319. My new e-mail address is tvrex@coax.com.

Data discussions

I have been discussing national and global transmission of data with some of our engineers in the field. And, while I certainly see hybrid fiber/coax (HFC) networks as being the answer to regional transmission of data, I believe a land-based Internet will not serve the future of long-distance data delivery. The infrastructure providing this service will not function at the speeds we need. And why have high-speed cable modems when the present transmission system will slow delivery down to a crawl or a busy signal?

If the telcos are going to claim that overuse of their systems for data and Web browsing is overloading their capabilities, then such a combined HFC and satellite system makes sense. As surely as cable delivered television to people outside the contours of the broadcast stations, perhaps cable's future is to provide TV, computer and telephone service to the nation and the world. HFC networks and the Internet can provide that future.

I believe HFC networks will "cluster" data for a geographical area similar to a local area network (LAN). Any data transmitted out of that cluster, say from Phoenix to New York, will be uplinked to a low-orbit satellite and vice versa.

A few weeks ago, I purchased a copy of *The Road Ahead* by Bill Gates. Perhaps you have already read the original version. But this is a completely revised and up-to-date edition.

Gates must have similar ideas to those discussed in this column because he and Craig McCaw have invested in a company, Teledesic, which will launch a network of low-orbit ("435 miles up—50 times closer to earth than the geosynchronous") satellites for that purpose. And I think that will enable cable operators to realize the full potential of high-speed modems. If you don't have the most recent edition of Gates' book, you can find it at most bookstores, retailing for $15.95 and published by Penguin Books. It's a "must-read."

Well, it's home from ET '97 in Nashville, TN, and back out on the road again. Three shows are taking place this month: The Texas Show, OFC '97 and Satellite '97. It's going to be a great year for the communications industry!

Rex Porter
Editor

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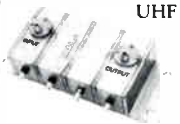

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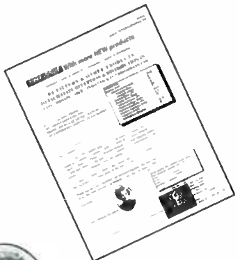

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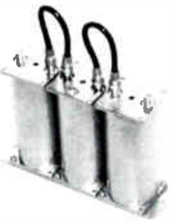

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Emily Bostick
President

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Industry develops data delivery specs

The Data Over Cable System Interface Specification working group announced at December's Western Show that it has developed a set of specifications aimed at gaining interoperable high-speed cable modems. The group is comprised of cable operators Comcast, Cox, TCI, Time Warner, Continental, Rogers as well as Cable Television Laboratories.

The specs include a radio frequency (RF) interface specification that was released last December to the 95 vendors that have signed the "Data Over Cable System Interface Specification Access Agreement."

Modems compliant with the spec will be capable of delivering data to users at a minimum rate of 27 million bits per second (Mbps). Hewlett-Packard, Bay Networks' LANcity Cable Modem Division and COM21 have all indicated interest in building interoperable modems that comply with this specification.

However, Motorola, a leader in cable modem shipments, announced it would make its own specs available to other manufacturers on a royalty-free basis.

MSOs shuffle telephony plans

Both Time Warner and TCI recently announced they were falling back on aggressive plans to roll out telephony to subscribers over their cable telecommunications networks. On the other hand, Cox Communications unveiled plans to launch switched residential and business services early this year.

TW said it will focus on offering telephony to its corporate customers rather than to residential cable subscribers. TCI announced it is simply putting the brakes on rollouts of telephony and Internet access in many of its systems.

Despite the fact that TW is dropping back on residential telephony, the MSO will continue to market the service in its Rochester, NY, system. That is currently its only hybrid fiber/coax (HFC) plant offering voice. Mike Luftman, spokesman for Time Warner, said that delays in implementing interconnection rules and regulations in many states warrants caution in telephony rollout.

Cox said it is including telephony right along with high-speed delivery in its two-way plans. At press time, the company was set to complete installation of three large switches (each able to serve up to 128,000 lines). Cox's two-way plans include plain old telephone (POTS) and DS-1, the 1.544 Mbps service, as well as integrated services digital network (ISDN). →

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GI splits into three entities

General Instrument Corp. announced a restructuring plan wherein the company will split into three separate entities: NextLevel Systems Inc., aimed at broadband technology; CommScope Inc., for the manufacture of cable; and General Semiconductor for making power semiconductors.

Communications Technology sister publication *CableFAX* reported that market analysts are hailing the move, saying it separates the high-growth broadband sector from the profitable but slower-growing cable and power units.

Vendors make moves into China

In an initiative to bring broadband voice, video and data communications to China, several cable telecommunications vendors are making business agreements in the country.

Motorola signed an agreement with the operating subsidiary of China's Ministry of Electronics Industry for the trial and supply of CableComm technology and CyberSURFR cable modems. Up to 10,000 cable access units and CyberSURFR cable modems are set for deployment and an additional 200,000 units will be shipped in 1998.

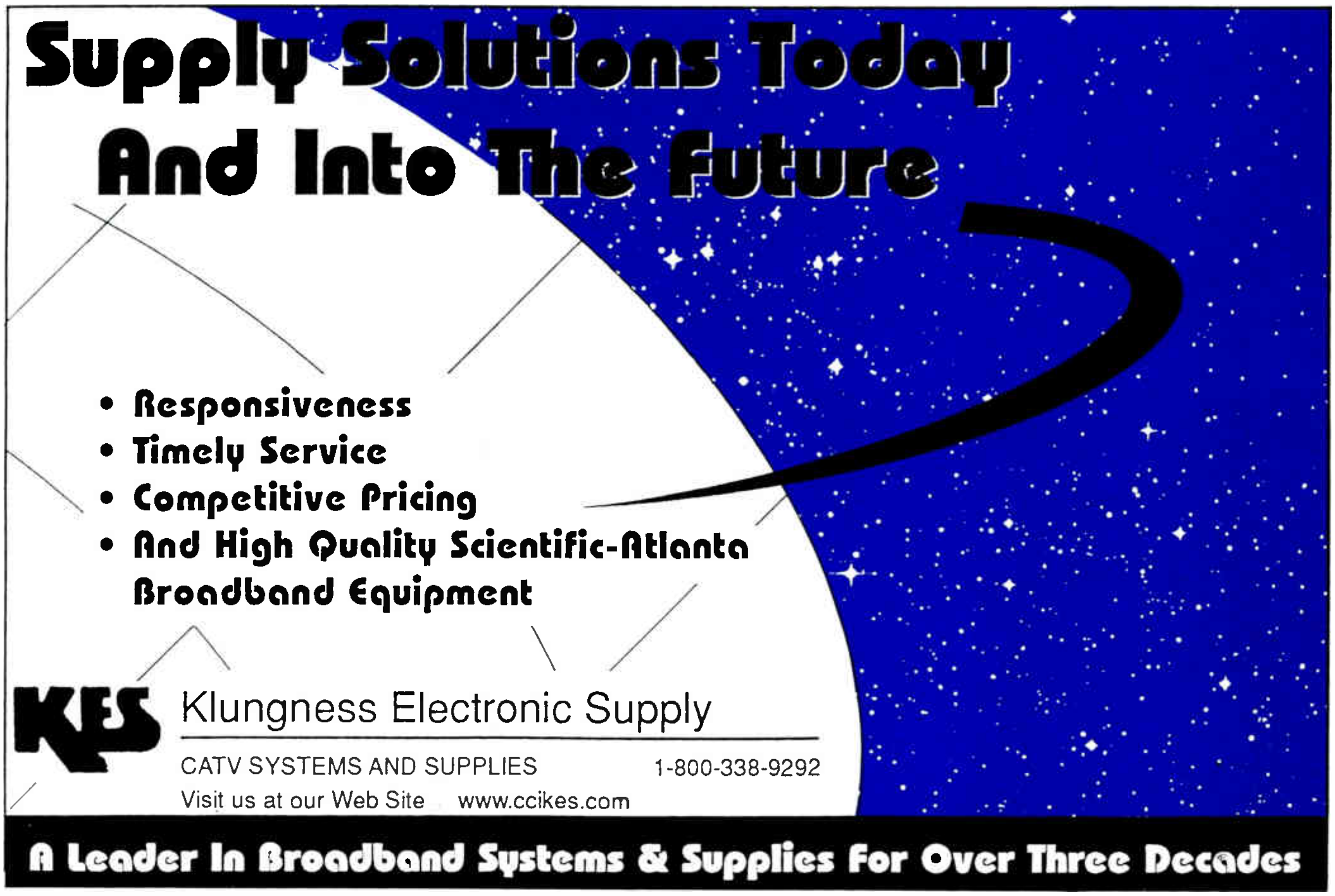
The CableComm system consists of both cable telephony and high-speed data technology. The cable telephony line allows for plain old telephone service (POTS) and other multimedia services over the hybrid fiber/coax (HFC) network. The CyberSURFR cable modem connects subscriber's personal computers to the high-speed cable TV infrastructure and offers speeds of up to 10 Mbps in the downstream path and an upstream data rate of up to 768 kbps.

In another move to help China develop its telecommunications network infrastructure, ADC Telecommunications will be distributing its fiber-optic cabling systems throughout China. As part of the agreement made between ADC and Nanjing Telecommunications Equipment Factory, NTEF will be the distributor for the marketing, sale and distribution of ADC's FL2000 fiber panel products.

ANSI approves first SCTE standard

The Society of Cable Telecommunications Engineers announced that the American National Standards Institute officially approved SCTE's first submitted standard, "F-Port (Female Outdoor) Physical Dimensions."

The standard was approved in late December 1996 after many months of editorial review and changes to refine and clarify the language detailing the standard. Two additional SCTE standards are presently scheduled for submission to ANSI: "Digital Video Transmission Standard for Cable Television" and "F-Port (Male Outdoor) Physical Dimensions." →



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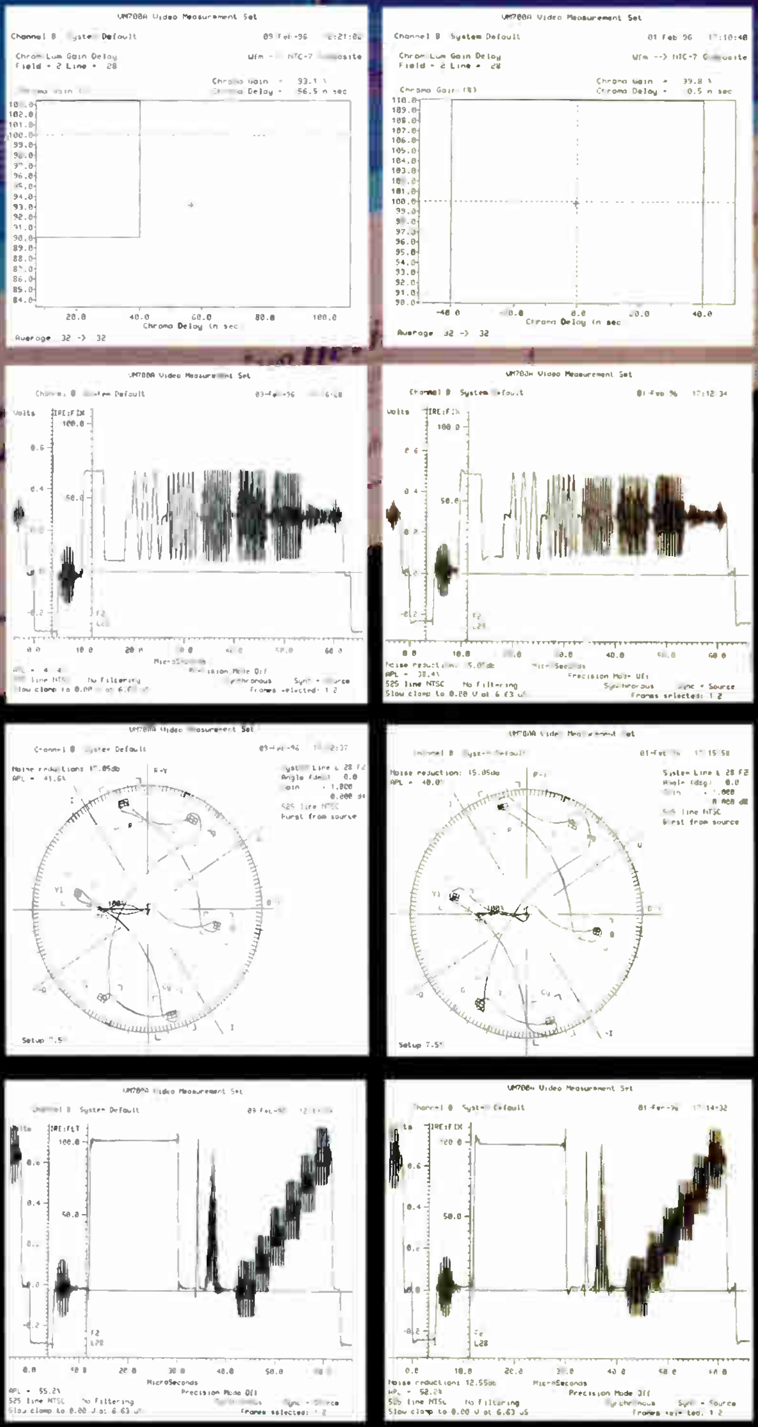

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Over the last year, the SCTE has been very active in the development of new standards for the cable telecommunications industry, jumping from 44 SCTE-developed standards in January 1996 to 80 by January 1997.

TCA Cable test: Telephony return

TCA Cable TV, in Tyler, TX, is set to begin tests on high-speed data delivery and cable modem performance using a telephony return path. Pending the trial's success, TCA will purchase 20,000 units over a two-year period for use in its systems throughout Texas, Arkansas and Louisiana. The modem selected for the trial is Scientific-Atlanta's dataXcellerator.

The unit operates over one-way plant using both a built-in analog 28.8/33.6 kbps telephone modem and the public telephone network for the reverse path. S-A will be providing status monitoring and remote network management through its Melbourne, FL, operations center.

NOTES

• **Time Warner** launched a new, free package to introduce high-speed cable modem technology to schools across the country. So far, 13,000 "Classroom Connections" kits have been distributed free to schools in areas served by the MSO, including Akron and Canton, OH.

• **Cox Communications** launched its @Home Networks high-speed Internet access service in Orange County, CA. The company has imminent plans to launch the service in other areas of that county as well as San Diego and Phoenix, AZ.

• **PowerTV** announced that Time Warner selected its operating system and Eagle multimedia hardware for its broadcast and two-way digital network solution (the Pegasus project). PowerTV technology will be incorporated into all digital set-tops supplied by **Scientific-Atlanta**, **Toshiba** and **Pioneer** to Time Warner.

• **Zenith Electronics** and **Network Computer Inc.**, a subsidiary of **Oracle Corp.**, joined forces to launch "a new generation of convergence products." Zenith plans to offer set-top boxes and integrated TV sets with interactive capabilities based on NCI's system software.

• **Stanford Telecommunications** was awarded a $1.5 million contract from **COM21** for cable TV return path modulator application-specific integrated circuits (ASICs) and receiver assemblies to be used in COM21's cable modem.

• **Alcatel** and **Hybrid Networks** announced an agreement wherein Alcatel will market, distribute and sell Hybrid's high-speed cable access systems worldwide.

• **Prime Cable** of Chicago is installing a two-zone 24-channel MPEG-2 digital ad insertion system from Channelmatic. The Prime Star Chicago system will be installed with a capacity to store 1,080 thirty-second commercials and will interface to a CCMS 20/20 traffic and billing system.

• **Marcus Cable** purchased **C-COR's** 862 MHz FlexNet amplifiers and FlexNode fiber nodes for a 3,500-mile HFC rebuild in its Fort Worth, TX, system. **CT**

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Members receive digital newsletter

Society of Cable Telecommunications Engineers members who attended Cable-Tec Expo '96 in Nashville received a copy of the premiere issue of a digital technology newsletter proposed by the Society called *DigiPoints*. The plan was to provide a new subscription service to SCTE members, allowing them to purchase this monthly newsletter that would provide information on the basics of digital theory, digital transmission technology and its applications in broadband telecommunications. Subscribers would receive a binder and, over the course of a year, 12 monthly issues (or chapters) to create an entire book on digital.

The availability of this new service from SCTE was publicized at Expo, directly to over 5,000 cable system managers and through ads that appeared in both technical and management trade magazines. This extensive promotional campaign on what the Society feels is a technology key to the industry's future generated wide interest.

Due to the interest generated, the training committee recommended to the board that this material be offered to all SCTE members free of charge by expanding the Society's monthly newsletter, *Interval*, to include *DigiPoints*. The Board's decision to proceed with this recommendation accomplishes two primary goals: 1) to provide technical training materials on digital technology; and 2) to bring the Society newsletter *Interval* to the next level of association-created newsletters, which is to contain technical information as well as Society news and information.

This act of goodwill toward the Society's members *and the industry* is one of SCTE's strongest training initiatives to date. With approval by the national board of directors and financial support in place in the 1997 budget, the first "chapter" of *DigiPoints* was included in the November/December 1996 issue of *Interval*. Subsequent chapters will follow in each *Interval* and continue through the 12-chapter series. At the conclusion of the series, the material also will be compiled into a hard-bound book and made available for purchase. "I am pleased to announce this new technical training program exclusively for SCTE members," stated SCTE president Bill Riker. "I urge them to read each installment as it arrives and take a moment to share *Interval* with their coworkers."

'97 election packages mailed

Election packages containing voting information on candidates for the seven open positions on the Society's national board of directors were mailed to all active national members in January. National members can elect two at-large directors to the board, while members in five SCTE regions will vote for directors to represent their areas. The nominations subcommittee submitted the following names to be placed on the 1997 ballot:

- **At-Large:** Nick Hamilton-Piercy, Rogers Cablesystems; Rob Marshall, Mid-America CATV Association; Pete Morse, Cable Technologies International; Andy Scott, National Cable Television Association; and Wendell Woody, Sprint North Supply.
- **Region 1:** Patrick O'Hare, TCI National Division; and Ralph Patterson, Patterson Communications.
- **Region 2:** Steve Johnson, Time Warner Cable; and Alan Babcock, TCI Cablevision.
- **Region 6:** Randy Cicatello, Warner Cable; and Robert Schaeffer, Technology Partners.
- **Region 9:** Jim Ludington,

INT2-Internetwork Integration Inc.; and Hugh McCarley, Cox Communications Inc.

• **Region 11:** Bernie Czarnecki, Cablemasters; and Dennis Quinter, Time Warner Cable.

Members also can add "write-in" votes. Election packages should arrive to members by mid-February, and all completed ballots must be postmarked no later than March 15. Enclosed in this year's election package is a survey developed by the SCTE national headquarters staff. If active members do not receive a package by mid-February, please contact SCTE national headquarters at (610) 363-6888.

Nominations open for 1997 awards

The Society seeks nominations for its 1997 Member of the Year Award. Presented each year at Cable-Tec Expo, this award is given by the SCTE board of directors to recognize a member for outstanding contributions to the goals and purposes of the Society. All persons nominated for the award must be active members of the Society. Nominations must be received in writing by SCTE national headquarters no later than April 1, 1997. All nominations will be presented to the board of directors for consideration, and the selected person will receive a plaque recognizing this honor at the 1997 Cable-Tec Expo, June 4-7 in Orlando, FL.

Since its establishment in 1974, the SCTE Member of the Year Award has been presented to 22 individuals: Alan Babcock, 1996; James Haag, 1995; Wendell Woody, 1994; Bill Grant, 1993; Ron Wolfe, 1992; Steve Allen, 1991; Richard Covell, 1990; Paul Beeman, 1989; Mike Aloisi, 1988; Rex Porter, 1987; Sally Kinsman, 1986; Pete Petrovich, 1985; David Franklin, 1984; John Kurpinski, 1983; Clifford Paul, 1982; Yves Fortier, 1981; Thomas Polis, 1980; Kenneth Gunter and Ralph Haimowitz, 1979; James Grabenstein, 1978; Frank Bias, 1977; Glenn Chambers, 1976; James Collins, 1975; and Steven Doudourfis, 1974.

The Society also is accepting nominations and entries for other awards to be presented at Cable-Tec Expo '97:

• *Personal Achievement Award.* This recognizes technical personnel for outstanding job performance.

• *Field Operations Award.* This promotes technical tools and procedures used in the field to enhance the work performed by installers, technicians and linemen.

• *SCTE Hall of Fame.* This recognizes national SCTE members who have made extraordinary contributions to the professional development, ideals, goals and enhancements of the Society and the industry. **CT**

For further information on Member of the Year and other award programs, contact SCTE national headquarters at (610) 363-6888.

By Ron Hranac

Reverse path impulse noise

December's Western Cable Show was another success for the California Cable Television Association, and, I imagine, also for most of the attendees. My money's worth came from the opportunities I had to visit with a couple of industry colleagues about the subject of reverse path impulse noise.

When we discuss reverse path problems, it's usually in reference to ingress of signals such as shortwave broadcasts, citizens band (CB) radio, ham transmissions and the like. Upstream equipment alignment and operation is another important issue. But one impairment that has not been well understood is impulse noise. Fortunately, recent research by both CableLabs and some system operators is shedding light on what may be one of our most serious problems in two-way operation.

What is it?

Impulse noise can best be described as noise spikes of very short duration, say, from less than one microsecond to several microseconds. Impulse noise may be random in nature, or it can be related to power line frequencies and harmonics. It sometimes is confined to certain parts of the reverse spectrum, and sometimes it can occupy the entire spectrum. Extremely fast risetime, short duration pulses contain an incredible amount of broadband energy. If its amplitude is high enough, impulse noise will cause active device clipping, especially in return path lasers.

Unfortunately, traditional frequency-domain measurement instruments such as spectrum analyzers aren't capable of showing the true extent of impulse noise, due to risetime and sweep speed limitations. It's possible to see some of a system's impulse noise by leaving a spectrum analyzer in max hold for an extended period of time, and narrowband time domain measurements can be performed on some analyzers. Still, this kind of equipment doesn't always provide the complete impulse noise picture. More on this later.

"Recent research by both CableLabs and some system operators is shedding light on what may be one of our most serious problems in two-way operation."

Where does impulse noise come from? A few common sources include power line switching transients, neon signs, vehicle ignitions, hair dryers, vacuum cleaners, heating and air-conditioning thermostats, garbage disposals and other in-home electrical appliances, and most electric switches. Even turning a TV set on and off can generate impulse noise. (See this column in the July and August 1996 issues of *Communications Technology.*)

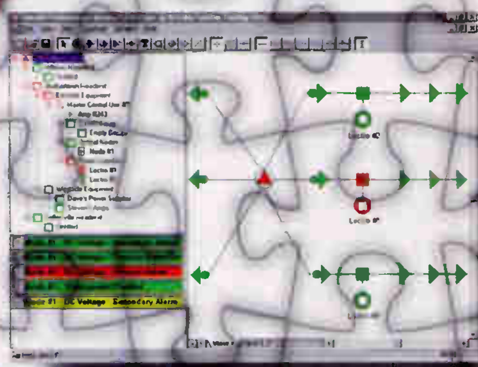
How does impulse get into a cable system's reverse path? Just about any place there is a breach in the network's shielding. This includes loose, corroded, or improperly installed connectors; damaged cable (i.e., cracked shield); insufficient cable shielding; open, loose or improperly torqued amplifier housing lids; loose passive devise faceplates; cheap drop passives; loose or corroded F-port terminators (locking or plain); and especially poorly shielded consumer devices such as TV sets, VCRs and FM tuners. It seems that a lot of the impulse noise and other transient phenomena are likely induced onto the cable shield's outer surface as common mode currents, and enter the network through any breach in shielding. The research I alluded to earlier continues to find that most impulse noise is getting in somewhere in the subscriber drop.

Two-way field tests

Back to my Western Show visits. The first was at the show's CableNet exhibit, a collaboration of CableLabs, the California Cable Television Association, and several vendors. This exhibit—a regular part of the Western Show for the past few years—features working examples of cable modems, cable telephony and other advanced technologies. Among other things, attendees can access the Internet with high-speed cable modems, or see comparisons of conventional 28.8 kbps telephone modems, integrated services digital network (ISDN), and 10 Mbps cable modems downloading the same graphics intensive Web page. When I stopped by CableLabs' portion of the exhibit, I had an interesting and informative chat with Tom Williams, senior member of CableLabs' technical staff.

The first thing Williams showed me was a draft copy of a CableLabs document that as of this writing was scheduled to be published in January. The document, "Characterization of Upstream Transient Impairments on Cable Television Systems," contains the results of several field tests conducted in operating two-way

Ron Hranac is senior vice president, engineering, for Denver-based consulting firm Coaxial International. He also is senior technical editor for "Communications Technology."



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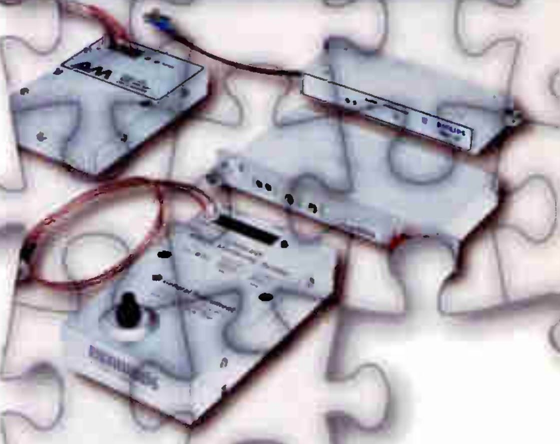

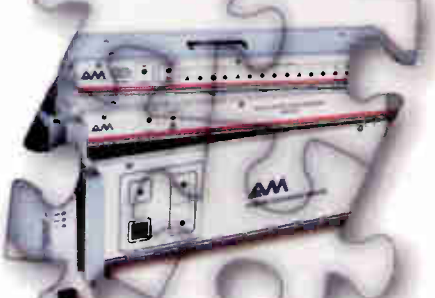

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systems. Using a CableLabs-developed device known as a CW Tester, transient impairments (e.g., impulse noise, RF ingress, signal clipping) were captured and analyzed. A good explanation of the CW Tester's theory of operation can be found in the 1996 National Cable Television Association paper "Analysis of Two-Way Cable System Transient Impairments," by Richard S. Prodan, Majid Chelehmal and Tom Williams.

The CW Tester counts the number of transient events in a specified period of time, and provides the approximate symbol error rate (SER), percent unavailability relative to a threshold such as 1×10^{-5} SER, and carrier-to-noise (C/N) and automatic gain control (AGC) measurements. Because of the CW Tester's design, it's capable of capturing events that may be too fast for more traditional spectrum analyzers or bit error rate (BER) testers.

In one system, a node was tested that had no subscriber drops connected. Over one 24-hour period, 89 transient events were counted. The SER was approximately 1×10^{-6}, and the unavailability relative to a 1×10^{-5} SER threshold was 0.06%. At the other extreme, a node in another system (with subscriber drops connected) typically had 1,000 to 2,000 or more transient events per 24-hour period. The SER was approximately 2.5×10^{-3}, and the unavailability relative to a 1×10^{-5} SER threshold was 4%. Ouch! CableLabs found that some systems are better than others, and not all systems have significant problems with transient events. But in those that do, the transient events can sometimes be serious enough to cause clipping in return path lasers. This can cause data throughput to fall dramatically.

My second Western Show visit was with Tom Staniec, director, network engineering of The Excalibur Group, a Time Warner Co. We discussed his article "Return Systems 102" that appeared in the December 1996 issue of *CED* magazine. Staniec found similar variations in two-way system performance. In one case, a node had nearly 7,000 transient events in a 24-hour period, approximately 1×10^{-3} SER, and an unavailability of 30%. (This is not a typo.) Big ouch! Many of the transient events were significant enough to cause return path laser clipping. Again, drops were found to be the source of most of the problems.

Impulse pay-per-view (IPPV) converters also were found to be the source of laser clipping when the converters' upstream carrier amplitudes were excessive. If laser clipping is severe enough, even robust data modulation schemes may not be enough to overcome it.

Making two-way work

So, how can you make two-way work reliably? Mostly by practicing what I've been preaching in these pages: Proper downstream and upstream and upstream network alignment; good drop practices; high quality drop materials; high pass filters (According to Staniec, the 40 dB filters are good enough. Be careful with windowed filters. They can still let enough impulse noise through to clip lasers.); no measurable signal leakage (If you simply meet the FCC's 20 µV/m downstream leakage spec, you can probably forget about upstream operations); and use common mode chokes made by coiling the cable at the input to all in-home devices. (See this column in the August 1996 issue of *Communications Technology.*) In other words, keep the coax plant real tight.

Another area that is very important has to do with upstream operating levels. They have to be set correctly, and not too close to the clipping threshold of reverse path electronics, especially lasers. This can be real tricky with complex data modulation schemes because data signals aren't easily measured with conventional test equipment. Furthermore, Staniec has found that reverse path operating headroom is not necessarily the same with regular video carriers or narrowband analog and/or data carriers as it is with wideband data signals. Quite simply, manufacturers need to do a better job of characterizing reverse laser performance and operating parameters, and we need to do a better job of measuring those signals.

These recommendations won't eliminate all two-way problems, but they certainly will help make two-way operation a little easier. As we learn more about the problems that can affect two-way networks, we still find that the problems are manageable, if we, as an industry, are willing to commit the necessary time and resources. **CT**

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Reader Service Number 19

By Justin J. Junkus

What is local number portability?

Would you like to keep the same phone number for life? And it wouldn't be just one of those special "dial 700" phone numbers that are an extra charge item and a separate dialing pattern.

How important is your phone number? People probably can't remember your street address, but your phone number is a permanent part of their memory system. Maybe it's not the number they remember. It could be the pattern on the touch tone pad. What about the auto dial function on your friend's phone? You're one button touch away from anyone who needs you, anytime.

Businesses have their identities even more embedded in the phone number than individuals. Customers memorize phone numbers. Business cards, stationery and all forms of paperwork are other examples of places where a change of phone numbers is expensive, time-consuming, and potentially confusing.

Most subscribers avoid changing numbers unless they move or have an area code change. The ability to choose between alternative local phone service providers has the potential for adding another reason to change your phone number. If you've studied telecommunications, you know that technology makes telephone numbers more than your phone's "address." They also are an inherent part of the way a call is routed through the public switched telephone network.

Portable alternatives

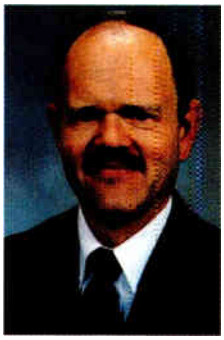
Fortunately, telecommunications technology also provides a solution that allows you to keep your phone identity, no matter whether you change telephone service providers or move. That solution is called local number portability (LNP). There are three types: service provider portability, location portability and service portability.

Service provider portability allows end users to keep their numbers when they change service providers. Obviously, this is a key benefit to service providers who are new entrants into the telephony business. For example, with service provider portability, a cable telephony company can sell potential new customers on a transparent move from the current phone company to their new service.

Location portability allows end users to keep their phone numbers after a geographic move. Although this sounds like a great idea, end users will need to balance local identity against a known phone number. In many cases today, companies opening new markets pay extra to have a local phone number indicating they are part of the local business community. When a business moves and takes its old number with it, local identity is no longer readily apparent to potential customers. They might view those first three digits of the seven-digit phone number as a red flag indicating the business is too remote to effectively service their needs.

Service portability means that end users should be able to change their service mix without needing a number change. This might come into play if the service provider's switching equipment were equipped to handle certain features on a limited basis. In the past, new features (such as digital lines) were often introduced on a phased basis, for groups of telephone numbers. Service providers can still implement features on a phased basis. Service portability, however, would ensure that any changes required for an end user to keep features on a move or change of providers would be the service provider's concern, not the end user's.

Congress made LNP a part of the Telecommunications Act of 1996 to foster competition. In addition, the Federal Communications Commission has an ongoing proceeding on LNP called CC Docket 96-115. As part of the Commission's activity in this area, in June 1996, it set December 31, 1998, as the required implementation date for service provider portability in the top 100 metropolitan serving areas. After December 1998, local exchange companies outside the top 10 metropolitan serving areas will be required to provide LNP upon request within six months.



Implementation

There are a number of technical ways to implement LNP, which we will discuss later. The FCC, however, didn't specify any particular technology in its requirements. Instead, it adopted the following performance criteria: support existing services and capabilities; efficiently use numbering resources; do not require end users to change phone numbers to gain portability; do not require carriers to rely on the data bases of other carriers to route calls; no service degradation or loss of reliability is permitted when portability is implemented; all implementations must be open interfaces, such that no carrier has a proprietary solution; both location and service portability must be accommodated in the future; and there can be no adverse impacts on outside areas where LNP is deployed.

Wireless service providers must deliver calls from their networks to ported numbers anywhere in the United States by December 31, 1998, and have service provider portability by June 30, 1999.

Interim solutions for providing LNP have been implemented in trials and early service offerings. Remote call forwarding (RCF) is one method of achieving LNP, but it has

Justin Junkus is president of KnowledgeLink Inc., a telecommunications consulting and training firm. He may be reached via e-mail at JJunkus@aol.com.

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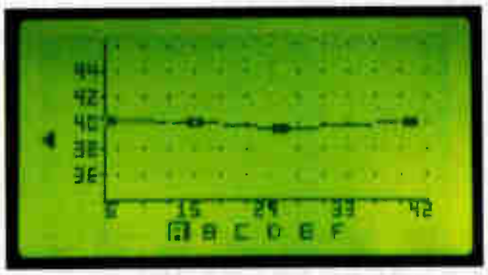

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at least three negative attributes that greatly diminish its value as a permanent solution.

First, RCF is essentially a call forwarding technology that requires two numbers to be dedicated to each ported end user. Calls to the old number are automatically forwarded to the new number. The new service provider must negotiate reimbursement for this capability with the incumbent service provider, and the capability is maintained by the incumbent. Secondly, many of the features associated with the line cannot be ported using RCF. Finally, operations and maintenance of ported lines is complicated and expensive.

Long-term implementations of LNP all involve the concept of call triggering and the use of a database search. Call triggering means that before a call can progress to the point of actual routing through the network, switches in the network must complete some other action. In the case of LNP, the other action is a search of a database to determine the routing for the call.

The actual database search may use one of two methods: single number domain or dual number domain. Single number domain solutions assign a routing number to ported telephone numbers to identify the correct carrier or telecommunications switch for the call. Dual number domain implementations assign an additional phone number to each ported subscriber, identifying their physical location.

The same arguments used against RCF regarding increased operations and maintenance apply to dual number domain implementations. For that reason, the telecommunications industry is moving toward single number domain solutions to LNP.

Federal advice

The location of the database, who controls it, and its maintenance are all important considerations. To avoid control of the system by any one service provider or vendor, third-party ownership and maintenance are essential. To ensure neutral ownership and maintenance of the database will occur, a federal advisory committee called the North American Numbering Council has been created. Within this committee, a working group called Local Number Portability Administration Selection is responsible for recommendations on the selection of LNP administrators, the national architecture of the databases, and the technical and operational requirements. The first meetings of this group occurred in late 1996.

Apart from the administrative considerations caused by LNP, there are a number of technical concerns involving network capacity and traffic management. Little actual field experience is available from early trials. What is apparent, however, is that with LNP, customers can frequently change service providers and with little advance notice. Network and switch planners will need to be increasingly aware of traffic patterns that are less predictable, and change often. Trunking between service provider switches, once relatively stable, will probably need to be evaluated frequently to avoid network blockages. Personnel with good backgrounds in traffic engineering will be even more essential to any service provider in an LNP environment. **CT**

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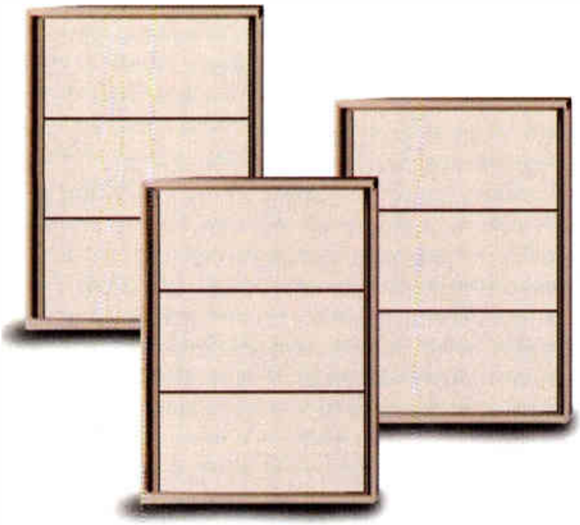

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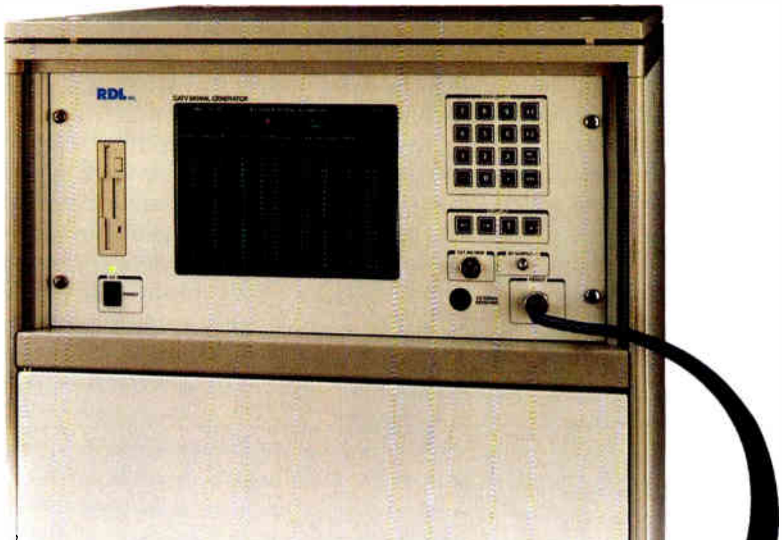

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Reader Service Number 80

By Kerry D. LaViolette and Eric J. Schnettler

Fiber in the HFC system

In this article, we'll look at techniques for aligning a return system and optimizing the return system's dynamic range. We'll investigate the applications for Fabry-Perot (F-P) and distributed feedback (DFB) lasers used in return transmitters in a cable environment. Our investigation of the hybrid fiber/coax (HFC) system includes independent performance testing of the radio frequency (RF) and fiber-optic sections of the system. In addition, we performed thermal cycling of the RF cascade over a temperature range from -40° to 60°C to determine the effects of thermal drift.

Kerry LaViolette is principle engineer and Eric Schnettler is engineering technician for Philips Broadband Networks, based in Manlius, NY.

We used a fully functional cable TV system for testing the performance of F-P and DFB lasers . The actual configuration of the tested cascade, shown in Figure 1, includes fiber links, five actives (each direction) and five cable spans. Both the forward and return systems were aligned for unity gain at ambient temperature. It should be noted that forward amplifiers numbered 1 through 4 provided 38 dB of gain at 750 MHz and that forward amplifiers numbered 5 and 6 provided 27 dB of gain at 750 MHz. Return amplifiers, capable of 24 dB of gain at 40 MHz, are integrated into each forward active. The system included an additional return amplifier that was terminated. This terminated amplifier was used to simulate the noise funneling of 50 return amplifiers in a typical tree-and-branch HFC network. This is a valid representation of the number of return amplifiers in a true cable return system.

For our test, the return system was loaded with a total of 21 quadrature phase shift keying (QPSK) data channels equally spaced from 5 to 40 MHz. Cable modems operating at T-1 rates provided the data channels used in the testing. One modem operating at 19 MHz was connected to an HP3784A bit error rate (BER) test set and was used to provide data that

Figure 1: Return system tested

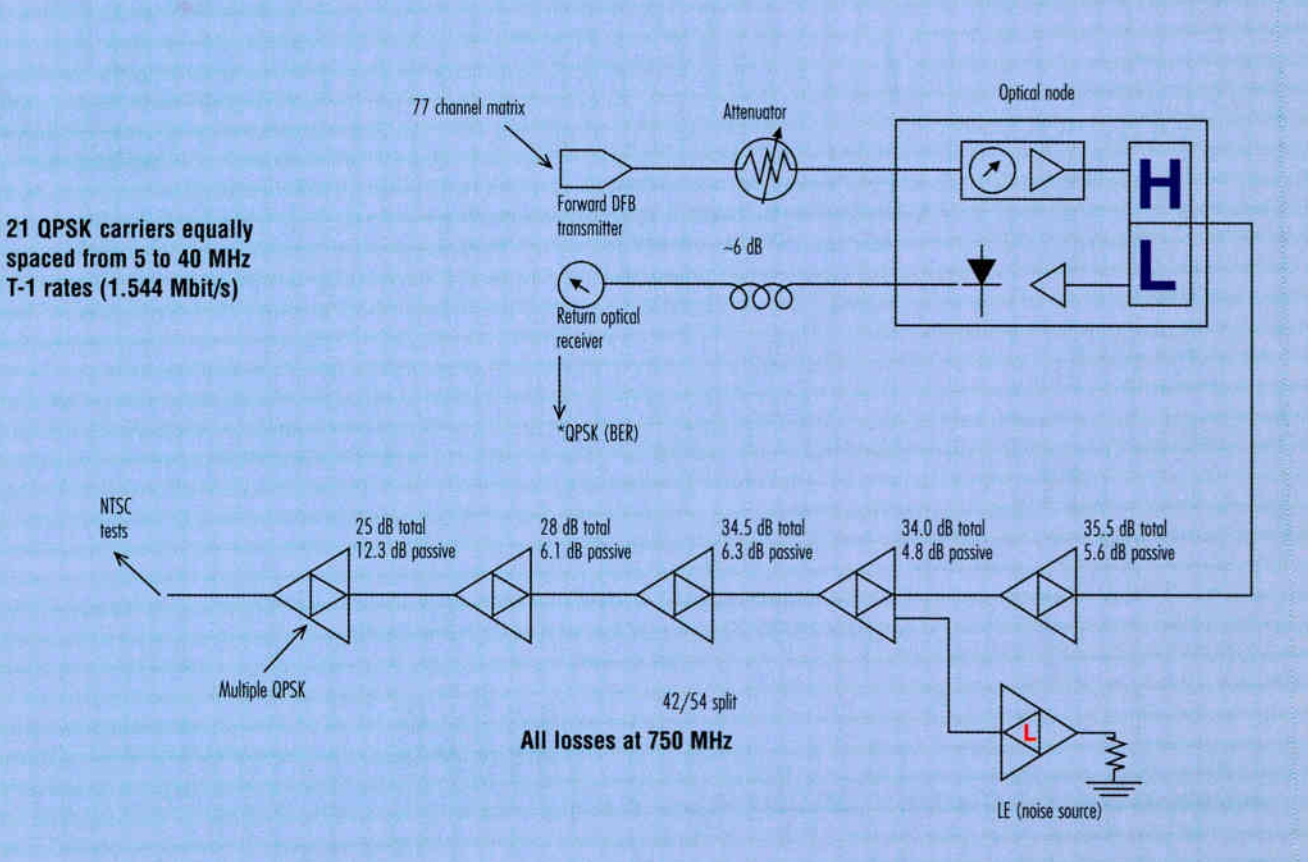
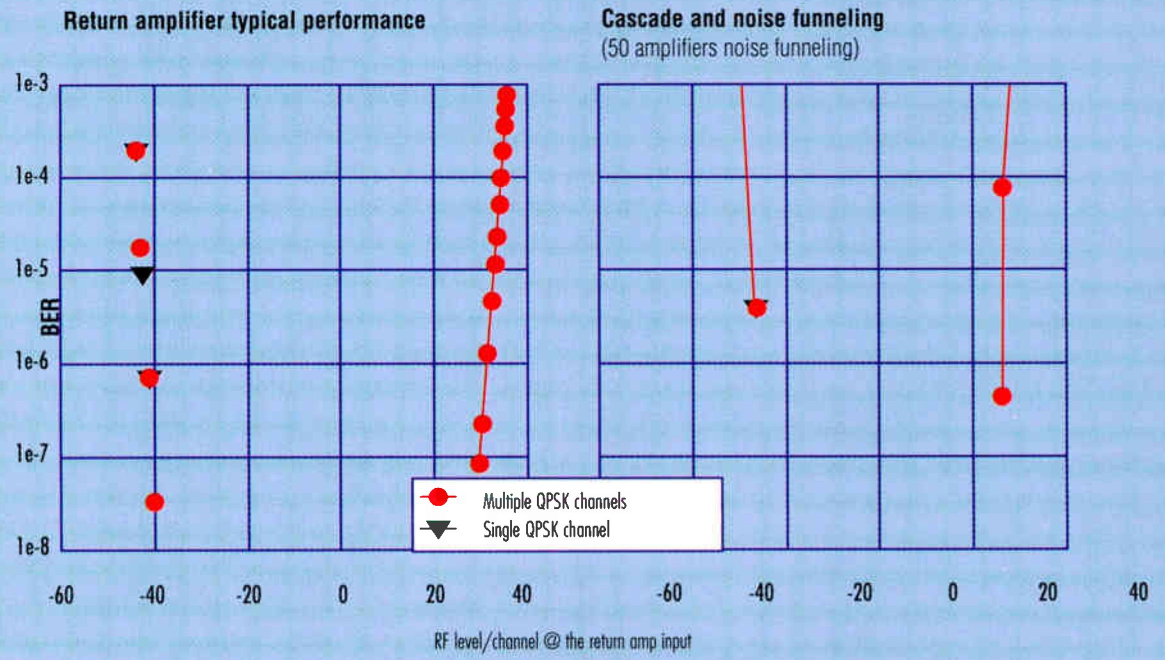


Figure 2: Return system RF amplifier performance



21 QSPK channels, 5 to 40 MHz spaced at 1.75 MHz, T-1 rate.Tested frequency 19 MHz.

was transmitted through the system. Performance of the system was measured by monitoring the BER as a function of RF level, both through the entire return system and through the fiber link individually. Both F-P and DFB lasers were used separately in the return transmitter to determine the laser's impact on the dynamic range performance of the system.

Noise funneling

Cable systems in the field are typically configured using a tree-and-branch architecture. Cascades of amplifiers branch out from the node in all directions to distribute the composite cable signal to subscribers. Typical cable amplifiers have up to three outputs allowing for additional "feeder" cascades. Upwards of 50 actives may be present in the cascades emanating from a single node and their thermal noise from each active "funnels" into the return RF system.

Dynamic signal nature

Through BER testing, it is possible to determine a return system dynamic range and select an optimum operating point. In an ideal situation, a return system would have a constant number of channels present and maintain constant signal level at all times. In reality, the loading of the return system depends on the number of users accessing the system. The total number of channels active in the return system at a given time varies considerably between peak and nonpeak periods. Because of this variation in channel loading, creating an automatic gain control (AGC) circuit that can properly maintain optimum RF power level into the return transmitter is difficult and cost-prohibitive. To properly set up a return system, the complete range of signal levels operating within the system must be considered.

Types of signals

Continuous wave (CW) carriers in the return band are used for system alignment. Once aligned, cable systems provide return bandwidth that is capable of supporting numerous modulated signal types. Amplitude shift key (ASK), frequency shift key (FSK) and QPSK digital modulated signals are all typical. Additional digital modulation schemes, such as 64-quadrature amplitude modulation (QAM), are expected to be introduced into the cable return system in the future. Combinations of digital and analog signals are common in today's return system. Typically, a separate fiber is dedicated in the return system for applications where video service, such as videoconferencing, is required.

Ingress

Ingress is the leakage of interfering RF signal energy into the cable distribution system. Typical sections of coaxial cable may have isolation values measuring well above 100 dB. Any given cable system may require hundreds of connections between all the coaxial components. As systems become more complex, the probability of the system having connections with diminished isolation becomes significant.

This situation is further compounded when the age of the system and thermal stress imposed on the system are taken into consideration. Amateur and FM radio, over-the-air TV, air traffic control and other forms of wireless communication are sources of RF signal that are present in the cable environment. These signals can leak into the cable system and reduce its overall performance.

Environment and signal level

Cable systems may have portions of coaxial cabling and fiber links residing underground as well as above ground. The underground portion of any system remains in a thermally stable environment. It is accepted that the ground temperature, at depths below the frost line, remains constant within a small window of variation for most geographical locations. The coaxial portion of a system installed above ground, however, can experience significant thermal variation over a given year.

Coaxial cable is a combination of aluminum, PTFE (Teflon) and copper, all of which have thermal coefficients of expansion. Individual sections of coaxial cable used in a cable system can experience upwards of 4 dB of change in insertion loss because of thermal changes alone. Because of the thermal variations in cable systems, it is necessary to develop AGC circuitry that can provide "constant" signal levels for all thermal changes.

AGC circuitry was installed to stabilize the forward portion of our cable system. Our return system contained no AGC circuitry and was allowed to drift with temperature during the collection of data presented in this article. In our return system, levels measured at the input to the return transmitter varied by 13 dB over a temperature range of -40° to 60°C.

Fiber portion of return

Short optical links are well suited for applications such as narrowcasting. In this cable architecture, noise caused by the optical transmitter dominates in the system. Telephony and home security systems typically take place over long optical links. In these cases, noise generated in the receiver dominates in the system. Typical cable return links range in optical length from 2-6 dB. At 1,310 nm this translates to short links of 6-18 km. This is significantly shorter than interactive return communication taking place over telephone lines.

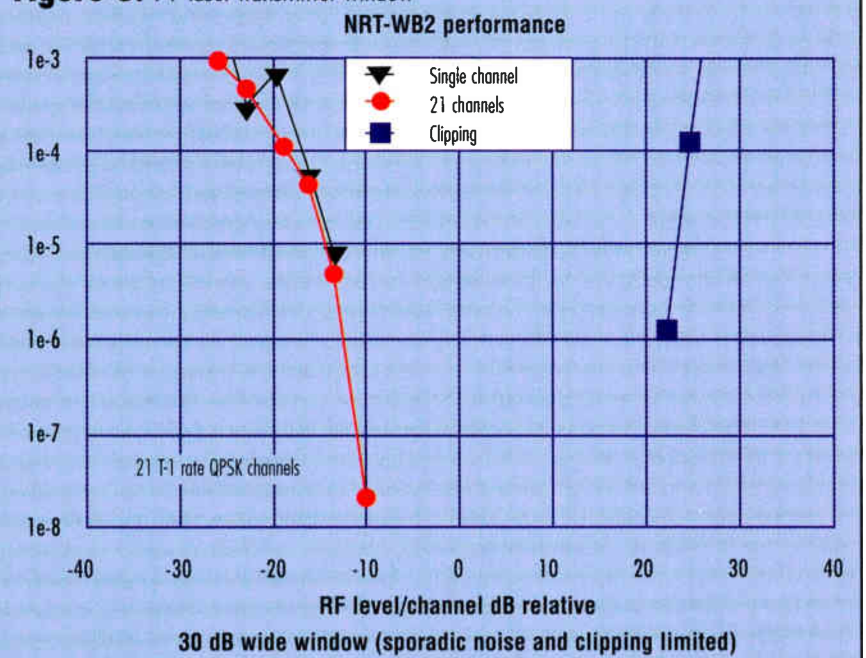
The F-P and DFB lasers in return transmitters have usable bandwidth out to 200 MHz, while typical cable return systems require bandwidth out to only 50 MHz. Cable operators have the option of upconverting individual return paths, so they can fill the entire return bandwidth provided by the return transmitter. Upconversion of the return paths allows for more efficient use of usable bandwidth with minimum additional cost. Four transmitter/receiver combinations, each operating from 5-40 MHz, can be replaced by one transmitter/receiver combination in conjunction with an upconverter operating across the entire 200 MHz bandwidth. Improvement in reliability caused by the reduction in the number of actives in the return path is an additional benefit of upconversion.

Dynamic signal load

The total RF power present at the input to the return transmitter is not constant. Ultimately, the number of subscribers actively using the return system determines the total RF power present at the input to the return transmitter. In a cable return system, the composite signal seen by the return transmitter can vary from a level consisting entirely of noise where no return signals are present, to that of clipping where multiple subscribers provide a composite RF signal high enough to drive the F-P or DFB laser into compression.

The level of activity in the return system also will be a variable over time. Telephone companies are aware of the variable nature of telephone traffic. They have documented system traffic for peak and off-peak times, for daily hours and for annual holidays. System designers need to understand the variable nature of the return system demand and how this will impact the overall system design. Designers also have to allow for this when the return system is configured. Operating levels for gateways, modems and other return system signals have to be selected so the system will function at both high- and low-traffic times.

Figure 3: F-P laser transmitter window



Ingress effects

Ingress manifests itself as a variable signal in both event duration and event power. System designers are tasked with designing the cable system such that the return operates at a level higher than that of ingress events, yet not so high that thermal variations coupled with ingress events push the return transmitter into compression. Determining the proper RF levels for the return system is a complex problem for systems designers. It requires intimate knowledge of the return system itself, the environment in which it will be operating, the activity of the users within the system, the devices connecting to the system and the dynamic range of the return system.

F-P lasers

F-P laser technology offers several advantages in cable return transmitter applications. The cost of an

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F-P laser is minimal because construction requires no optical isolator and no thermal-electric cooler. Operational characteristics of F-P lasers in return systems have demonstrated fully acceptable performance levels for transmission of CW carriers as well as digitally modulated signals.

There are some disadvantages in using F-P lasers, as well. F-P lasers are subject to sporadic noise events. F-P lasers, having no optical isolators, are subject to feedback from the fiber. This feedback allows the F-P laser to enter a quasi-chaotic state where random bursts of energy elevate the noise floor. Measured at the receiver, these sporadic noise events mimic ingress bursts across the band.

DFB lasers

Traditionally, DFB laser technology has been used for forward system signal transmissions. Only recently have DFB lasers found applications in return systems. DFB lasers offer some advantages over F-P lasers. With optical isolators and better relative intensity noise (RIN) characteristics, DFBs have improved performance over F-P lasers when multiple CW signals are required in the return system. DFB lasers also are subject to sporadic noise events, even though they have an optical isolator to reduce feedback from the fiber.

There also are some disadvantages in using DFB lasers. DFBs are significantly more expensive than F-P lasers. The optical isolator alone adds over $1,000 to the cost of the DFB. Performance improvement provided by DFB lasers is minimal. Few applications truly require the performance of a return DFB when the cost is taken into consideration.

Testing results

• *Definition of operating window (QPSK).* The dynamic range of an HFC return system is determined by measuring the BER through the system as a function of optical modulation index (OMI) or equivalent input level/channel. For relatively low OMI, bit errors increase because of a number of factors, including both white noise and sporadic noise. Either noise can dominate, depending on the specific system setup. At the other extreme, high input (large OMI) causes system components to either compress (amplifiers) or clip (lasers). The resultant distortion shows up as bit errors limiting the maximum input to the system. For our purposes, the operating window is defined as the input level in which the BER is below 1×10^{-8}.

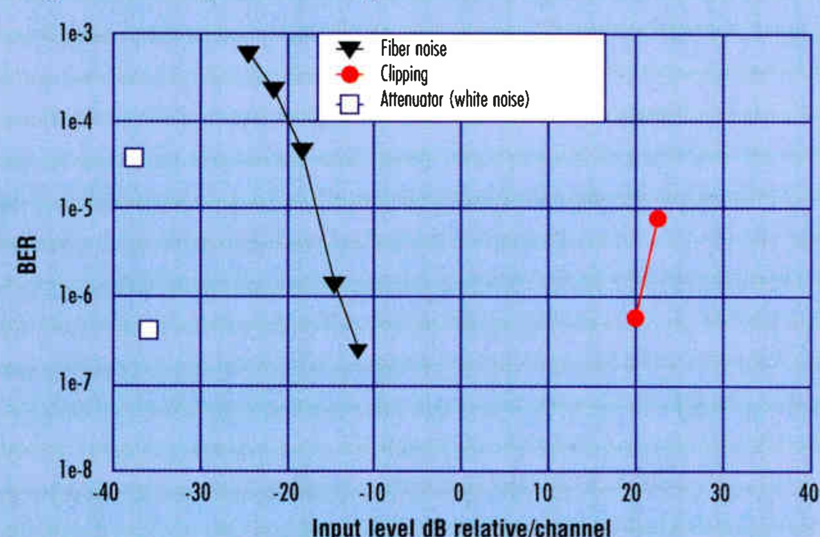
• *RF window.* We performed bit error testing for the entire system as well as the RF cascade alone. Determining the dynamic range of the RF cascade alone was performed by supplying the pseudo-random data to the input of the return system and measuring the BER at the input to the return transmitter. A dynamic range of 45 dB was demonstrated for the RF cascade over a temperature range of -40° to 60°C. Dynamic range of the RF system could be improved by adding thermal compensation. Thermal pads have been installed and additional testing is expected in the future to determine the maximum dynamic range for the RF cascade. (See Figure 2 on page 27.)

• *F-P window.* BER testing of the F-P return transmitter demonstrated a dynamic range of 30 dB over the tested temperature range. Limitations on the dynamic range for the F-P laser are caused by both the sporadic noise characteristics of the laser at low level inputs and clipping, or saturating, at high level inputs. The sporadic noise event becomes the dominant source of bit errors for low level RF inputs to the transmitter. The RF level, which drives the transmitter into compression or clipping, determines the upper limit for BER. The lack of thermal compensation in the RF cascade limited the dynamic range of the complete return system. (See Figure 3 on page 28.)

• *DFB window.* BER testing of the DFB return transmitter demonstrated a dynamic range of 40 dB over the tested temperature range. Limitations for the DFB return laser are similar to that of the F-P laser. Sporadic noise events in DFB lasers still occur but are reduced to some extent because of the isolation between the fiber and the laser's output. The optical isolator required by the DFB laser's design causes this performance improvement. The upper limit of the BER window is still limited by the absolute level that causes the laser to clip and is similar to that of the F-P laser. (See Figure 4.)

• *DFB vs. F-P results (QPSK and beyond).* As the return cable system is filled with data, an increasing demand will be placed on the performance of the return transmitter's laser. We have demonstrated that cable return systems can be made functional using both F-P and DFB laser technology. Considerations given to the type of data within the system and to the environment in which the system operates must be made when determining the correct laser for the return transmitter. For some applications, the 10 dB improvement in the dynamic range of the system, which is realized by using the DFB over the F-P laser, is required. The cost differential between the F-P and DFB lasers is substantial and also will be part of the system design consideration. **CT**

Figure 4: BER performance of typical uncooled isolated DFB for HFC return



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Reader Service Number 128

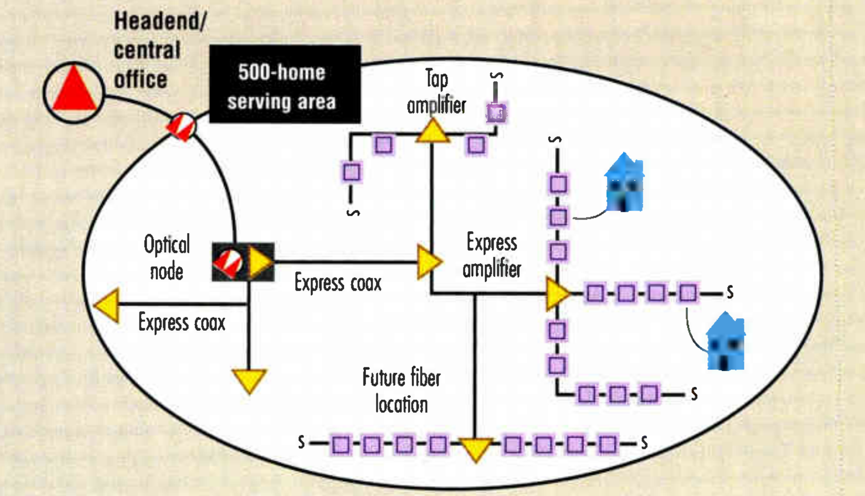
By Paul Pishal

Using a telephony return path

A logical first step in implementing two-way services is to evaluate cable modems since they require little infrastructure, generate significant income and have huge potential subscriber penetration. Interim cable modem solutions exist that use the customer's telephone line for the return path. They are a powerful way for service providers to enter the Internet access market in the near future.

Eventually, the engineering and operational challenges of the cable network's return path must be overcome in order to launch bandwidth-rich, two-way services. The key to a robust two-way network is to achieve reliable and rugged operations that optimize power and bandwidth efficiency.

Figure 1: HFC deployment architectures coaxial distribution



Today's network

The deployment of two-way hybrid fiber/coax (HFC) networks is still in its infancy in the United States, with less than 20% of current cable plant two-way enabled. Though the technology for transmitting signals from the home (upstream) has existed for some time, a marketplace for services that utilize this capability have yet to be developed. However, demand for better Internet access, telecommunications deregulation and affordable digital modulation are now setting the stage for new services to be introduced.

Planning for two-way

Successfully implementing cable modems and other two-way services depends on four fundamental criteria:

- Having sufficient return bandwidth efficiency.
- Designing a reverse path to insure signal integrity.
- Managing ingress.
- Managing all reverse path services as a system.

Paul Pishal is director of technology systems planning for Scientific-Atlanta Inc.

Sufficient bandwidth efficiency

Traditional HFC designs have called for node sizes of 1,000 to 2,000 homes. With few services utilizing a return path, the 5 to 30 MHz shared by this number of homes has been sufficient. Anticipating two-way services, technology improvements increased the bandwidth to 5 to 40 MHz. Introducing cable modems and deploying other potential services, such as interactive digital TV and telephony, will quickly saturate this bandwidth. The solution is to match node size with service penetration and traffic expectations. (See the article in *Communications Technology's* October issue, "Reverse traffic considerations on HFC node size migration" by Tim Wilk.)

To deliver voice, video and data services, node sizes of 500 homes—with a migration path to 250 homes or less—has proven to match traffic needs with construction costs and return on investment. (See Figure 1.) Fiber can be deployed to even smaller node sizes, but construction and equipment costs are high and can make service delivery uncompetitive.

Signal integrity

The primary goal of reverse path design is to ensure that the carrier-to-noise ratio (C/N) received at the headend will be sufficient to support an acceptable bit error rate (BER) for the cable modem or other digital services. Reverse path design encompasses the coaxial feeds back from the homes (including home wiring), the reverse optical transmitters, the optical receivers and the cable demodulators. A layer of complexity is added by the fact that multiple services use multiple carriers—each having a differing spectral width and power level requirement.

Criteria for a reliable reverse path include coaxial system design, laser dynamics and multiple carrier implications.

Coaxial system design

The cable modem will coexist with other services that utilize the reverse path. Current reverse path design recommendations for equalizing the plant require all reverse carriers to arrive at equal power levels as they traverse back through the coaxial plant and on to the node for optical transmission back to the headend. Keeping the levels relatively constant with each other minimizes the impact of transmission signal distortions. (See Figure 2 on page 34.)

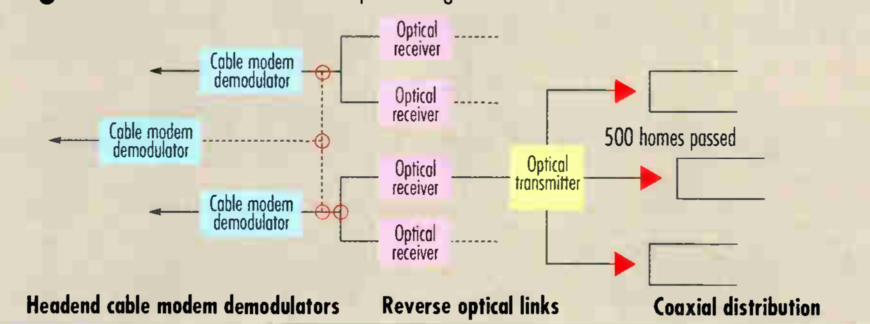
Transmitting the return signal at as high a level as possible has the

advantage of overcoming any noise and resultant signal impairments that exist on the return path. However, if the levels are too high, clipping can occur in upstream electronics, especially lasers. Cable modems, along with set-tops and cable telephony units, all have transmit power control. Since many of these new home devices also have auto output level adjustment, understanding how the plant is designed will insure the stability of this feedback mechanism.

Laser dynamics

Laser selection is based on dynamic range and the linearity of the optics over that dynamic range. With multiple subcarriers in the 5 to 40 MHz band, the resultant signal power of these carriers can drive the laser to clipping. The solution is to choose a modulation scheme that provides maximum BER efficiency without overdriving the laser. The return optical transmitter predominantly deployed today is a Fabry-Perot (F-P) laser. Its low cost makes it economically attractive to deploy. Cooled distributed feedback (DFB) lasers provide more dynamic properties than F-P lasers, but at a much higher cost.

Figure 2: Cable modem reverse path design



Multiple carriers

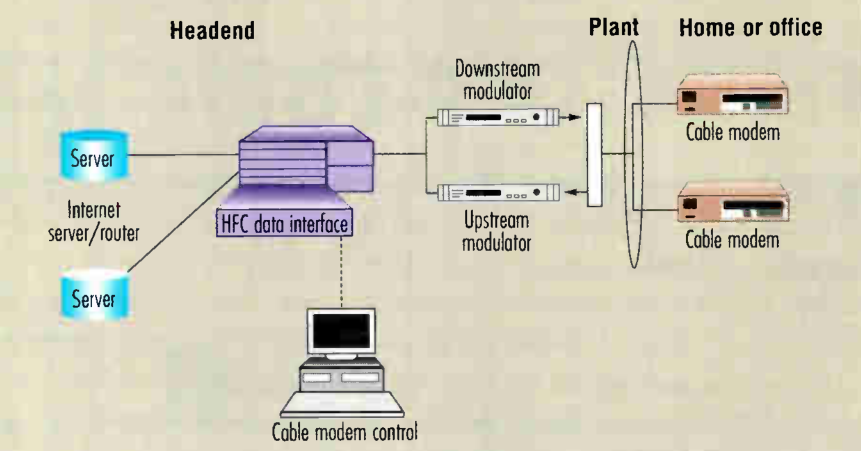
Until industry standards are established, the spectral width and power output of each manufacturer's two-way services will be developed independently of other manufacturers. Therefore, upstream carriers will vary in terms of power and bandwidth. Current methods for determining the impact of these carriers on the laser have some incorrect assumptions. Ideal carrier loading would suggest a spectrum of equal power per hertz. But this ideal expectation is difficult to achieve in an environment without system standards for upstream transmit levels, varying carrier bandwidth and varying reverse design.

Managing ingress

One of the major concerns of HFC is the incidence of ingress and its impact on the signal quality of all return services. Sources of ingress include two-way radio and shortwave transmissions, power line corona, motors, computer terminals and even cable TV terminal hardware. Noise can enter the coaxial plant at areas that are

poorly terminated or not properly shielded, or through devices connected to the plant itself. There have been numerous suggestions for minimizing the impact of ingress, but studies show that good housekeeping derives the greatest benefit. Proper cable terminations, shielding integrity and home wiring terminations all reduce ingress. Managing the customer's home wiring is the most problematic. Without direct home access to ensure drop integrity, some debatable alternatives may be installing signal filters at the tap.

Figure 3: High-speed information access



Managing the reverse

Identifying service problems and isolating their cause is not possible without network management. Network management ties the transmission path monitoring to the BER of the cable modem user, thereby sectionalizing problems as either transmission path-related or not. The complexity of new two-way services will continue to drive additional requirements for enhanced network management solutions. (See Figure 3.)

A revenue resource

Though the issues involved in activating a return path seem daunting, they can be addressed with careful network planning and management. But this takes time, of course. Eager to act now to satisfy strong consumer demand for high-speed Internet access, some service providers are considering not waiting on upgrades to their HFC plant with a reverse path. Instead, they are introducing cable modems that use the customer's telephone line as the reverse path, with a plan to migrate to an HFC return path as soon as appropriate. **CT**

By Adrian Jones

Focus on S-CDMA technology

An effective data-over-cable network must support both small- and large-scale cable TV architectures by strategic placement of cable modem termination systems, Internet protocol (IP) routers and other servers at both remote distribution hubs and centrally located headend systems. Equally important, the cable data network must be intelligently subnetted into one or more logical IP subnets.

Over a hybrid fiber/coax (HFC) architecture, an effective data network must support operation in a range of cable plant environments, including those with high levels of noise and ingress. Synchronous code division multiple access (S-CDMA) spread spectrum technology is a transmission system that provides an effective solution to upstream noise, allowing cable operators to offer a highly robust end-to-end cable TV data network.

Figure 1: End-to-end cable data network

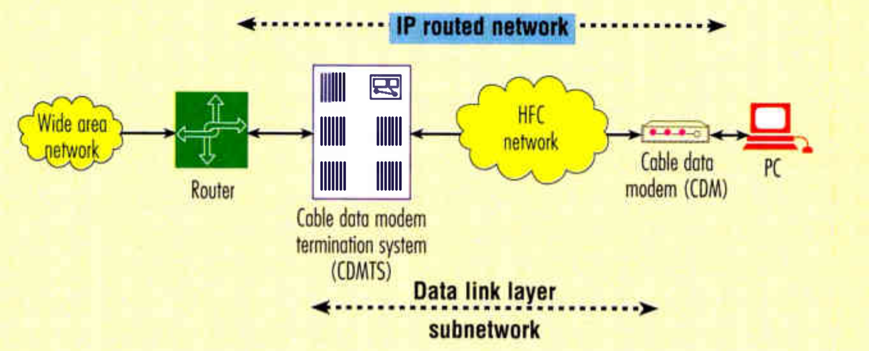
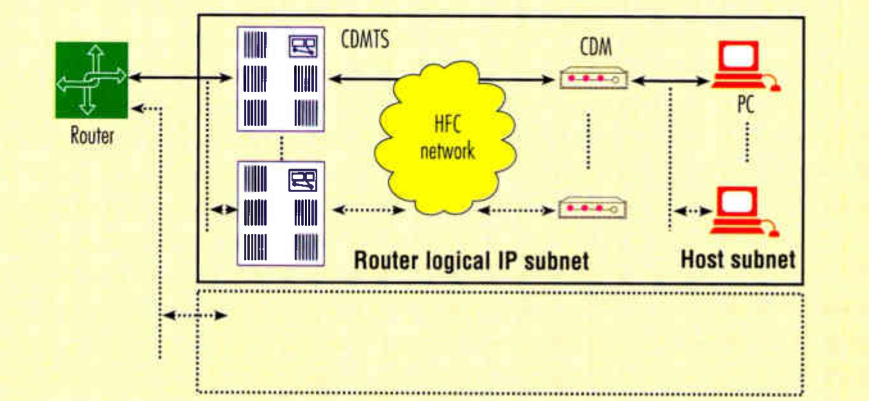


Figure 2: Logical IP subnetwork configuration



Data services

For the cable network operator to provide IP-based data network services it is necessary to address issues associated with security, scalability, multiple levels of service and traffic management. From the perspective of deployment, the network operator requires a robust, reliable and above all, cost-effective access system that operates alongside the current cable services and requires little or no changes to the existing cable infrastructure.

It is useful to consider the cable data network as an end-to-end network consisting of three separate overlaid networks: IP routed network, a data link layer subnetwork, and the physical HFC access network as shown in Figure 1.

The IP packet data service uses the packet data bearer service capabilities of the routed data link layer cable subnetwork, which in turn uses the Media Access Control (MAC) protocol and physical transmission medium of the physical layer of the HFC access network. A router provides all internetworking between different customer PCs and the wide area network (WAN).

Depending on the physical architecture of the cable network and the number of users supported, an operator may consider a logical IP subnetwork (LIS) configuration. The cable data network can be configured as one or more IP subnetworks subtending a router as shown in Figure 2. Multiple PCs in a private LAN also may be connected to a cable modem.

In the subnetwork configuration, RF channels are used as the physical transmission medium in the HFC access networks and separate RF channels in a different frequency spectrum are used for upstream and downstream transmission. One or more upstream and downstream channel pairs may be connected to a router IP subnet, which may accommodate as many as 10,000 host PCs.

Network data is carried transparently across the access network such that all information from a subscriber's PC is sent (via the cable data modem/cable data modem transmission system data link layer) to the router. Because the cable network does not support direct host-to-host communication, data from one host to another on the same router subnet is forwarded by the router. →

Adrian Jones is director of business strategy for Terayon Corp., in Santa Clara, CA.

IP features

Several IP service features can be supported over a cable data network service and may include: guaranteed and best-effort IP service delivery (e.g., reservation and integrated services protocol); packet/protocol filtering (such as packet access, filtering, forwarding, and control); subscription or service order-based service provisioning and access; dynamic and static configuration of subscriber PC IP addresses; and different tiers of IP service (such as using IP access list).

Service tiers

Cable data network service providers may require support of different tiers of IP service using different accounting schemes. Depending on the service tier subscribed to, a host can have access to different servers and application services such as premium Web pages and multicast groups. Different tiers of IP services may be supported by choosing the allocated IP address to fall into particular IP ranges. An example of this may be IP multicasting services.

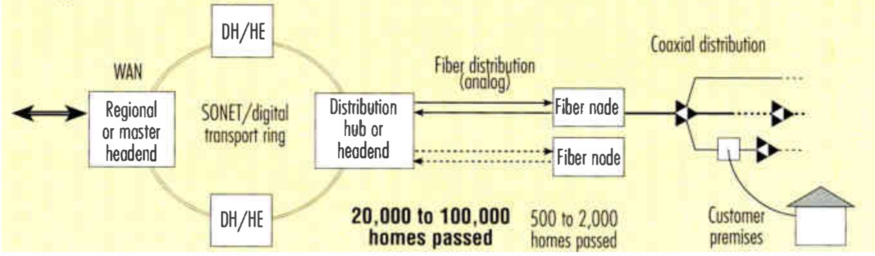
Access network services

Data link layer protocols being developed by some industry consortiums support a slot-and-frame approach in both upstream and downstream directions. The cable headend equipment broadcasts traffic to all subscribers' cable data modems as point-to-multipoint traffic. In the upstream direction, the cable network resources are shared and subscribers have to contend for it using a multipoint-to-point access protocol. Various combinations of upstream access schemes and data modulation techniques are used for digital transmission of the cable data network service over the analog transmission medium of the HFC access networks. Different modulation techniques include quadrature phase shift keying (QPSK); quadrature amplitude modulation (QAM) with modulation orders of 16, 64 or 256; and orthogonal frequency division multiplexing (OFDM).

There are several schemes to support the access to, and sharing of cable data network resources in the upstream direction including, but not limited to the following methods: S-CDMA; time division multiple access (TDMA); and frequency division multiple access (FDMA).

In most systems, the cable headend equipment arbitrates and allocates upstream bandwidth among the subscribers using a bandwidth management algorithm.

Figure 3: Example HFC access network

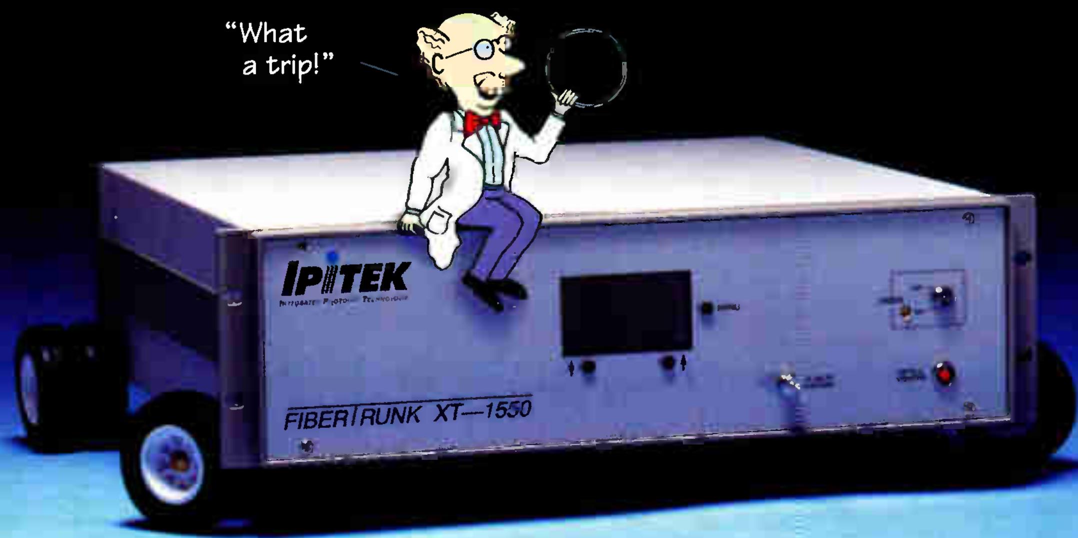


HFC network architecture

The physical HFC access network is a shared-media, tree-and-branch architecture with analog transmission over fiber trunks, and coaxial cable used for distribution to end points. Although there is no one architecture of cable plant, a "typical" physical layout of an HFC access network is illustrated in Figure 3. The majority of the existing HFC networks are sub-split systems with a 5 to 30-42 MHz upstream frequency spectrum and downstream 6 MHz channels stacked between 50 to 550-750 MHz.

The access network consists of remote distribution hubs connected to a central cable headend that may support more than 100,000 homes passed. Each distribution hub may feed between 40 and 200 fiber nodes, each of which feeds a coaxial distribution network covering between 500 and 2,000

Long distance carrier



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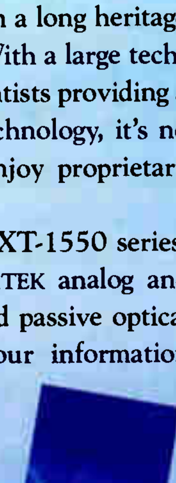

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homes passed. The fiber node provides the optical-electrical conversion for both the downstream and upstream RF channels.

Fiber nodes may be connected to the distribution hub using separate point-to-point fibers or as part of a ring structure. The spectrum for each fiber node in the forward, reverse or both directions may be aggregated at the headend, allowing the cable operator to flexibly alter the plant topology from within the distribution hub. These remote hubs are often interconnected to a centralized headend using a digital transmission medium such as a synchronous optical network (SONET) ring.

S-CDMA transmission

A physical transmission system that combines robustness, reliability, bandwidth efficiency, grade of service management and security is a direct sequence spread spectrum and a data link layer using time division multiplexing and S-CDMA.

S-CDMA allows frequency and temporal spreading of each transmitted data symbol and Trellis coding and forward error correction (FEC) for ingress-resistant implementation of the upstream bandwidth. The system also has been shown in tests to be resilient to narrowband and impulse noise interference. Network operators can now earn revenue across the whole return spectrum including the noisy sub-20 MHz frequency bands.

The underlying symbol encoding in S-CDMA uses 16-QAM to provide the high spectral efficiency possible under channel conditions. At full capacity, the system provides symmetric 9.2 Mbps of end-user data with out-of-band access, control and management messaging. The system provides graceful degradation of transmission capacity under extremely harsh conditions to maintain signal integrity and a given end-to-end error performance without incurring service-affecting interruptions.

Grade of service management

Asynchronous transfer mode (ATM) is one means of transporting Ethernet frames between the router and cable modem using RFC 1483 encapsulation techniques. ATM supports different quality of service (QOS) classes for guaranteed minimum/constant bit rate (CBR) and available bit rate (ABR) services and allows the network operator to provide services such as voice, data and video simultaneously.

Field trial results

Plant condition	Node size (homes passed)	Error-free seconds
Clean node	3,300	99.87%
Uncleaned node	6,200	99.13%
Aggregate of eight nodes	30,000	98.3%

Security

Unlike other physical layer technologies, S-CDMA modulation encodes data such that it is extremely difficult to decipher. The physical layer also utilizes spread spectrum code hopping, a technique developed by the U.S. military for secure wireless communications.

Field trials

Recent field trials have been conducted on various cable plants (see accompanying table) with node sizes and conditions aimed at stress testing the S-CDMA access system. These tests involved the following: a "clean" HFC node; an aggregate of eight nodes spanning more than 30,000 homes to verify operation on a large, all-coax network; and a node that had not been cleaned of noise to test deployment with rapid, low-cost return path conditioning.

Test results demonstrate the system's ability to run error-free in a 6 MHz channel centered on 14 MHz with 14 Mbps raw data rate (9.2 Mbps continuous user data) for more than 98% of the time. On the unclean plant, the modem ran at less than 1E-5 BER for 99% of the test.

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[2] Droms, R., "Dynamic Host Configuration Protocol", RFC1531, Bucknell University, October 1993.

[3] Deering, S., "Host Extensions for IP Multicasting", STD 5, RFC1112, Stanford University, August 1989. CT

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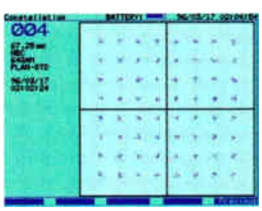

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Reader Service Number 35

By Alex Zavistovich

ET '97 in a word: Data

The theme for the Society of Cable Telecommunications Engineers Emerging Technologies '97 conference was, in a word, data.

Whether discussing theory, applications or new technology, paper presenters at the gathering focused on the bidirectional capabilities of cable networks, and how those capabilities can translate into revenue for operators.

The three-day event, held last month at the Opryland Hotel in Nashville, TN, drew over 1,000 engineering professionals looking for ways to optimize their network performance, and gain an understanding of the technology related to bringing data services to subscribers. Following is an example of some of the papers presented.

Tutorials

There's no doubt that data networking is here, and as it increases in significance in the cable industry, understanding interconnection principles becomes critical.

In tutorials before the ET '97 conference, Jim Stratigos of Media4 gave an overview of the open systems interconnection (OSI), a seven-layer model with specific functions per layer. The application layer provides for network applications such as file transfer and terminal emulation. The presentation layer offers data formatting, compression and encryption. The session layer provides for establishment and maintenance of sessions. The transport layer provides for end-to-end reliable delivery. The network layer allows delivery of packet information, including routing. The data link layer enables the transfer of units of information, framing and error checking. Finally, the physical layer permits transmission of binary data of a medium.

Stratigos also gave an Ethernet overview, explaining its use in allowing computers to share a common wired media. New varieties of Ethernet include 100VG-AnyLAN/IEEE 802.12, 100Base-T, ISO Ethernet and Gigabit Ethernet.

Georgia Tech's Mostafa Ammar gave an executive-level explanation of transmission control protocol/Internet protocol (TCP/IP). Two basic Internet transport protocols are TCP and user datagram protocol (UDP). TCP enables reliable sequenced byte stream delivery. It is connection-oriented with flow and congestion control, and the choice for most applications. UDP, now used for video and audio, is connectionless and is useful in multiplexing applications.

Ipsilon's Larry Lang explained IP switching. Combining IP software functionality and asynchronous transfer mode (ATM) hardware speed, IP switching may be the solution to providing service in an environment where exploding numbers of users are taxing the Internet backbone. Lang said the IP switching simplifies address mapping, removing steps that in turn saves bandwidth and delay, and makes the system less complex.

Standards

Roger Hays of A.D. Little provided an update on development of data over cable service interface specifications (DOCSIS). Work has

Alex Zavistovich is executive editor of "Communications Technology."

been conducted by a team including representatives of Comcast, Continental, Cox, Rogers, TCI, Time Warner and CableLabs. Operating assumptions included defining interfaces to and within the data over cable service delivery system, incorporating as much pre-existing work as possible, and keeping interfaces free and open. The goal ultimately is to promote the commercial deployment of data over cable. The team has specified the use of layered protocols with minimal coupling to support future upgrades; a slotted media access control (MAC) to support multiple grades of service; and standard network management protocol and variable data rate/channel width in the upstream direction.

The basic transport scheme enables both early interoperable modems and more advanced current units to coexist. The rest of the DOCSIS spec will facilitate uniform services and lower operations and maintenance costs, as well as reducing manufacturers' entry risks by letting them build to an MSO-supported guideline. A release from CableLabs indicated that the radio frequency portion of the spec was released December 5 to some 95 vendors who signed a DOCSIS access agreement. All documents related to the work are available at the DOCSIS project web site: http://www.cablemodem.com.

Integration, maintenance

You thought you had prepared your network to offer advanced services, and during routine monitoring and maintenance you've begun noticing some problems. Terry Wright of Atlanta-based Convergence Systems outlined some such problems and their causes in a paper dubbed "System Integration Challenges in High-Speed Data Services Deployment." Looking just at amplifiers, some potential problems include not enough amplification, too much amplification, distortion of received signals, improper equalization, microreflections (also a problem in fiber nodes) and injection and amplification of spurious signals. A variety of causes may be at work, including bad amp seals, failed amps, failed diplexers, poor grounding, poorly made connectors, stripped screws on the amp housing, faulty jumpers, faulty powering to amplifiers, and poor isolation in amplifiers.

Looking beyond amplifiers, other physical network problems can be caused by poorly made F-connectors, loose connections, nicked cable at the trunk, cracked shielding, leaking passives, or bad tap ports. Other sources of problems include single leg splitter failure, conductor micro-fractures, power leakage into the signal, cable plant inductance, and oxidized connectors, shielding or conductors.

Wright also detailed the steps in preparing to deploy data services. An engineer or systems integrator must first fully understand his existing business, the infrastructure and the market. He must then create a vision statement outlining critical success factors for the project, then develop and execute a project plan that integrates these success factors into the infrastructure of the existing business.

Work-at-home

With all the commotion about Internet over cable, the revenue potential of work-at-home applications may be overlooked. According to Douglas Wolfe of West End Systems, integrated data and voice for work-at-home applications can be employed on hybrid fiber/coax (HFC) networks for as little as $30,000-$40,000. Wolfe, who explained the technology involved in his company's WestBound 9600 broadband access platform, pointed out that work-at-home "provides an opportunity for cable TV operators to focus on a high margin, niche application, with a customer base that tends to be more loyal and pays its bills on time." The only available integrated voice and data work-at-home service today, Wolfe said, is integrated services digital network (ISDN), with monthly rates averaging nearly $300 per month for local and more than $600 for long distance access, at speeds of 64 kbps to 128 kbps. →

"We have to ask ourselves if it would be easier to find, support and maintain one (work-at-home) customer at $300 per month or 10 Internet access customers at $30 per month," according to Wolfe. Whatever the answer, he said, cable operators now have the option to decide.

Network security

What do you need to keep a secure wide area network (WAN) connection free from hackers, vandals and spies? Bill Hancock of Network-1 Software and Technology enumerated the list: encryption facilities, dial-up security of mobile users, secured application, a network rescue team for tactical problems, a router with filters, and a firewall system, among other things.

A filtering router, said Hancock, enables a protocol stack to be filtered by a set of commands in the router. This device is critical for keeping router table attacks at bay, as well as other attempts to access network facilities. A firewall is a hardware/software combination that restricts access to or from any addressable entity on a computer network. Firewalls are used at interconnections to external dirty networks, at internal security "pooled" network nodes, and factory or process control networks. There are four types of firewalls: packet filtering, application filtering, application proxy filtering and application/packet filtering hybrids.

What are some things firewalls can't do? They don't provide protection from insiders with an axe to grind or from connections that don't go through the firewall. They can't defend against viruses without additional scanning equipment, and they offer no protection from what looks like a legitimate session but is actually more insidious. For those and other reasons, Hancock advocates a firewall at every node, not just for Internet connections or between networks.

Proceedings manual

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INSTRUMENTS

By Jeff Keller

Technology abbreviations 101

When I began my career in cable TV over 19 years ago, I remember somebody telling me that all I needed to understand was AC, DC and RF. Well, for many years that seemed to be pretty much true. Today, in the fast-growing field of telecommunications, we need to know the terms that are familiar to the telephone company, as well as some computer lingo, if we are to be able to understand our expanding business.

I have compiled a list of acronyms that are used throughout the cable telecommunications industry that may help you to keep up the next time you're sitting in a conference or seminar and the acronyms start flying. IHIOSH (I hope it's of some help).

AAL: ATM adaptation layer
AC: Alternating current
ACD: Automatic call distribution
ACP: Adjacent channel power
ADP: Automatic data processing
ADPCM: Adaptive differential pulse code modulation
ADSI: Analog display services interface
ADSL: Asymmetrical digital subscriber line
ADX: Automatic data exchange
AFC: Automatic frequency control
AFT: Automatic fine tuning
AGC: Automatic gain control
AIN: Advanced intelligent network
AIS: Alarm indicating signal

Jeff Keller is service manager/senior technician for Bend Cable Communications in Bend, OR. He can be reached at (541) 382-5551.

ALC: Automatic level control
ALI: Automatic location identification
ALSC: Automatic level and slope control
AM: Amplitude modulation
AM/FM: Automated mapping/facilities management
AML: Amplitude modulated link
AMPS: Advanced mobile phone service
ANI: Automatic number identification
ANSI: American National Standards Institute
AOS: Alternative operator services
API: Application programming interface
APS: Automatic protection switching
ARRL: American Radio Relay League
ARU: Audio response unit
ASC: Automatic slope control
ASCII: American Standard Code for Information Interchange
AT: Access tandem
ATIS: Alliance for Telecommunications Industry Solutions
ATM: Asynchronous transfer mode
AWC: Area-wide Centrex
BASIC: Beginner's All-Purpose Symbolic Instruction Code
BBTH: Broadband-to-the-home
BCD: Binary code decimal
BCT/E Certification: Broadband Communications Technician/Engineer Certification
BER: Bit error rate
BERT: Bit error rate tester
BETRS: Basic exchange telecommunications radio service
BHCC: Busy hour call completion
BIP-8: Bit interleaved parity-8
BISDN: Broadband integrated services digital network
BML: Business management layer
BPS: Bits per second
BPSK: Binary phase shift keying
BRI: Basic rate interface
BTSC: Broadcast Television Systems Committee
CA: Commercial announcement
CAC: Carrier access code
CAD: Computer-aided design
CAN: Cable area network

CAP: Carrier-less amplitude and phase technology
CAPs: Competitive access providers
CARS: Community antenna relay station/service
CATV: Community antenna TV
CB: Citizens band
CBR: Constant bit rate
CCD: Charge coupled device
CCF: Custom calling features
CCITT: Comite Consultatif Internationale de Telegraphique et Telephnique

(*See also* ITU)

CDMA: Code division multiple access
CDPD: Cellular digital packet data
CDV: Cell delay variation
CER: Cell error rate
CEV: Controlled environmental vault
CIC: Cable in conduit
CIC: Carrier identification code
CID: Cable in the ditch
CISC: Complex instruction set computer
CLASS: Custom local area signaling services
CLI: Cumulative leakage index
CLID: Calling line identification
CLP: Cell loss priority
CLR: Cell loss ratio
CMIP: Common management information protocol
CNR or C/N: Carrier-to-noise ratio
CO: Central office
COBOL: Common business-oriented language
CODEC: Coder/decoder
COOLAN: Central office-based local area network
COS: Corporation for open systems
COT: Customer-originated trace
CPE: Customer premises equipment
CPS: Characters per second
CPU: Central processing unit
CRC: Cyclic redundancy check
CRT: Cathode ray tube
CSA: Canadian Standards Association
CSMA/CD: Carrier sense multiple access with collision detection
CSO: Composite second order
CSR: Customer service representative
CSU: Channel service unit

CT: Cordless telephone
CTB: Composite triple beat
CTD: Cell transfer delay
CW: Continuous wave
CWS: Can we serve
DA: Directory assistance
DALS: Dedicated access lines
DBS: Direct broadcast satellite
DC: Directional coupler
DC: Direct current
DCC: Data communications channel
DCE: Data communications equipment
DCS: Digital cross-connect
DDS: Digital data service
DES: Data encryption standard
DFB: Distributed feedback
DHCP: Dynamic host configuration protocol
DID: Direct inward dialing or drop-in-duct
DLC: Digital loop carrier
DMS: Digital multiplex systems
DMT: Discrete multitone
DPN: Data packet network
DR: Dynamic range
DRAM: Digital recorded announcement machine
DS: Digital signal
DSB-SC: Double sideband-suppressed carrier
DSL: Digital subscriber line
DS0: Digital service, level 0
DSU: Data service unit
DTC: Decoder time clock
DTE: Data terminal equipment
DTMF: Dual tone multifrequency
DVB-C: Digital video broadcast via cable
DWDM: Dense wavelength division multiplexing
DWS: Dialable wideband service
EAEO: Equal access end office
EAS: Emergency Alert System or extended area service
ECSA: Exchange Carrier Standards Association
EDI: Electronic data interchange
EIA: Electronic Industries Association
EIRP: Effective isotopic radiated power
EMI: Electromagnetic interference
EML: Element management layer
ENIS: Element management system
EO&C: Expert observation & commentary
EPROM: Erasable programmable read only memory →

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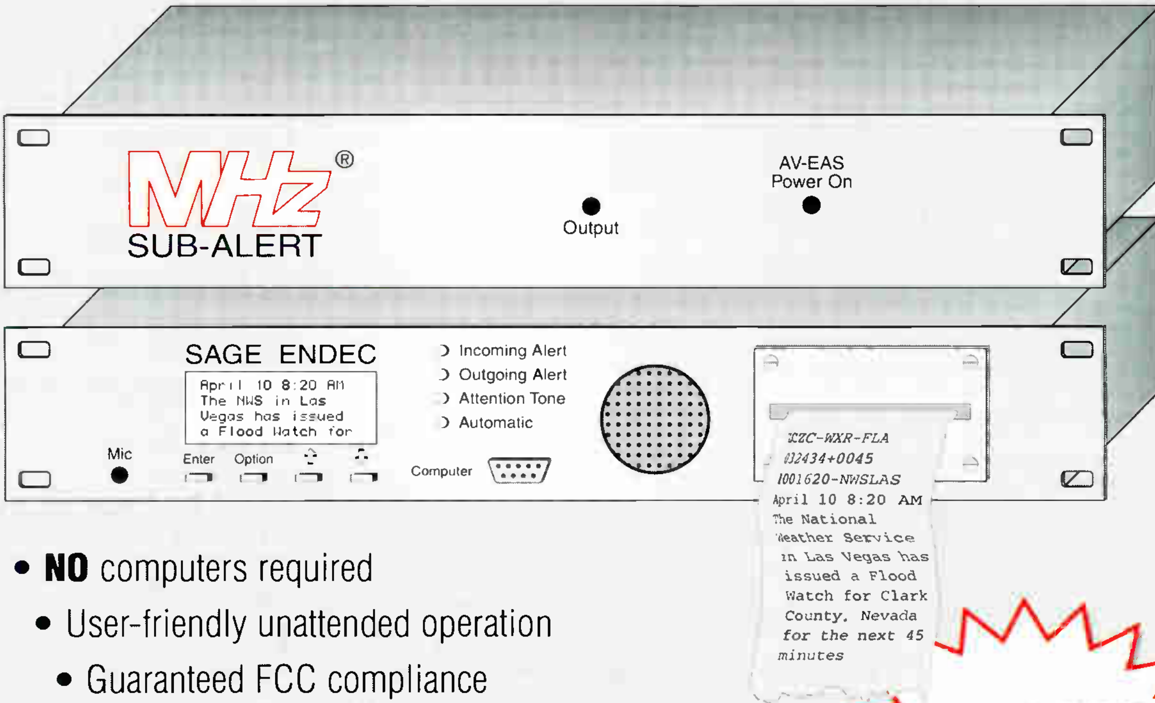

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ERP: Effective radiated power
ESA: Emergency stand-alone
ESP: Enhanced service provider
ESS: Electronic switching system
ET: Emerging Technologies
ETDMA: Enhanced time division multiple access
ETSI: European Technical Standards Institute
EVM: Error vector magnitude
FAQ: Frequently asked questions
FCC: Federal Communications Commission
FCOT: Fiber central office terminal
FD: Floppy disc
FDDI: Fiber distributed data interface
FDM: Frequency division multiplexing
FDMA: Frequency division multiple access
FEC: Forward error correction
FERF: Far end receive failure
FITL: Fiber-in-the-loop
FM: Frequency modulation
FML: Frequency modulated link
FMO: Frequency modulated oscillator
FOSE: Fiber-optic splice enclosure
FOTS: Fiber-optic transmission systems
F-P: Fabry-Perot
FSK: Frequency shift keying
FSM: Field strength meter
FTP: File transfer protocol
FTTC: Fiber-to-the-curb
FTTF: Fiber-to-the-feeder
FTTH: Fiber-to-the-home
FX: Foreign exchange
FYI: For your information
GaAsFET: Gallium-Arsenide-field-effect-transistor
GI: Graded index
GIS: Geographic information system
GPS: Global positioning system
GSM: Global system for mobile communication
GUI: Graphical user interface
HDBH: High day busy hour
HDSL: High bit rate digital subscriber line
HDT: Host digital terminal
HDTV: High definition TV
HFC: Hybrid fiber/coax
HFW: Hybrid fiber/wireless
HITS: Headend in the sky
HPF: High pass filter
HRC: Harmonically related carriers
HSCD: High-speed cable data
HTML: Hypertext markup language
HTTP: Hypertext transfer protocol
IC: Integrated circuit
ICC: Incremental coherent carriers
ICCF: Industry Carriers Compatibility Forum
ICN: Integrated community network
ICS: Integrated communication system
IDDD: International direct distance dialing
IDLC: Integrated digital loop carrier
IEEE: Institute of Electrical and Electronic Engineers
IIETF: Internet Engineering Task Force
IF: Intermediate frequency
IGP: Interior gateway protocol
IHC: In-home cabling subcommittee
ILEC: Incumbent local exchange carrier
IM: Intermodulation
IN: Intelligent network
INMS: Integrated network management system
I/O: Input-output
IOC: Independent operating companies
IOR: Index of refraction
IP: Intelligent peripherals
IP: Internet protocol
IPPV: Impulse pay-per-view
IPS: Interface Practices Subcommittee
IRC: Incrementally related carriers
IRE: The Institute of Radio Engineers *or* a unit of video measurement: 140 IRE = 1 volt peak-to-peak
ISDN: Integrated services digital network
ISO: International Standards Organization
ISP: Internet service provider
ISR: International simple resale
IT: Information technology
ITS: Insertion test signals
ITU: International Telecommunication Union
ITU-TSS: International Telecommunications Union-Telecommunications Standards Sector
IVR: Interactive voice response
IXCs: Interexchange carriers (sometimes abbreviated as IECS)
JEC: Joint engineering committee
KSU: Key service unit
LAN: Local area network
LATA: Local access and transport area
LCD: Liquid crystal display
LCS: Leased circuit service
LDS: Local distribution service
LEC: Local exchange carrier
LED: Light emitting diode
LEO: Low earth orbit →

LIFO: Last in: first out
LILO: Last in: last out
LMDS: Local multipoint distribution service
LNA: Low noise amplifier
LNB/LNC: Low-noise block converter
LO: Local origination
LOP: Local origination programming
LOS: Line-of-sight
LPF: Low-pass filter
LPM: Lines per minute
MAC: Medium access control
MAN: Metropolitan area network
MATV: Master antenna TV system
MBG: Multilocation business group
MCR: Master control room
MDF: Main distribution frame
MDPE: Medium density polyethylene
MDS: Multipoint distribution service or message delivery service
MDU: Multiple dwelling units
MIER: Modulation error ratio
MF: Multifrequency
MFJ: Modification of final judgment
MIBS: Management information bases
MIPS: Million instructions per second
MM: Multimode
MMDS: Multichannel multipoint distribution service *or* microwave multipoint distribution system
MODEM: Modulator/demodulator
MPEG: Moving Pictures Expert Group
MSA: Metropolitan service area
MSA: Metropolitan statistical area
MSO: Multiple system operator
MTBF: Mean time between failures
MTS: Modem termination system
MTS: Multichannel TV sound
MTSO: Mobile telephone switching office
MTTR: Mean time to repair
MUX: Multiplexer
NA: Numerical aperture
NAB: National Association of Broadcasters
NAMIC: National Association of Minorities in Cable
NAMPS: Narrowband AMPS
NANP: North American numbering plan
NAP: Network access points
NCOS: Network class of service
NCP: Network control program
NCTA: National Cable Television Association
NCTI: National Cable Television Institute
ND:YAG: Neodymium Yttrium Aluminum Garnet
NE: Network element
NEC: National Electrical Code
NEDA: National Electronics Distributors Association
NEMA: National Electronic Manufacturers Association
NESC: National Electrical Safety Code
NET: National educational TV
NFS: Network file system
NIC: Network information center
NID: Network interface device
NII: National information infrastructure
NIU: Network interface unit
NML: Network management layer
NMS: Network management system
NNI: Network/network interface
NNI: Network/node interface
NOC: Network operations center
NPA: Numbering plan area
NPRM: Notice of proposed rulemaking
NTC: Network Transmission Committee
NTSC: National Television System Committee
NVOD: Near-video-on-demand
OAM&P: Operations, administration, maintenance and provisioning
OC: Optical carrier
OCC: Other common carrier
OC-N: Optical carrier level N
OEM: Original equipment manufacturer
ONA: Open network architecture
ONU: Optical network units
OOP: Object-oriented programming
OPX: Off-premises extension
OQPSK: Offset quadrature phase shift keying
OR: Optical receiver
OSD: On-screen display
OSI: Open system interconnection
OSPF: Open shortest path first
OSS: Operations support systems
OTDR: Optical time domain reflectometer
OTG: On-time guarantee
OTN: Optical transition nodes
OTP: Office of Telecommunications Policy
PABX: Private automatic branch exchange
PAD: Packet assembler and disassembler
PAL: Phase alteration line
PBX: Private branch exchange
PC: Personal computer or printed circuit
PCIA: Personal Communications Industry Association
PCM: Pulse code modulation
PCN: Personal communications network
PCS: Personal communications services
PDN: Primary directory number
PDN: Public data network
PE: Polyethylene
PIN: Personal identification number
PM: Phase modulation
PNNI: Private network to network interface
POP: Points of presence or proof-of-performance
POTS: Plain old telephone service
PPP: Point-to-point protocol
PPV: Pay-per-view
PRI: Primary rate interface
PROM: Programmable read-only memory
PS: Power supply
PSC: Public Service Commission (also known as the PUC)
PSTN: Public switched telephone network
PTT: Post, Telegraphs and Telephones
PUC: Public Utilities Commission
PVC: Permanent virtual circuit
PVC: Polyvinyl Chloride
QAM: Quadrature amplitude modulation
QOS: Quality of service
QPSK: Quadrature phase shift keying
RAD/RASP: Remote antenna device/remote antenna signal processing
RAID: Redundant array of independent disks
RAM: Random access memory
RAO: Revenue accounting office
RBOC: Regional Bell Operating Company
RCC: Radio Common Carrier
RDBMS: Relational database management system
REA: Rural Electrification Administration
RF: Radio frequency
RFC: Request for comments
RFI: Radio frequency interference
RFP: Request for proposal
RHC: Regional holding company
RIN: Relative intensity noise
RIP: Routing information protocol
RISC: Reduced instruction set computing
RL: Return loss
RMS: Root mean square
ROM: Read-only memory
RPC: Remote procedure call
RSA: Rural service area
SAP: Secondary audio program
SBE: Society of Broadcast Engineers
SBS: Satellite Business Systems
SBS: Stimulated Brillouin scattering
SCA: Subsidiary communications authority
SCAI: Switch-to-computer applications interface
SCBA: Small Cable Business Association
S-CDMA: Synchronous code division multiplex access
SCE: Service creation environment
SCP: Service control point
SCSI: Small computer system interface
SCTE: Society of Cable Telecommunications Engineers
SDH: Synchronous digital hierarchy
SDO: Standards Development Organization
SDSL: Single-line digital subscriber line
SGDF: Supergroup distribution frame
SHL: Studio-to-headend link
SI: Step index
SIR: Sustained information rate
SLIP: Serial line Internet protocol
SLM: Signal level meter
SLS: Single line service
SM: Single mode
SMATV: Satellite master antenna TV system
SMDR: Station message detail recording
SMDS: Switched multimegabit data service
SML: Service management layer
SMPTE: Society of Motion Picture and Television Engineers
SMR: Specialized mobile radio
SMS: Service management system
SMTP: Simple mail transfer protocol
SNR or S/N: Signal-to-noise ratio
SNA: Systems network architecture
SNAIP: Simple network management protocol
SONET: Synchronous optical network
SPC: Stored program control
SPE: Synchronous payload envelope
SRL: Structural return loss
SSB: Single sideband
SSB: Star-star-bus
SSP: Service switching point
SS7: Signaling System number 7
STL: Studio-to-transmitter link
STP: Signaling transfer point
STS: Synchronous transport signal
SVC: Switched virtual circuit
TA: Technical advisory
TAMI: Television Accessory Manufacturers Institute
TASO: Television Allocation Study Organization
TCC: Telephone coordinating circuit
TCP/IP: Transmission control protocol/Internet protocol
TDD: Telecommunications device for the deaf
TDM: Time division multiplexing
TDMA: Time division multiple access

TDR: Time domain reflectometer
TFTP: Trivial file transfer protocol
TL: Transaction language
TMN: Telecommunications management network
TR: Technical reference
TSI: Time slot interchange
TVRO: Television receive-only earth station
UAR: Universal asynchronous receiver
UBR: Unspecified bit rate
UDP: User datagram protocol
UHF: Ultra-high frequency
UNI: User network interface
UPS: Uninterruptible power supply
URL: Uniform resource locator
USTA: United States Telephone Association
UTP: Unshielded twisted-pair
VAN: Value-added network
VANC: Voice activated network control
VAPN: Virtual access to private networks
VBI: Vertical blanking interval
VBR: Variable bit rate
VC: Virtual channel
VCI: Virtual channel identifier
VCR: Videocassette recorder
VCXO: Voltage controlled crystal oscillator
VDSL: Very high data rate digital subscriber line
VDT: Video dial tone
VHF: Very high frequency
VHS: Video home system
VIRS: Vertical interval reference test signal
VITS: Vertical interval test signal
VLSI: Very large scale integration
VOD: Video-on-demand
VOP: Velocity of propagation
VP: Virtual path
VPI: Virtual path identifier
VPN: Virtual private networks
VRU: Voice response unit
VSAT: Very small aperture terminal
VSB: Vestigial sideband
VSWR: Voltage standing wave ratio
VT: Virtual tributary
VTR: Videotape recorder
VU: Volume unit
WAIS: Wide area information servers
WAN: Wide area network
WATS: Wide area telecommunications service
WDM: Wavelength division multiplexing
WICT: Women in Cable & Telecommunications
WPBX: Wireless private branch exchange
WWW: World Wide Web
XO: Crystal oscillator

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Reader Service Number 8

By Woody Cash

Simple ways to measure C/N

This article will explore three of the more common methods of nonintrusive carrier-to-noise (C/N) measurements, examine the measurements and explain how to use them to test your network.

As the need for network testing increases, so does the need to perform all testing to ensure uninterrupted service. More than ever before, a network's performance must be tested in a nonintrusive manner.

Figure 1: Screen capture of C/N measurement method (Example 1)

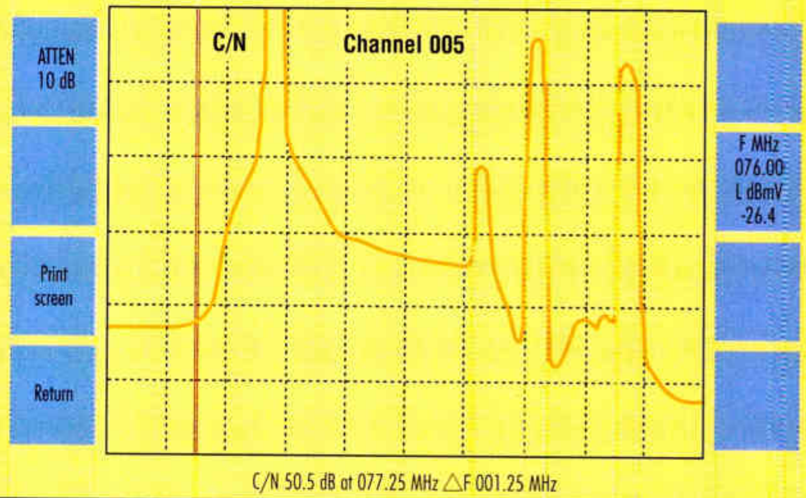
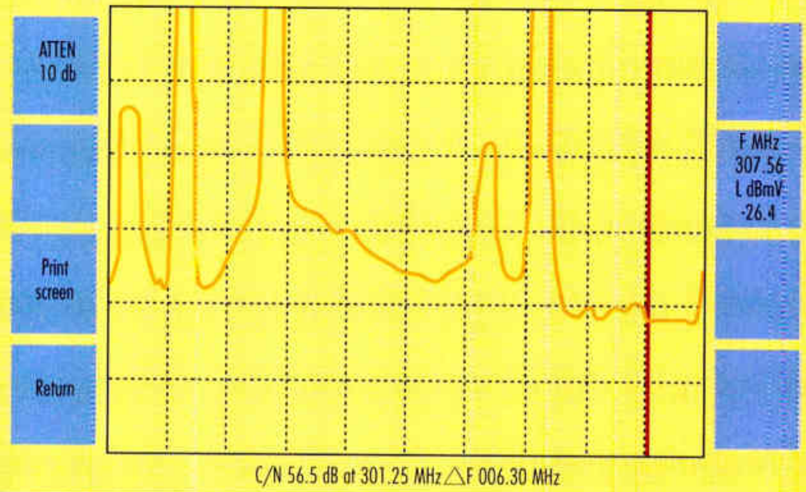


Figure 2: Screen capture of C/N measurement method (Example 2)



Measurement methods

The first method of measuring C/N is to measure the video carrier level compared to the level of noise in the space between the video carrier measured and the lower adjacent audio carrier. This is illustrated in Figure 1.

"A preselector or bandpass filter should be used to increase the dynamic range of the test equipment."

This measurement is somewhat limited because energy from the modulators' processors overlap in this area and this power is combined with the noise. Thus, the noise measured is noise plus energy from modulators/processors.

A second method is to conduct automated C/N measurements (typically synchronized with video).

In automated C/N measurement, a signal-to-noise (S/N) measurement is sampled during quiet lines of the vertical interval. With some fancy processing, this results in a C/N measurement. Like the first, this process also is limited because of noise contribution—the sum of the total combined noise sources starting at the broadcast point. *(Editor's note: This method will provide an indication of the total noise seen by the subscriber.)*

These measurements will not provide a result greater than the actual C/N, but it is usually difficult to measure a C/N that is greater than 45 dBc.

Another method of measuring C/N is by measuring the video carrier level compared to the level of noise in a vacant upper adjacent channel. This is illustrated in Figure 2.

This method allows the measurement of noise without the residual power of modulators or processors. →

Woody Cash is system technician and crew chief for TCI in San Jose, CA.

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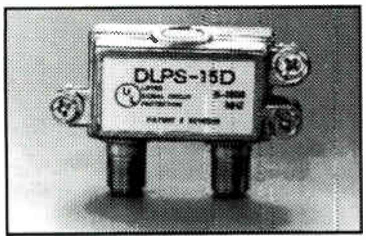

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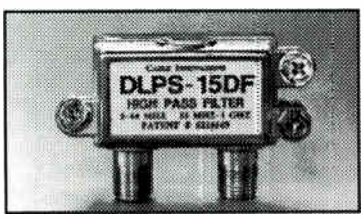
Reader Service Number 302



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The DLPS-15DF offers a wider and deeper filter, longer life, greater current handling capacity and faster response than any other type of protector/filter. **Reader Service Number 303**

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Reader Service Number 304

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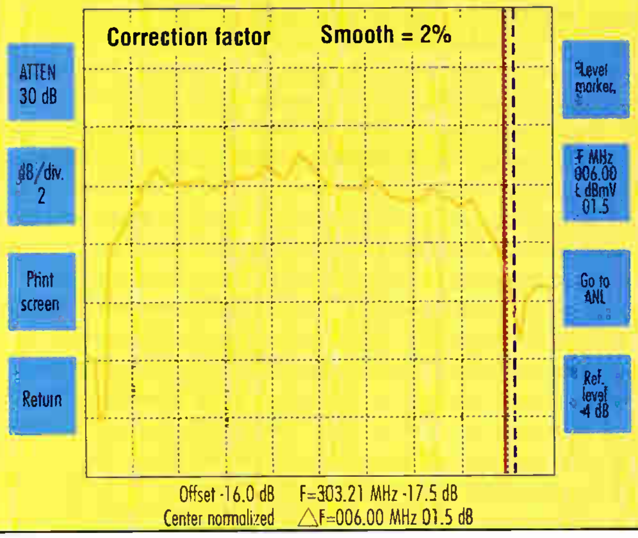
Figure 3: C/N of 48 dB with correction of -1.5 = 46.5



This method is very useful for checking the plant part of the system independently, without including the variable of the previously mentioned methods. When this method is used, you also must check for any roll-off between the two points of measurement. This can easily be done with a sweep system.

The difference in amplitude between the two frequencies becomes a correction factor. For example, if there is a 1.5 dB roll-off between the video carrier frequency and the frequency where the noise is measured, the correction factor is a -1.5. If the carrier to noise reads 48 dB and we have a correction factor of -1.5, the C/N is actually 46.5 dB. (See Figure 3.)

When making such sensitive measurements, a preselector or bandpass filter should be used to increase the dynamic range of the test equipment. If a bandpass filter is used it will most likely be inserted after the video carrier level measurement and before the noise level measurement. Therefore, the insertion loss of the bandpass filter must be factored.

Stepping up

In conclusion, all three methods of in-service C/N measurements are useful when performing network testing. The lower adjacent out-of-band measurement is good for relative measurements, but is somewhat limited. The automated tests are good when checking end-of-lines, or looking for worst-case C/N.

A preferred method, called the step-up method, is good for testing the plant part of the network, especially where the C/N may exceed 50 dB. Using the step up method to measure C/N allows for accurate testing of your network without disruption of service.

"Using the step-up method to measure C/N allows for accurate testing of your network without disruption of service."

C/N is usually consistent over the entire spectrum and a measurement at the high end of the spectrum will result in a C/N that typically exists throughout the bandpass. This measurement also can be performed in most empty spots in the spectrum such as the guard band between Chs. 4 and 5 and in the FM band.

"NCTA Recommended Practices for Measurements on Cable TV Systems" (July 1993) was used as a reference in this article. **CT**

By Dan Harris

Chromatic dispersion for 1,550 single-mode transmission

This month's "Ask A Fiber Expert" column answers questions about chromatic dispersion.

• What is chromatic dispersion and how does it affect video transmission?

Chromatic dispersion causes the distortion of optical signals that contain multiple wavelength components. The fiber core's index of refraction is a function of the optical wavelength, which causes different wavelength components of practical sources to travel at different speeds. This creates distortion in both analog and digital transmission systems. When combined with spectral instability of optical sources, it also can be a source of random noise. Chromatic dispersion is measured in units of picoseconds per nanometer per kilometer [ps/(nm*km)], which means that signal degradation due to chromatic dispersion gets worse as both source linewidth (nm) and transmission distance (km) increase.

Dan Harris is market development engineering manager for Corning.

As shown in Figure 1, standard single-mode fiber is designed to have no chromatic dispersion at 1,310 nm. At 1,550 nm, however, the dispersion becomes significant with typical values around 17 ps/(nm*km). To minimize chromatic dispersion at 1,550 nm, dispersion-compensating devices for standard single-mode fiber are available, as well as an array of dispersion-shifted fibers that are designed to have minimal dispersion at 1,550 nm.

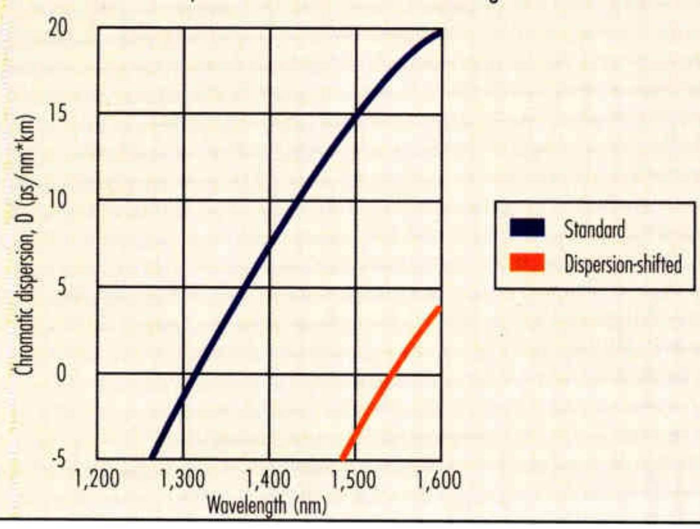
Chromatic dispersion

High dispersion can cause severe problems in both analog and digital systems. In analog video transmission, chromatic dispersion interacts with other system attributes to create composite second order (CSO) distortion. Two primary causes of dispersion-induced CSO distortion are:

1) Laser chirp: The spectral broadening of a directly modulated distributed feedback (DFB) source resulting from "chirp" creates CSO in the presence of chromatic dispersion. At 1,550 nm on standard single-mode fiber, CSO easily can reach intolerable levels for directly modulated sources, depending on the amount of laser chirp and the transmission distance. For this reason, there are practically no directly modulated 1,550 nm sources in use within cable TV transmission systems to date.

2) Self-phase modulation (SPM): SPM is a nonlinear effect caused by injecting too much optical power into the fiber. These high optical power levels (typically near 100 mW for single-mode fibers) actually alter the refractive index of the fiber core, effectively "chirping" the optical spectrum in the fiber. The interaction of the broadened spectrum with chromatic dispersion results in CSO distortion. This effect can be just as pronounced as that seen with laser chirp, depending on the amount of spectral broadening that occurs.

Figure 1: Chromatic dispersion as a function of wavelength



One interesting element of dispersion-induced CSO is the relationship between the laser chirp and SPM components: The two components are exactly "out of phase," which means that when their magnitudes are equal, they cancel each other and the net CSO is 0. Unfortunately, since the magnitudes for the two components are seldom equal, the two components generally cannot be relied upon to reduce dispersion-induced CSO. In most practical applications, laser chirp will be the dominant cause of distortion for directly modulated sources, while SPM dominates in externally modulated systems.

• I'm considering 1,550 nm transmission of analog video to take

advantage of lower attenuation and optical amplifiers at that wavelength. Since chromatic dispersion is quite high on standard single-mode fiber at 1,550 nm, should I be concerned?

It depends on the transmitter technology, transmission distance, and fiber type. Externally modulated 1,550 nm DFB laser transmitters are available from several vendors today, and these units significantly outperform standard 1,310 nm DFB units on standard single-mode fiber (SMF) in many applications. However, because of the high dispersion in SMF at 1,550 nm, the high input powers associated with transmission over very long distances with externally modulated 1,550 nm DFBs can generate unacceptably high levels of CSO distortion through SPM. On the other hand, the possibility of using directly modulated 1,550 nm DFB sources with SMF is severely limited because of CSO resulting from the interaction of laser chirp and chromatic dispersion.

"High dispersion can cause severe problems in both analog and digital systems."

Figure 2: Theoretical calculations for laser chirp component

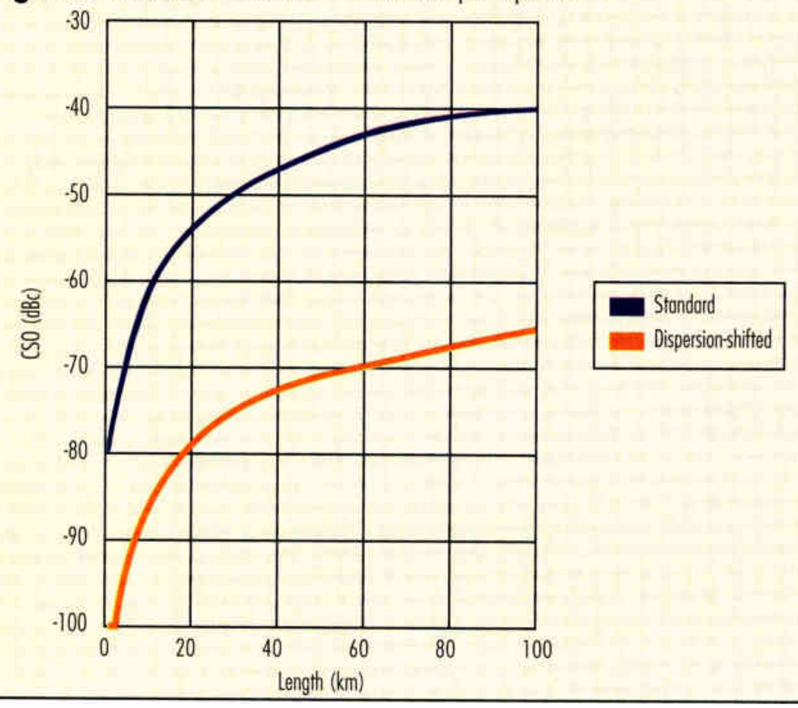
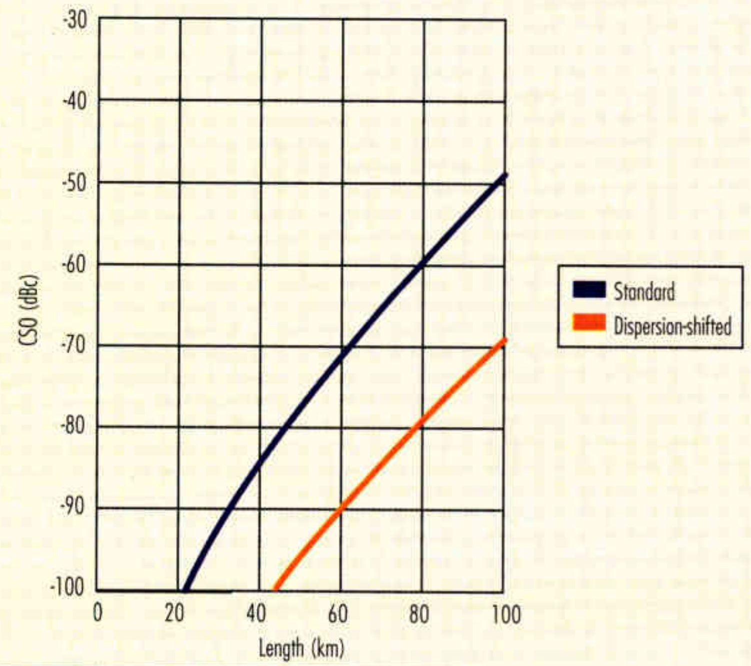


Figure 3: Theoretical calculations for self-phase modulation component



• What are the factors affecting dispersion-induced distortion and how can I reduce it?

Dispersion-induced distortion produced by laser chirp and SPM is dependent on several common factors, including the following:

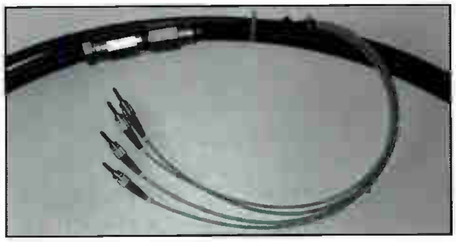
Carrier frequency: Fiber-induced CSO generally increases with modulation frequency, so any fiber-related distortion is greatest at the highest carrier frequency.

Chromatic dispersion and transmission distance: The greater the dispersion, the more severe CSO distortion becomes. CSO distortion also accrues with fiber length (i.e., CSO levels are higher at longer transmission distances). Theoretical calculations provided in Figures 2 and 3 illustrate this dependence for dispersion-induced CSO.

Specifically, Figure 2 represents the CSO vs. transmission distance for a typical 1,550 nm directly modulated DFB. Over standard single-mode fiber, these calculations show that CSO levels can exceed -70 dBc after less than 10 km. However, for dispersion-shifted fiber, CSO levels can be maintained to -70 dBc for distances beyond 50 km.

Figure 3 shows calculations for CSO distortion arising from SPM for an externally modulated 1,550 nm laser for various transmission distances. In this example, trans-

Advertisement



Fiber Optic CATV Drop Cables

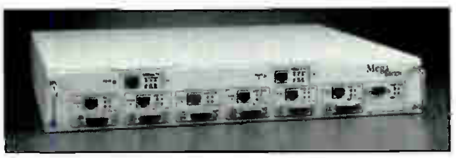
Radiant offers a full line of fiber optic cable plant products. The company guarantees drop cables with back reflections of -60dB for ultra polish terminations and -70dB for angle polish terminations. Available from two to twelve fibers with customer specified node connector. Also available are fiber optic assemblies, couplers, fiber management systems and the industry's first and best low backreflection attenuators— both fixed and variable.

Reader Service Number 231

Cost-Effective Systems Transmit Baseband Video/Audio Over Fiber

Several cost-efficient systems that transmit Baseband video/audio over fiber are now available from Radiant Communications. Whether your requirements call for one-way transmission with broadcast quality (RS250), or bi-directional (two-way) transmission using one fiber, Radiant has the solution. In addition, data or stereo audio are available options. These systems are now in use by all major MSO's nationwide in applications including college seminars, town meetings, direct feeds from broadcast studios or remote antenna sites, video conferences and CCTV.

Reader Service Number 233



New Unique Fiber Optic Ethernet System Eliminates Data Collisions

Radiant introduces the most cost effective and technologically advanced method of connecting remote ethernet hubs together. The series DL200 allows transmission distances up to 100Km and data throughputs of 100Mbs. It can be used for any size system — large or small. Typical applications include interconnecting large metropolitan school districts or remote college or industry locations. Budgetary cost is less than $3000 per location.

Reader Service Number 235

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Reader Service Number 93

mission power is adjusted as length increases to maintain 0 dBm at the optical receiver. Here, CSO created from SPM on standard single-mode fiber exceeds -70 dBc after about 60-70 km, while the dispersion shifted-fiber maintains acceptable CSO levels up to 100 km.

Note that the amount of laser chirp does not affect the SPM component of CSO. Furthermore, SPM depends on two factors that do not affect the chirp component of CSO (the optical input power and the effective cross sectional area of the fiber core).

Reducing distortion

For the laser chirp component of dispersion-induced CSO, there are only two basic ways to reduce the total CSO: either limit laser chirp or reduce chromatic dispersion. In today's 1,550 nm systems, externally modulated lasers are commonly used to limit laser chirp. This source performs well with standard single-mode fiber, although the cost is fundamentally higher than a directly modulated DFB laser. Since significant chirp will be present with the directly modulated source, fiber dispersion must be limited in order to facilitate the use of these devices.

The SPM component of dispersion-induced distortion can be minimized either by limiting optical input power to the fiber, increasing the effective core area of the fiber, or reducing dispersion. Lowering optical input power is not generally desirable, since the ability to achieve high source powers with erbium-doped fiber amplifiers (EDFAs) is a common motivation for moving to the 1,550 nm window. Increasing the effective fiber core area can help, although the CSO gains from any

> **"Chromatic dispersion can be a debilitating source of CSO distortion for 1,550 nm systems operating on standard single-mode fiber."**

practical increase would provide only a few decibels reduction in CSO.

Since chromatic dispersion is the common thread for both components, CSO will decrease in both cases simply by reducing chromatic dispersion. At the 1,550 nm wavelength, a dispersion-shifted fiber or a dispersion-compensating device with standard single-mode fiber can be used. Because dispersion-compensating devices tend to be fairly lossy, however, the advantage of lower attenuation is at least partially negated when these devices are used.

Since attenuation in dispersion-shifted fibers at 1,550 nm is comparable to standard single-mode fiber, dispersion-shifted fiber is the best option for new installations designed for operation at 1,550 nm. Dispersion-compensating devices are best suited for upgrading previously installed 1,310 nm-based standard fiber systems.

Conclusions

Chromatic dispersion can be a debilitating source of CSO distortion for 1,550 nm systems operating on standard single-mode fiber. If directly modulated DFB lasers are deployed at 1,550 nm, the laser chirp-induced CSO would limit transmission distance to only a few kilometers. More expensive externally modulated transmitters can be used to overcome the laser chirp problem, but at high optical powers, even these transmitters are subject to nonlinear SPM that can cause high CSO after 60 km.

The effects of high chromatic dispersion over standard single-mode fiber can be successfully overcome by using a dispersion-compensating device or dispersion-shifted fiber. Since practical dispersion compensating devices carry a significant optical loss penalty, they are appropriate primarily for retrofits of previously installed systems designed for 1,310 nm operation. For new systems designed for 1,550 nm operation, dispersion-shifted fiber can be used to reduce chromatic dispersion, and simultaneously provide optical attenuation as low as uncompensated standard single-mode fiber.

References

[1] M. R. Phillips, et. al., "Nonlinear distortion generated by dispersive transmission of chirped intensity-modulated signals," *IEEE Photonics Technology Letters*, Volume 3, Number 5, pages 481-483, 1991.

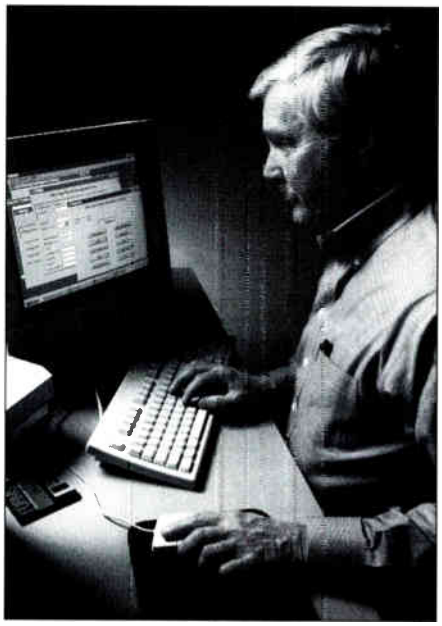
[2] D. A. Atlas, "Fiber induced distortion and phase noise to intensity noise conversion in externally modulated CATV systems," *NCTA Technical Papers*, pages 289-293, 1996. **CT**

Digital ad insertion

Axicom developed its ADvantage system for small- to medium-sized cable TV operators seeking to replace their analog insertion equipment with a digital advertising insertion system. The ADvantage system is an integrated solution consisting of hardware, software, installation, maintenance and training. The hardware portion of the system is built with off-the-shelf, industry-standard components including Pentium microprocessors.

The system can scale from four to 20 channels and uses a centralized storage model that handles video segments of any length, including infomercials. This architecture provides all channels with immediate access to every spot. Staging or transferring spots prior to playback is not required. System pricing is based on the number of channels, and starts at $64,996.

Reader service #269



Record management

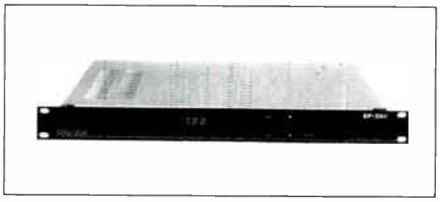
GN Nettest's Laser Precision Division has developed FORMS, a database management system for simplified fiber record keeping, accessibility and reporting. FORMS allows the user to archive, access, view, manipulate, manage and report test data on a personal computer. Once the database is stored, a customer can generate a number of reports including information on bidirectional splice loss, cable and fiber information and performance, fiber acceptance, landmarks, span information and splice loss information. Users also can manipulate and overlay splice traces.

FORMS is compatible with PC-3000 optical time domain reflectometer (OTDR) emulation software and can be used for information generated by all Laser Precision OTDRs, mini-OTDRs and also with traces generated by a number of other manufacturers' OTDRs. A complimentary FORMS demo disk is available from Laser Precision.

Reader service #310 →

Fault detector

ComSonics expanded its line of products with WindowLite Digital and its new TDR Tech. WindowLite Digital expands the company's WindowLite line. The TDR Tech is a hand-held cable fault locator that sends a high-speed pulse down the cable with the reflected pulse indicating fault type and distance to fault. Its range is 15 to 2,000 feet.
Reader service #281



Processor/translator

Finline Technologies Ltd. introduced its SP-550 agile processor/translator that includes improved noise performance, injection locking for coherent frequency and channel transfer, digital frequency synthesis and PLL technology.

Available in NTSC, PAL and SECAM, the SP-550 has an input/output frequency of 7 to 550 MHz, tuning in 250 kHz steps and 10 kHz frequency offsets for the output signal. An IF loop-through is provided for sampling and demodulation. The front panel has metering and access to all controls. Electronic memory and nonvolatile power backup are available features. The SP-550 is menu-driven and has an onboard microprocessor that is said to allow for effective system configuration.
Reader service #311

Cable-in-conduit

CommScope, a division of General Instrument, now includes in its product line Con/Quest, a preassembled, cable-in-conduit system that features the CommScope cable product line in select grade, high-density polyethylene conduit. The company also has added a cable for power delivery in centralized power networks. Power Feeder offers low DC loop resistance in a feeder cable size (625), optimized for long-distance delivery of high current and easy installation. It has aluminum, coaxial construction to reduce pole loading for longer spans.

Additionally, CommScope now has 12 varieties of jacket colors for its headend cables. The firm also has teamed up with White Sands Cable, a manufacturer of cable assemblies, to offer jumper cable products, which are available through the latter company's service center.
Reader service #282

Grounding block

Signal Vision introduced a new grounding block, the SV-A7G, designed for use in expanded bandwidth applications up to 1 GHz. A patented insert provides return loss characteristics of 25 dB. The grounding block is constructed of brass base plating over zinc for conductivity and nickel for interface continuity.
Reader service #268 →

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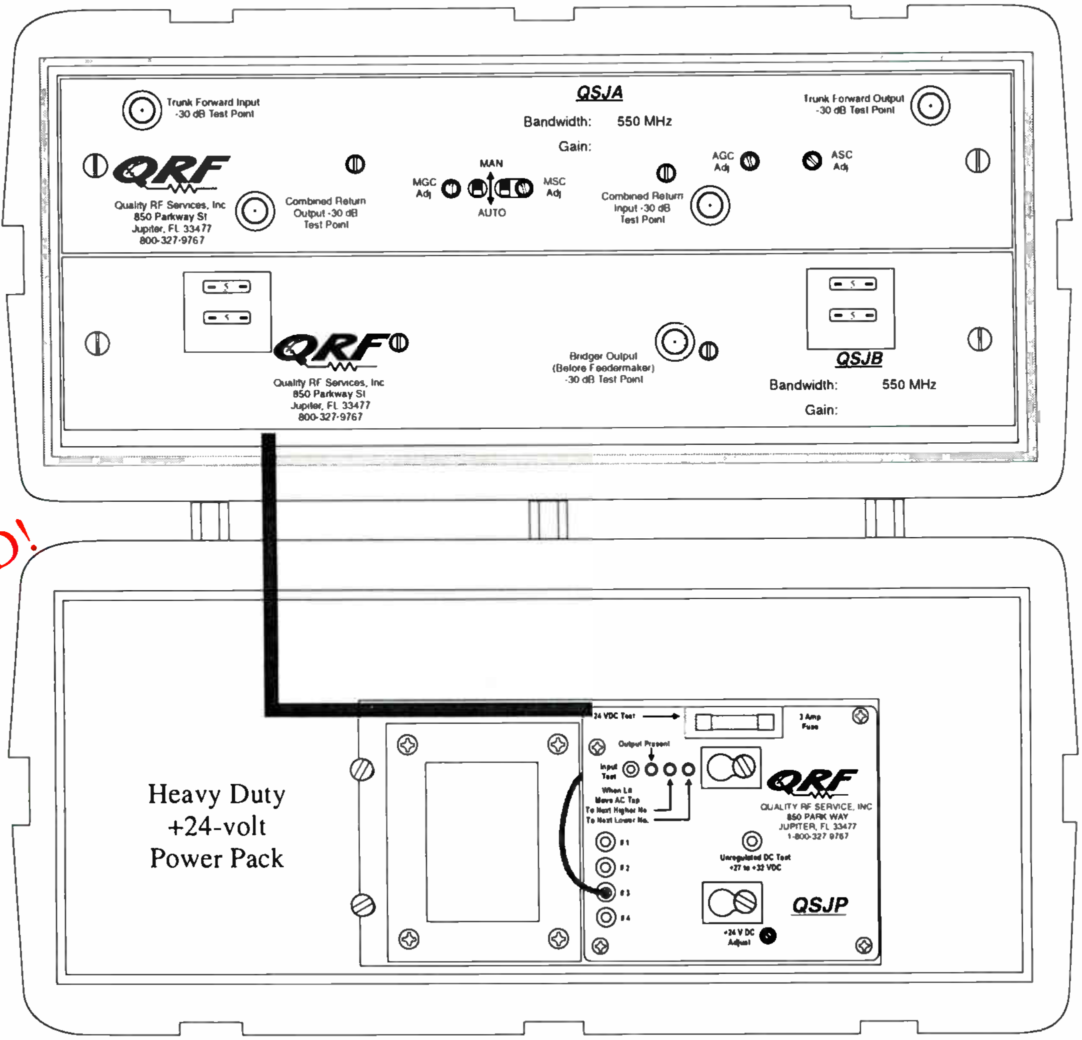

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Reader Service Number 89

Stringing blocks

As part of a new line of aerial construction tools, Jameson Corp. introduced two new sets of stringing blocks, Easy Rider and Versa Block. The Easy Rider overlash block is 1.5 inches in width and features a steel frame and brass roller axle for cable alignment. The Versa Block allows for cable placement from aerial lift buckets or from the ground using lay-up sticks.

Reader service #308

Analog set-top

Pioneer New Media Technologies introduced the BA-V2000, an advanced analog set-top offering a full-featured cable solution with 860 MHz tuning. The device features greater interactivity and full downloadability for the user with a user interface, fully encrypted conditional access decoding for high security and communications from their 64 kbps out-of-band data carrier, 40 kbps per field in-band data, and 19.2 kbps contention-based upstream data.

Pioneer's BA-V2000 offers 288 x 192 dot graphics resolution, (16 out of 4,096 colors); a WINK engine; 32-bit CPU with 6 MIPS technology allowing real-time OS, multitasking and preemptive task switching.

The set-top was designed to be subscriber-friendly with an easy-to-read front panel clock display, A/B bypass switch, a VCR controller, Ch. 3/4 RF and baseband stereo outputs, a memory expansion option as well as a preloaded application. The standard BA-V2000 configuration offers encrypted conditional access data, downloadable security algorithms, a secure microprocessor, DPS and GSS decoding, slave control, and optional multivendor compatibility.

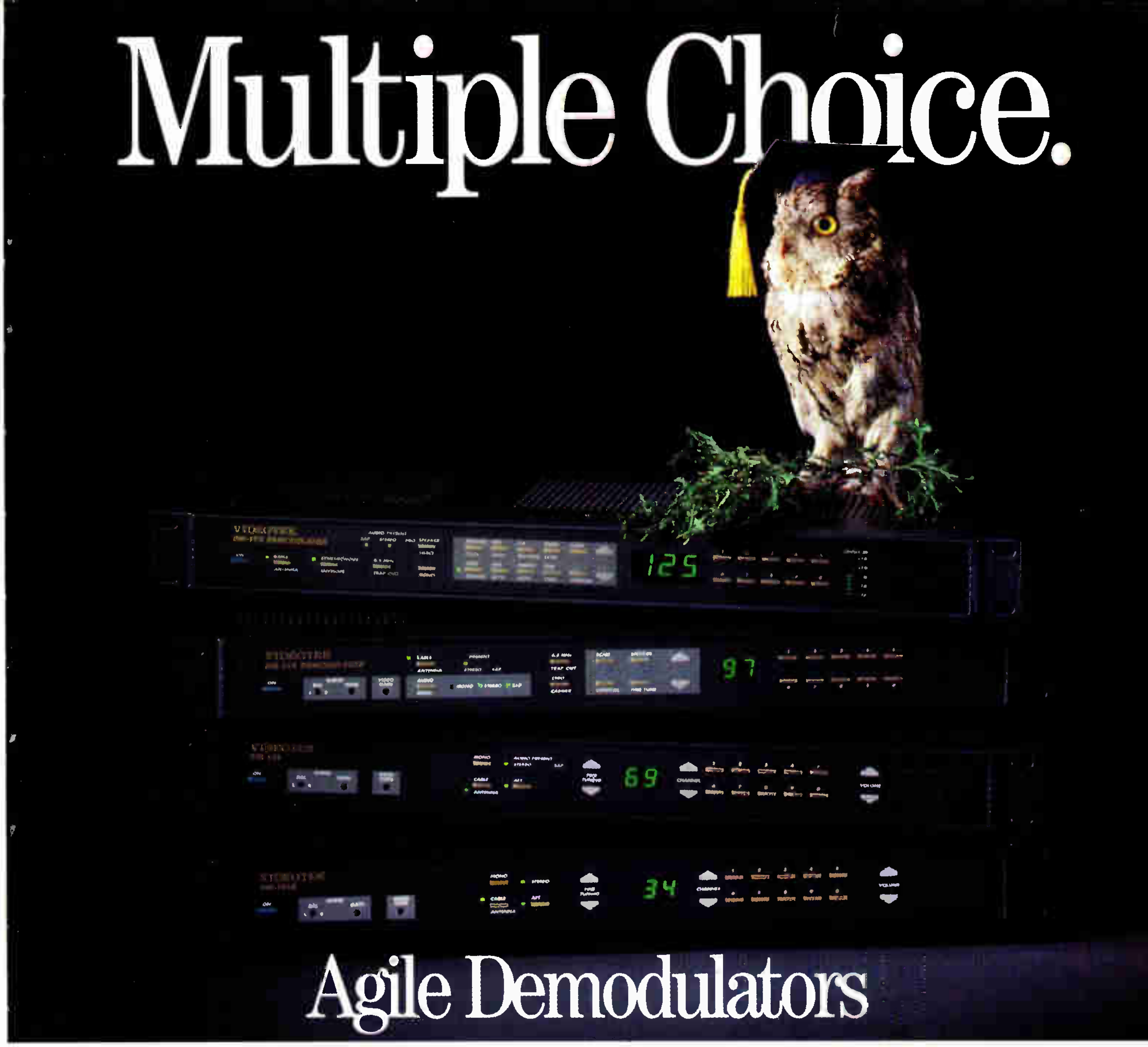
Reader service #292

Splice case

MultiLink unveiled a splice case that accommodates 144 mechanical/fusion splices or up to 288 ribbon count splices. Installation and reentry does not require mastics, heat shrink or drilling. The case is available with the cover, allowing midspan through splicing and a complete line of splice trays and mounting options.

MultiLink also has designed a nonconductive Sno-Shoe for 90° locations where traditional configurations are not applicable. The 16-inch diameter circle design allows two half-circle units to be adjusted to desired coil diameter and up to a 25-inch captive length. A 2- x 2-inch channel allows numerous coil wraps while preventing microbends.

Reader service #290 →


Multiple Choice.
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Fiber products

Pirelli is entering the North American connectivity and premise cable marketplace with products to terminate and distribute optical fiber cables in cable TV headends and telecommunications central offices.

The key products available from Pirelli include SC- and FC-type cable assemblies, fiber management systems, optical receiver node cables and riser and plenum interconnect and distribution cables. The cables are available in APC or Ultra PC, and all are inspected for ferrule surface finish, insertion loss and return loss. Assemblies include a serial number for traceability and are available for both single-mode and multimode fiber.

Reader service #294

Amplifier

Philips Broadband Networks' Diamond Net optical node amplifier (6-DNA) features four active power doubling outputs with full-analog capabilities at 862 MHz. The four-port DNA can be configured to provide up to four high-level (distribution) outputs or a combination of low-level (trunk) and high-level outputs. The unit has fewer external splits than conventional units and its right angle ports are adaptable to both pedestal and underground installations.

The four-port DNA also features a 90%-efficient switching mode power supply and has an input voltage range of 42-90 VAC making the unit readily adaptable to both 60 and 90 VAC systems. With the addition of a seventh port powering kit, power inserters are no longer required. The unit also supplies 15-amp power-passing capability at -70 dBc hum modulation allowing for greater reach, simplified maintenance and increased control of the powering system.

Reader service #307

Level monitor

The Cheetah Ping Level Monitor from Superior Electronics pinpoints subscriber groupings affected by service outages by monitoring power levels in three frequency bands. Operators receive an alarm if power levels fall off or are out of specifications that are user definable.

Based on ASIC technology, the Ping Level Monitor also can be used to facilitate return path level balancing. The monitor is an addition to the Cheetah status and performance monitoring system and is fully compatible with CheetahNet software.

Reader service #302

ANTRONIX® Brings "Plug And Play" Technology To The CATV Industry !

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Multiplexing

News Digital Systems introduced a new statistical multiplexing system, Reflex, which enables operators to achieve improved levels of transmission efficiency and picture quality through dynamic allocation. Reflex works in conjunction with the widely-adopted DMV System 3000 digital video compression solution to quickly identify changes in video source material and automatically varies the allocated bit rate in real time during live service transmission. It maintains the optimum balance of video quality and bandwidth economy at any given time for each individual video channel. Reflex automatically handles content variability, which eliminates the operators's need to set up complex scheduling systems.

The integrated system reduces the bit rate of the digital video signal to between 1% to 5% of the original. Redundant information is removed from areas of low detail and areas of low or predictable movement. Buffers are used to regulate the thresholds of the process to ensure that the output rate is maintained at a constant level.

Reader service #291

HFC products

West End introduced the newest members of its WestBound 9600 family of products, which enables voice, data and LAN communications over HFC broadband infrastructures. The WestBound network interface unit (NIU) with integral Ethernet router enables HFC network connectivity for telephony, business data and Ethernet devices. The WestBound NIU family delivers multi-service applications including teleworking, business data access, residential Internet access and residential primary and second line telephone service.

Integral to the NIU is an Ethernet router for workstation connection in remote teleworking, high-speed residential Internet access or LAN interconnect for business applications. Full TCP/IP and Novel IPX protocol routing is enabled with 4.1 data compression, boosting throughput.

Reader service #284

Outdoor repeater

Cable AML designed its outdoor repeater, Model OAR-005, to operate in the 12.7 to 13.2 GHz (CARS) band. The repeater, the first in a family of outdoor repeaters operating at frequencies from 2 to 20 GHz, features a broadband design with solid-state microwave technology.

Cable AML's proprietary linearization technology is incorporated in the repeater. Despite possible outdoor ambient temperatures of between -40 and +500° C, this thermal design allows for a low-device operating temperature and does not compromise the operating lifetime of the power amplifier. An AGC circuit maintains steady output power and a low specified distortion over the full outdoor temperature range.

Reader service #278 →

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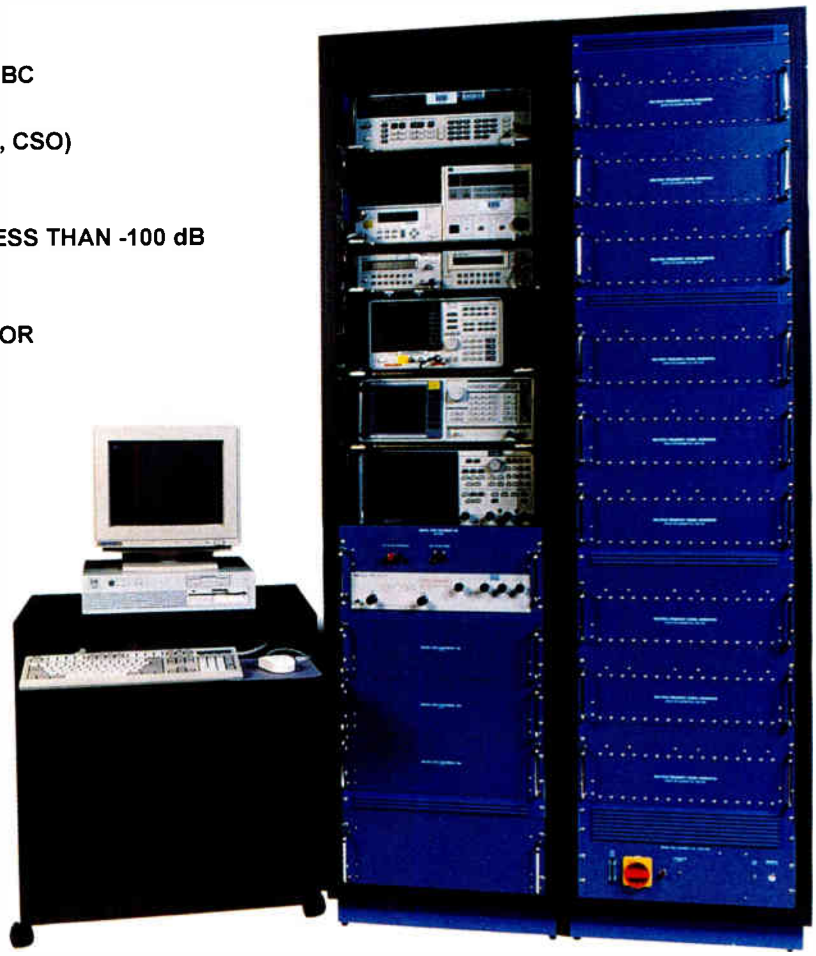

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Return tester

Trilithic's Guardian RSVP is said to be the first return path testing instrument specifically designed for the needs (and the equipment budget) of the cable TV installer. The RSVP works with a Trilithic 9580 SST sweep and ingress analyzer mounted in the headend. The RSVP automatically verifies that the level needed to communicate with the headend is within the range of the set-top terminal, then automatically measures the carrier-to-ingress and carrier-to-noise ratios of the entire return path, from set-top terminal to the headend. The RSVP scores the results as "pass" or "fail" and displays the measurement data.

The Guardian IsoMeter is used with the Trilithic Guardian RSVP to test the shielding effectiveness of house cabling. The RSVP injects a tone-modulated test signal into the subscriber's house cabling. The installer uses the IsoMeter to track down leakage of the test signal caused by broken shields, loose connectors or other sites that would admit ingress. The IsoMeter emits an audio tone that varies with leak amplitude, to help track down shielding problems.

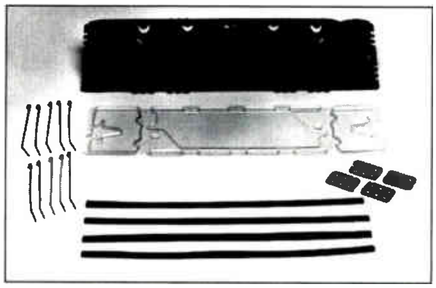
Reader service #280

Amp, coupler

Qintar's new STV-525LA, a higher gain, in-line amplifier with passive return is making it possible to combine over-the-air signals with satellite signals to provide local programming. It has a frequency range of 950-2,050 and can be used for amplifying satellite (DSS), MATV and MMDS signals. STV-525LA is completely weatherproof and comes with a five-year warranty.

Qintar also released DCW1G-*, a new indoor high-frequency directional coupler for use with satellite systems. It has tap values of 6 dB to 30 dB and can be used with applications requiring a directional coupler at higher frequencies, such as MDU. The coupler offers isolation, return loss and through-loss specifications, and a five-year warranty.

Reader service #298



Splice trays

Two new fiber-optic splice trays designed for convenient maintenance and easy splicing and designed for use with the 3M brand 2178 and 2178-S fiber-optic splice case, are now available from 3M. The 3M 2522 small fiber splice tray and the large fiber splice tray accommodate most types of splices and combine with 3M fiber-optic closures to provide protection for splices in underground, aerial and pedestal applications.

For smaller splicing jobs, the 2522 splice tray organizer holds up to two 3M brand 2521 series splice inserts and for larger splicing jobs, the 2523 splice organizer holds up to four 2521 series splice inserts.

Reader service #304

Two-way pack

Cable operators will be able to offer subscribers two-way data capability over the coaxial cable installed in a majority of American homes through a new IBM package of hardware, software and services called IBM Cable On-Line. The IBM-developed cable modem, access system and operational support system make it possible for cable operators to deploy data services at 30 Mbps into the home or small office and 2.5 Mbps from the modem into the network. This access speed represents a dramatic advantage over standard telephony modems that transmit data at 28.8 kbps and ISDN lines that transmit data at 128 kbps.

By using asynchronous transfer mode (ATM) technology as the underlying transport technology, IBM Cable On-Line makes it possible for cable operators to apportion bandwidth and customize a subscriber's service.

Reader service #279 →

A Bright New Light in the Headend Universe

PULSAR

BARCO introduces PULSAR, a revolutionary modulator for CATV headend applications requiring high quality RF signal and automatic provisioning. PULSAR offers remote monitoring and control of all modulator functions. An intelligent "white limiter" and video AGC prevent overmodulation and automatically optimize video input signal levels.

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Easy-to-use front panel keys allow direct control of video and audio RF levels, modulation depth, frequency deviation, and input switching. An RS-485 interface allows remote control of the unit.

Maximum Flexibility

PULSAR operates with 110 Vac or -48 Vdc, making it compatible with both conventional CATV or Telco powering schemes. The modulators feature IF substitution and are compatible with all major scrambling techniques.

Find Out More!

PULSAR gives CATV operators and Telcos an entirely new dimension in signal and service delivery. To find out why PULSAR will transform the future of headend modulators, call 770/218-3200.

- High RF Output Over the Entire Frequency Range
- White Limiter and Video AGC
- Auto Set-Up, Auto Alignment
- Complete Software Control for Monitoring and Backup
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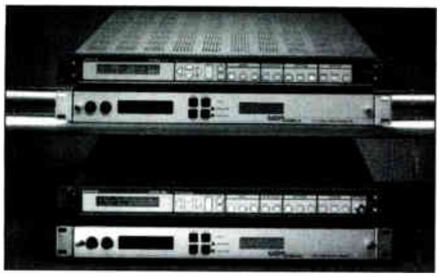
Reader Service Number 23



Transmit system

Barco launched Lynx, a transmission system allowing high-speed transport of original headend quality signals over long distances. The system includes Barco 12-bit codecs combined with C-COR's 3.1 Gb/s 16-channel digital optical terminals at the transmit and receive sites.

It provides undistorted IF output at the decoder and is suited for network applications that require the linking of multiple hub sites via a redundant ring. Lynx interfaces with ROSA, Barco's operations support system (OSS), adding network management capabilities.

Reader service #306

Distribution, management products

ADC Telecommunications launched its RF Worx family of products, a new line of modular, high-performance RF distribution and management products. ADC's RF Worx product line consists of a series of modular RF splitters, combiners, attenuators, equalizers, monitors and amplification redundancy switch products designed to simplify headend signal management for any 5 MHz to 1 GHz application.

The modular design provides flexibility to support future growth and headend reconfiguration. RF Worx products help reduce up-front costs by allowing modules to be added as the need to support expanding services offerings arises. The RF Worx modules are housed in one chassis location at the front of an equipment line-up so that tuning and adjustment of signals can be accomplished in a complete assembly, rather than at several diverse component locations throughout the headend.

The RF Worx splitter or combiner modules work in headend combing, distribution, narrowcast insertion and reverse path applications. When configured in a system, the RF Worx product line will provide high isolation, allowing shared frequencies to be reused without amplification. A large variety of modules is available to ensure a correct signal combining.

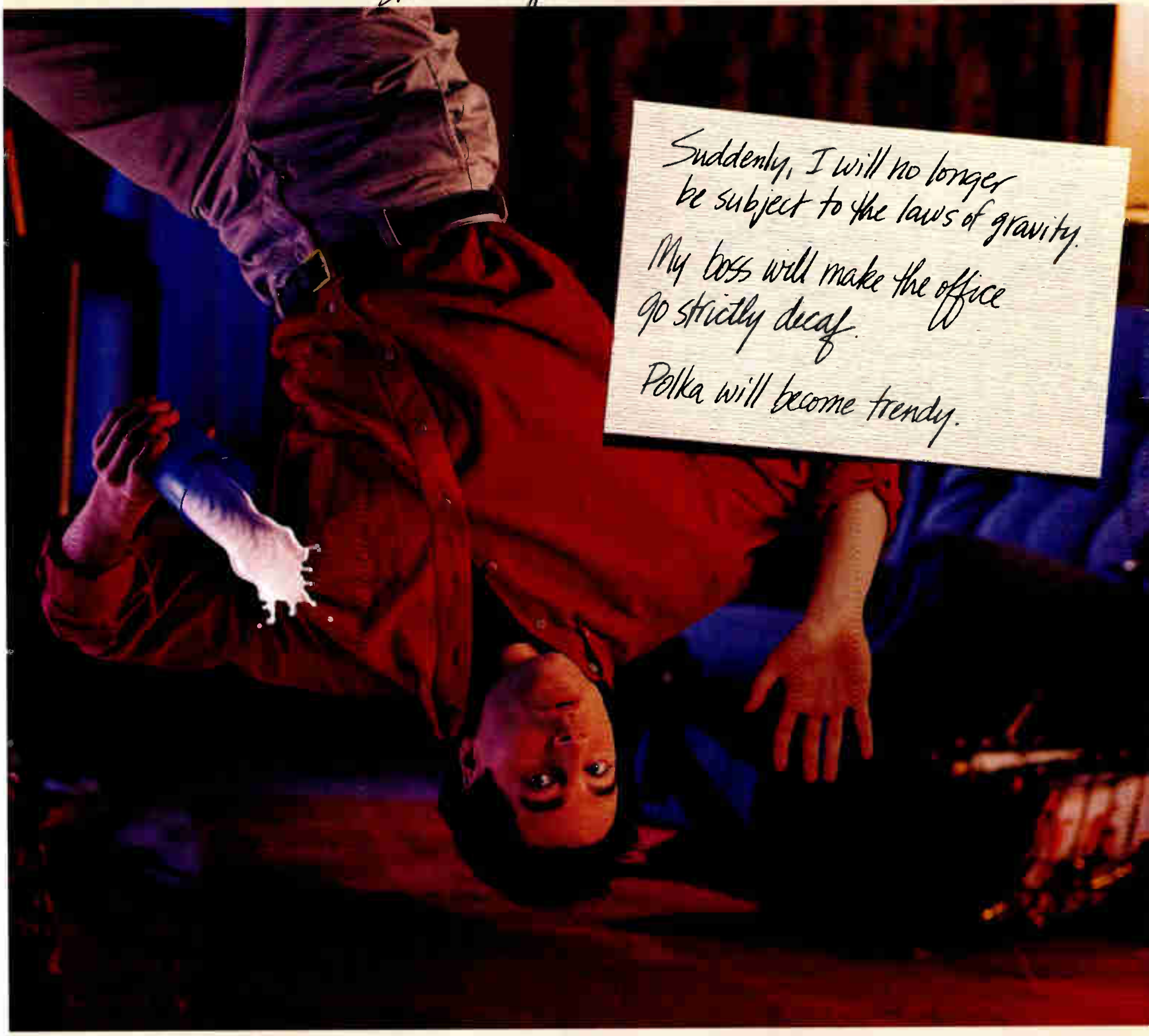
Reader service #272

Hybrid solution: Headend-to-hub

ATx Telecom Systems, a Scientific-Atlanta company, introduced the Javelin 1,550/1,310 hybrid solution for headend-to-hub interconnects. The combined performance of Javelin transmitters and EDFAs provides the high power needed to retransmit through the Scientific-Atlanta System 70 1,310 transmission network and maintain four to six RF amplifier cascades on the coaxial portion of the HFC network.

Reader service #300

THE FEARS OF *Steve Ringer*, CATV NETWORK ENGINEER



BUT AS FOR THE FUTURE OF HIS NETWORK, HE HASN'T GOT A CARE IN THE WORLD.

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***Reader Service Number** 67*

Ingress management

New from AM Communications is the scanning ingress management system (SIMS). The product, in conjunction with the OmniVU system software, provides a significant tool for managing and controlling the return path noise that interferes with many HFC systems. This technology is currently being delivered to domestic and international customers. The SIMS ingress analyzer is a headend unit that monitors the return path spectrum of up to eight inputs. This unit is typically configured to signal an alarm if the background noise or ingress rises above a user-defined threshold.

SIMS, which is OmniStat compliant, integrates with the OmniVu control system to identify the source of system noise in two-way transmission plants. Operators are then able to make system level adjustments through the element management system to minimize the effects of the identified noise source.

Reader service #288

Modular transmission system

The Synchronous Group introduced the Constellation Series, a new product family of modular fiber-optic transmission elements designed to provide the user maximum flexibility in system design and deployment. All of the optical elements are interchangeable, providing multiple configurations to meet any system requirement. Constellation's elements use a common intelligent platform and include: Antares, a new, high-performance 1,550 nm external modulation transmitter; Sirius, an erbium-doped fiber amplifier (EDFA); Orion, a lower power 1,550 nm transmitter; and Pegasus, a new line of 1,310 nm DFB transmitters. The system contains a complete internal status monitoring system and offers an SNMP proxy agent to allow full network management capability.

The Antares EM transmitter allows the operator to configure a dual-transmitter system with an internal optical switch for full backup and automatic projection switching. It also may be configured for operation as two independent transmission elements. The Sirius EDFA element may be used in conjunction with the transmitter or separately as an independent optical amplifier. The Constellation CS platform holds up to eight optical elements and provides direct reading, slot independent status monitoring for any element in the system.

Reader service #275

Modular receiver

Harmonic Lightwaves developed the HRM 3810 rack-mount receiver for broadband networks. The 870 MHz 3810 modular forward path receiver fits directly into Harmonic's HLP 4000 platform. Its housing is identical to the compact design of Harmonic's PWRLink DFB transmitter and MAXLink transmitter and optical amplifier modules. The HRM 3810 offers an RF power detector and alarm for detection of system problems before signals reach the optical link. If a problem is detected, the nature and location of the problem are indicated on the alphanumeric display of the HLP 4000. In addition, an alarm LED is activated on the receiver module's front panel. The HRM 3810 supports a broad range of optical input levels from -6 to +3 dBm. It features GaAs amplifiers.

Two receivers interface for automatic backup. The receivers also have built-in comprehensive local and remote management capabilities, enabled through embedded microprocessors and Harmonic's NETWatch element management system.

Reader service #287

Leak detector

The new Search Lite from Trilithic is an installer's leakage detector designed for the new era of overbuilt systems. Lightweight, simple to use and as small as a pager, the Search Lite is the successor to Trilithic's Searcher.

The Search Lite is compatible with Trilithic's patented Channel Tagging System, and is immune to "false alarms" caused by motor noise, power line interference or leakage from overbuilt cable systems.

Reader service #296→

Wavetek's Multi-User Stealth Reverse Sweep

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Reader Service Number 55

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System decoder

Toshiba America Electronic Components launched its system decoder IC for set-top box (STB) and DVD applications—the TC81220F—providing the industry's highest level of integration onto a single chip for interactive TV applications. These functions include Toshiba's R3900 MIPS RISC processor core (R300 A-based architecture), a programmable transport processor, dedicated MPEG-2 video and audio decoder cores, a software modem, a development and debug interface, synchronous dynamic random access memory (SDRAM) and dynamic random access memory (DRAM) controllers and the necessary peripherals (smart card interface, DMA controller, timer, modem interface, VCXO interface, audio and video DAC interface, and P1394 interface).

Applications for the TC81220F include direct broadcast satellite (DBS), transport standards such as DirecTV's Digital Satellite System (DSS), Digital Video Broadcast (DVB) and (DMC). The chip also supports DVD program stream, digital cable TV, and MMDS wireless cable technology. The system can decode various encoded MPEG-2 transport streams in 16:9 or 4:3 resolution to deliver superior quality video output. The programmable transport processor supports 32 Packet IDs (PIDs) and is fully DVB, DSS, DMC and DVD compliant. A DVB descrambler is integrated on the chip, combined with the embedded RISC microprocessor.

Reader service #271

Double-tier capacity

Electroline's MTS, an MDU system that remotely controls analog bandwidth without using set-top decoders, signal filters or signal encoding, has doubled its capacity from eight tiers to 22 separate program tiers, and may include as many as four broadband tiers. Service to multiple dwelling units can be remotely activated or disabled by a few strokes on a PC keyboard.

Reader service #276

Enclosure

Alpha Technologies added a new ground-mount enclosure to its line of cable TV enclosures. The CTER is an all-aluminum, weather-resistant enclosure finished in a durable powder coat, providing corrosion resistance and long service life.

The enclosure solution maximizes working space while minimizing visible neighborhood hardware intrusion. Expanded work space allows the collocation of power supply, standby batteries and other system active and passive devices, reducing the total number of enclosures required in the system. The CTER enclosure is compatible with all Alpha AM and XM Series power supplies and can be configured in a variety of customer-specific applications.

Reader service #277

Cable modem

New Media's Cyber City cable modem system uses broadband cable TV networks for downstream communication and narrowband phone line for upstream communication. (The system can be implemented on wireless cable and satellite networks as well.) A bidirectional solution that supports both upstream and downstream communication over the HFC network will be available this year. Cyber City connects the cable TV's headend via a high-speed line (WAN connection) to an existing Internet services provider. The end user is supplied with the Cyber City internal cable modem that is hooked directly to the cable network (like a standard TV set). In addition to the cable modem, the end user station includes a telephone modem in order to support the uplink transmission to the ISP center.

The Cyber City navigator is a fully animated, color-rich, icon-oriented end-user interface that enables an intuitive navigation in cyberspace. The system offers three security levels—a network management system, hardware ID and logon procedure and user password. The network management system (NMS) option gives complete control to the service provider on the access of each user to any specific service.

Reader service #286→

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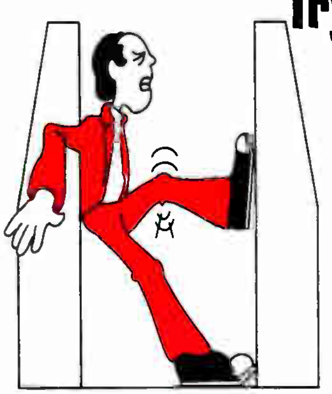

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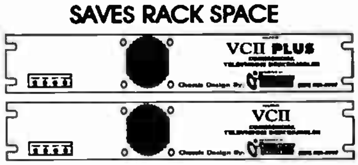

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Modem products

Terayon Corp. announced the availability of its cable modem products, including the TeraPro cable modem, the TeraLink 1000 Master Controller and the TeraView Element Management System. Tests of Terayon's 14 Mbps system utilized a 6 MHz slice of spectrum in the 11-17 MHz band. Terayon's cable modem is based on synchronous code division multiple access (S-CDMA), a spread spectrum approach for enhanced performance in high-noise conditions.

Tests were conducted in both treated and untreated cable plants: one clean node passing 3,400 homes, one unswept node passing 6,200 and an aggregate of eight fiber nodes passing over 300,000 homes. The Terayon cable modem system operated with 0 bit errors 98.3% of the time, even in narrowband interference conditions at 13 dB. Operators can offer multiple classes of tiered services, including premium, guaranteed services for business users who demand high-bandwidth capability. Operators also can capitalize on high-speed applications such as telecommuting, corporate Intranets, video conferencing, multimedia and on-line games.

Reader service #283

Receivers/decoders

TV/COM International announced a new family of professional integrated receiver decoders (IRDs), the P2000 Series, for the digital cable industry. These digital cable headend products address a rapidly growing need to accelerate the delivery of digital video to the consumer. The entry-level P2020 specifically targets cable TV, private/business TV (BTV) networks and SMATV (satellite master antenna TV) applications.

The product provides one video stream and two audio services. In addition to the SCPC (single channel per carrier) capability, the P2020 provides MCPC (multiple channels per carrier) capability. Other products in the P2000 line will include the P2040 and P2060, targeting the mid- and high-ends of the market, respectively. The P2020 features TV/COM's patented variable rate demodulator (VRD) QPSK receiver technology (2-90 Mbps). An optional conditional access module and smart card also are available, providing security for programming in compliance with MPEG-2 and digital video broadcasting (DVB) standards.

The P2020 feature set includes extended L-band (950-2150 MHz) single satellite input, high quality video/audio composite output (NTSC or PAL) and VBI (vertical blanking interval) re-insertion, including teletext or closed captioning.

Reader service #273

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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.

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

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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


INTRODUCING...
System Showcase
A NEW quarterly feature in *Communications Technology*
Learn how top cable operators are incorporating the latest technological advances into their systems.
Beginning in March, **System Showcase** examines a leading cable operation and explains how its engineers are utilizing new network architectures and hardware to broaden their services, overcome challenges and prepare for the future.
If you're planning to upgrade or enhance your system, this in-depth feature is a must-read!
And it's only available in ***Communications Technology***, the official trade journal of the Society of Cable Telecommunications Engineers.
COMING NEXT MONTH:
Video, Voice & Data Over HFC:
It's Closer Than You Think

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

☛ *SCTE Installer Certification, Assuring Quality Performance*—SCTE Director of Training Ralph Haimowitz provides an overview of the Society's Installer Certification Program, which will aid in the implementation of the program in your company. (45 min.) Order #T-1071, $20. **(Reference for Installer Certification)**

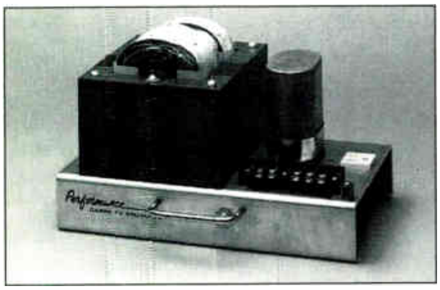
☛ *Signal Leakage, CLI and the FCC*—Robert V.C. Dickinson, Brian James and John Wong give a frank discussion of the new rules for signal leakage, including maximum leakage levels, methods of measuring, computations and offsets. (1 hr., 20 min.) Order #T-1073, $45.

☛ *Supervisory and Management Skills*—Rollins University Professor Bill Brown deals with such topics as employee turnover, absenteeism and poor job performance. How can you turn these problems around? Is money the answer? What do employees hope for in an ideal effective and motivating leader? This program provides insight to these problems that face every cable operator. (1 hr., 15 min.) Order #T-1074, $45. **(Reference for BCT/E Category VII)**

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.

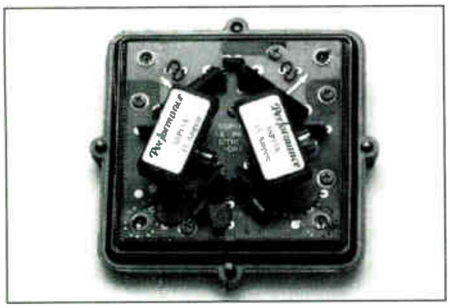
To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment 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. **CT**



REPLACEMENT FERRO fits most manufacturers cabinets

The Performance Model FR2000 60V/16A Ferroresonant power supply is designed to replace or retrofit discontinued and obsolete power supplies. It fits most existing cabinet configurations and connects using existing wiring. Price is $299, call 800/279-6330.

Reader Service Number 115



SURGE-GARD protects against nuisance fuse blowing and resets in 60 seconds

Self-resetting circuit breaker fits fuse clips in Jerrold SSP power inserters. The Performance Surge-Gard replaces fuses in locations where they frequently blow for no apparent reason causing unnecessary truck rolls. Merely remove the undependable fuse and snap-in the Surge-Gard. Specify Model SG15A for 15 ampere protection. Cost only $17 (100 & up). Call toll free 800/279-6330.

Reader Service Number 116

VOLTEX CATV-27 Standby battery costs only $64.95

Best high temperature battery available! Normally outlasts valve regulated gelled electrolyte batteries two to one in CATV applications and provides as much as 15% longer run time. By far the best battery value on the market today. Call Performance today for details 800/279-6330.

Reader Service Number 117

BATTERY TESTER checks 12 volt standby batteries automatically

The Performance Model BT 1200 universal battery tester checks gelled electrolyte and lead acid batteries in 10 seconds. Since batteries deteriorate gradually, regular testing with this unique device enables you to log changes in voltage levels as they occur. Having this history lets you know when to do preventive maintenance before a critical battery fails. Price is $250. Order today, call toll free 800/279-6330

Reader Service Number 118

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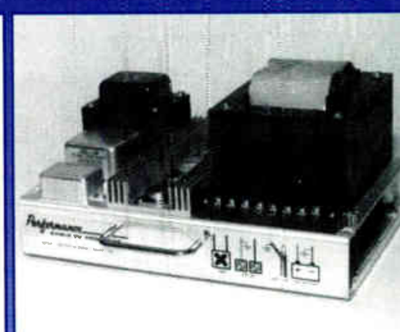

with this

The **Retro-Power** inverter is the replacement of choice for discontinued, obsolete and non-functional 60 Volt standby power supplies and is designed to fit directly into any manufacturers cabinet. Interconnection is easily done using existing wiring and for added savings, the unit may be used with any existing 60 Volt ferroresonant power supply. Adapters are available when replacing plug-in power supplies, allowing for quick and simple installation. Specify Model SB1000 priced at $499.00. Call today, toll free 800-279-6330

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Reader Service Number 124

February

1: SCTE Cascade Range Chapter, Installer Certification exams, TCI office, Salem, OR. Contact Cindy Welsh, (503) 667-9390, ext. 226.
8: SCTE Llano Estacado Chapter seminar, fiber basics, Cox Cable office, Lubbock, TX. Contact David Fielder, (806) 793-7475, ext. 4518.
10-11: Society of Cable Telecommunications Engineers regional training seminar, "Introduction to Telephony," Columbus, OH. Contact SCTE national headquarters, (610) 363-6888.
12: SCTE Bluegrass Chapter seminar, transportation systems, Holiday Inn, Elizabethtown, KY. Contact Max Henry, (502) 435-4433.
12-14: Society of Cable Telecommunications Engineers regional training seminar, "Introduction to Fiber Optics," Columbus, OH. Contact SCTE national headquarters, (610) 363-6888.
17-18 and 19-21: American Research Group, fiber-optic design course, Albuquerque, NM. Contact Mike Morris, (919) 461-8630
18-20: OFC '97 conference, Dallas. Contact the Optical Society of America, (202) 416-1980.
19-21: Texas Show '97, San Antonio, TX. Contact the Texas Cable & Telecommunications Association, (512) 474-2082.
24-25 and 26-28: American Research Group, fiber-optic design course, Morristown, NJ. Contact Mike Morris, (919) 461-8630.

March

3-4: Society of Cable Telecommunications Engineers regional seminar, "Data Technology for Technicians," Holiday Convention Center, Omaha, NE. Contact (800) 542-5040.
3-4: Society of Cable Telecommunications Engineers regional training seminar, "Introduction to Data Communications," Omaha, NE. Contact SCTE national headquarters, (610) 363-6888.
4-6: Washington State University course, "Telecommunications Infrastructure Planning—Strategic Planning for the Telecommunications Needs in Buildings," Atlanta. Contact (800) 942-4978.
5: SCTE Great Plains Chapter vendor day and technical seminars, Holiday Convention Center, Omaha, NE. Contact Duff Campbell, (402) 466-0933.
6-7: Society of Cable Telecommunications Engineers regional training seminar, "Introduction to Telephony," Holiday Convention Center, Omaha, NE. Contact (800) 542-5040.
13: Society of Cable Telecommunications Engineers Satellite Tele-Seminar program, Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET, "BCT/E Category IV Overview." Contact SCTE national headquarters, (610) 363-6888.
16-19: National Show '97, New Orleans. Contact the National Cable Television Association, (202) 775-3669.
20: SCTE Big Sky Chapter, seminar and BCT/E and Installer Certification exams to be administered, Jackson Creek Saloon, Helena, MT. Contact Marla DeShaw, (406) 632-4300.

April

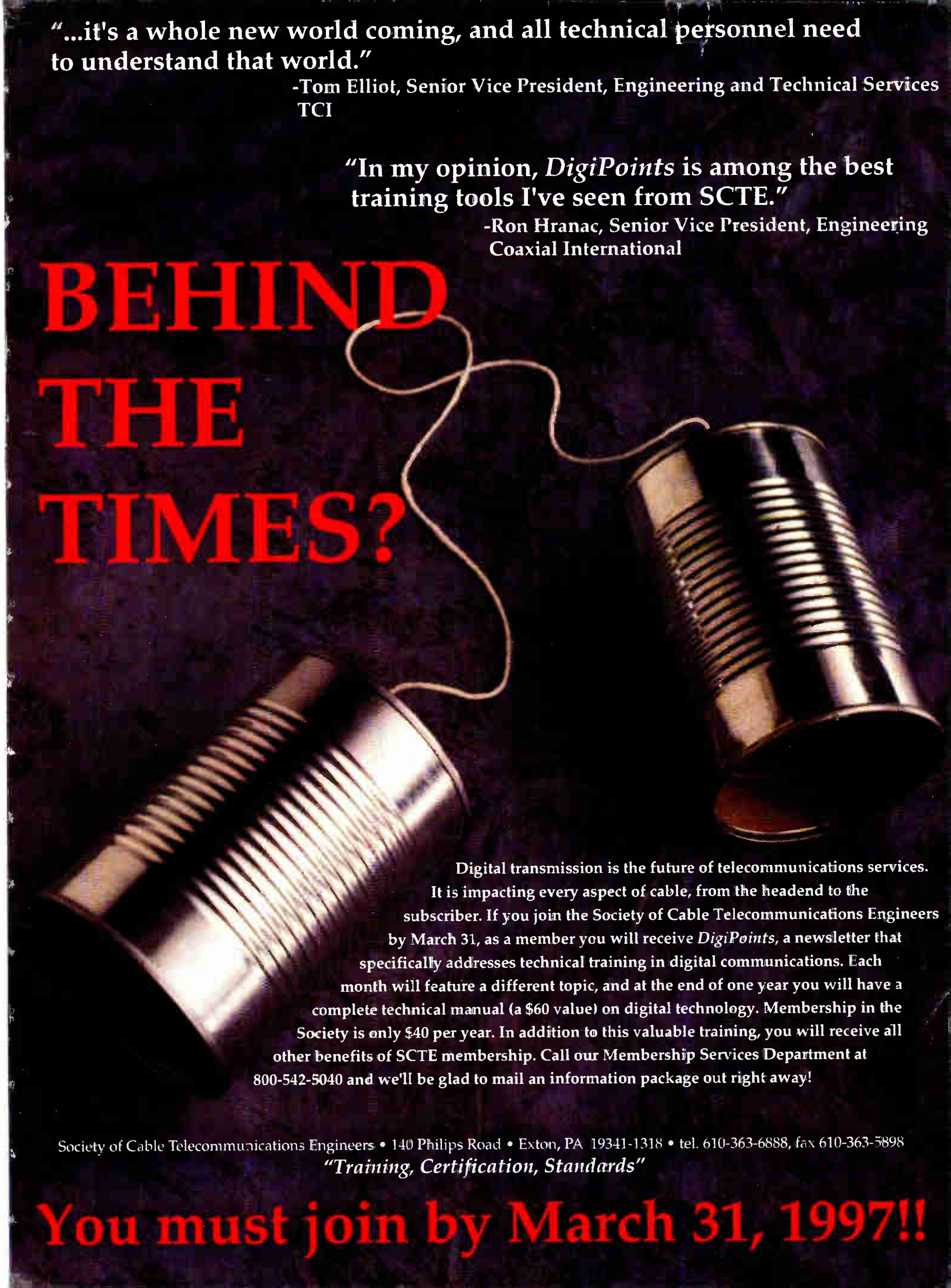
8: Society of Cable Telecommunications Engineers regional training seminar, "OSHA/Safety," Portland, OR. Contact SCTE national headquarters, (610) 363-6888.
9-11: Society of Cable Telecommunications Engineers regional training seminar, "Introduction to Fiber Optics," Portland, OR. Contact SCTE national headquarters, (610) 363-6888.
9: SCTE Delaware Valley Chapter vendor fair, Williamson's Restaurant, Horsham, PA. Contact Chuck Tolton, (215) 657-5850.
10: Society of Cable Telecommunications Engineers Satellite Tele-Seminar program, Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET, "BCT/E Category V Overview." Contact SCTE national headquarters, (610) 363-6888.
10: SCTE North Central Texas Chapter, seminar, EAS and telco updates, Contact Lynn Watson, (817) 790-7557.
17: SCTE New England Chapter, BCT/E and Installer Certification exams, Marlboro, MA. Contact Tom Garcia, (508) 562-1675.
19: SCTE Llano Estacado Chapter seminar, headend tests and measurements, Cox Cable Office, Lubbock, TX. Contact David Fielder, (806) 793-7475, ext. 4518.
22-24: Washington State University course, "Telecommunications Infrastructure Planning—Strategic Planning for the Telecommunications Needs in Buildings," Atlanta. Contact (800) 942-4978.
24: SCTE Michiana Chapter, BCT/E and Installer Certification exams, LaPorte, IN. Contact Russ Stickney, (219) 259-8015.
28-29: Society of Cable Telecommunications Engineers regional training seminar, "Introduction to Telephony," Tampa, FL. Contact SCTE national headquarters, (610) 363-6888.
April 30-May 2: Society of Cable Telecommunications Engineers regional training seminar, "Technology for Technicians II," Tampa, FL. Contact SCTE national headquarters, (610) 363-6888.

May

11-14: Canadian Cable Television Association Convention and Cablexpo, Toronto. Contact the CCTA, (613) 232-2631.
13-15: Washington State University course, "Telecommunications Infrastructure Planning—Strategic Planning for the Telecommunications Needs in Buildings," Atlanta. Contact (800) 942-4978. **CT**

Planning ahead

June 2-5: Supercomm, New Orleans. Contact U.S. Telephone Association, (202) 326-7300.
June 4-7: SCTE Cable-Tec Expo '97, Orange County Convention Center, Orlando, FL. Contact SCTE national headquarters, (610) 363-6888.
Aug. 18-20: Great Lakes Cable Expo, Indianapolis. Contact (317) 845-8100.
Oct. 14-16: Mid-America Cable Show, Kansas City, MO. Contact (913) 841-9241.
Oct. 20-22: Eastern Cable Show, Atlanta. Contact the Southern Cable Television Association, (404) 255-1608.
Dec. 10-12: The Western Show, Anaheim, CA. Contact the California Cable Television Association, (510) 428-2225.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CABLE TRIVIA

By Rex Porter

Our historical guru (aka Editor Rex Porter) has provided us with these trivia questions on the cable industry. Answers to the last set of questions appear first. (The last "Cable Trivia" ran on page 140 of the December issue.) Look for answers to this month's questions in a future issue (along with a new set of questions). The person supplying the most correct answers will be awarded a special Trivia T-shirt. You may only win once per calendar year.

To be in the running for a prize, your answers need to be postmarked or faxed to us by the 20th of the month of the issue date that the specific trivia test appears in. The first person who sends in the most correct answers will be the award winner. Good luck!

Your answers need to be sent to: The Trivia Judge, *Communications Technology*, 1900 Grant St., Suite 720, Denver, CO 80203 or fax: (303) 839-1564.

Trivia #12 answers

1) Feb. 8, 1996
2) New Jersey
3) Alexander Graham Bell
4) Bill Daniels
5) Hidetsugu Yagi
6) Greg Liptak

Trivia #13

1) Awarded the Larry Boggs Award in 1978, he previously managed both broadcast stations and cable TV systems. He has served almost every position of the NCTA board and his son is a well known member of the Society of Cable Telecommunications Engineers. He is:
- A) Rex Bradley
- B) Roy Bliss
- C) Ed Allen
- D) Isaac Blonder

2) A Professional Engineer, he is a Senior Member of the SCTE, a member of the IEEE, a fellow of the AES, among numerous other organizations. He is the author of "Hey Man—Why Man?" He leads a company that can help technicians sniff out any problem with ingress/egress. He is:
- A) Bob Spann
- B) Bill Bresnan
- C) Sid Topol
- D) Warren Braun

3) Receiving extensive training from the USN radar schools, he began his cable TV career with Teleprompter in Elmira, NY. Leaving New York, he continued his career throughout south Texas and finally ended up in Big D, heading up engineering for one of the large MSOs of the '70s and '80s. He is:
- A) Ken Gunter
- B) Hank Cicconi
- C) Jack Stone
- D) Pete Collins

4) A 1948 graduate of the U.S. Naval Academy, he is an "original" member of the NCTA Pioneers. Presented the Larry Boggs Award in 1966, he was a founder of the Texas Association. Able to knock out a sweet tune on the ivories, he is:
- A) Ben Conroy, Jr.
- B) Frank Thompson
- C) Bill Daniels
- D) Charles Sammons

5) A graduate of Rice University, he was vice president of engineering for the first company to receive an HBO program via satellite in Fort Pierce and Vero Beach, FL. A member of IEEE, he has served the SCTE, being named Member of The Year. He is:
- A) Shorty Coryell
- B) Ralph Haimowitz
- C) Ken Gunter
- D) Joe Hale

And the winner is...

At press time, the winner for Cable Trivia #12 (which ran in the December 1996 issue) was not decided. Look for the winner's name to be published in a future issue of *Communications Technology*. **CT**

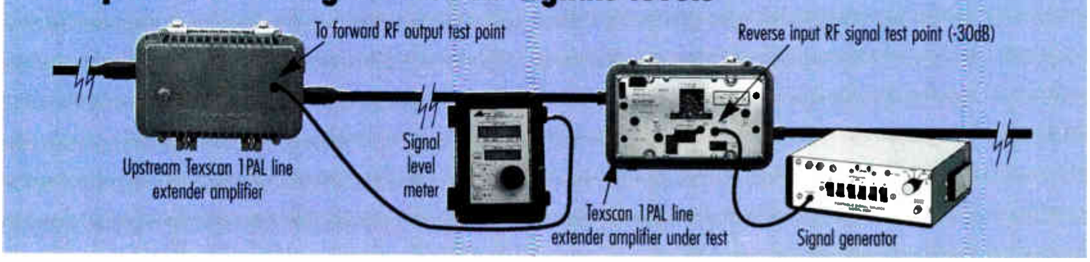
TRAINING

By the National Cable Television Institute

Return path in line extenders: Part 2

This month concludes the series on the return path in line extenders with a look at rough balancing the reverse RF signal. Although it specifically focuses on the Texscan 1PAL 750 MHz LE, many of the procedures are applicable to other like LEs. Its purpose is to provide useful information complemented by training suggestions to reinforce the material in a classroom setting. The top portion is excerpted from a lesson in NCTI's Service Technician Course. The hands-on training suggestions are modeled after NCTI's new facilitator training courses for administering the hands-on labs. © NCTI.

Setup for measuring reverse RF signals levels



Determining the proper reverse equalizer (EQ) value for a Texscan 1PAL 750 MHz line extender (LE) amp requires connecting test equipment, measuring reverse RF signals, performing calculations and selecting/installing the required EQ.

To connect test equipment as in the figure: 1) verify there are jumper wires in the reverse EQ and the reverse output and input attenuator pad plug-in locations; 2) connect a jumper cable between the RF output port of a signal generator and the reverse input RF signal test point of the LE under test; and 3) connect a jumper cable between the SLM RF input port and the upstream LE's external forward RF output test point, which in this case also functions as the reverse input RF signal test point without having to open the cover.

To measure reverse input RF signals for determining the required reverse EQ value: 1) use your system's design map to determine the system-required highest reverse video carrier signal level, and add 30 dB (the attenuation at the test point of the LE under test) to that signal level to obtain the required highest reverse input signal level; 2) set the signal generator to inject the required highest reverse input signal level; (3) measure and record the signal level at the SLM and add 30 dB (the attenuation at the test point of the upstream LE) to obtain the actual highest reverse video carrier signal level; and 4) if your system utilizes more than one reverse carrier, repeat steps 1-3 using your system's lowest reverse video carrier signal level to obtain the actual lowest reverse video carrier signal level.

To calculate the required reverse EQ value and to select and install that EQ: 1) calculate the required EQ value by subtracting the actual highest from the lowest reverse video carrier signal levels; 2) select an EQ value that provides a flat response between your system's highest and lowest video carrier signal levels; and 3) remove the jumper wire and install the selected EQ into the reverse equalizer plug-in location in the LE being rough balanced. If the required EQ value is zero, leave the jumper wire or install a 0 dB equalizer in the reverse EQ plug-in location.

Selecting reverse attenuator pad

Using the same setup (see figure) to determine the proper reverse attenuator pad value for the LE: 1) verify jumper wires are installed in the reverse output and input pad plug-in locations 2) set the signal generator to inject the required highest reverse input signal level; 3) measure the highest reverse video carrier signal level and add 30 dB (to include the 30 dB of attenuation at the test point of the upstream LE) to obtain the actual highest reverse video carrier signal level; 4) calculate the required reverse attenuator pad value by subtracting your system-required from the actual highest reverse video carrier signal levels; 5) select a pad with a value that is as close as possible to the required reverse attenuator pad value; and 6) remove the jumper wire and install the selected pad in the reverse output attenuator pad plug-in location.

Next month's installment will cover return path considerations in distribution amplifiers.

Hands-on performance training

***Proficiency objective:** Rough balance the reverse RF signal in your line extender amplifier(s).*

Summarize the main steps that are required to rough balance the reverse signal in your system's LE(s).

Make sure students understand why the signal level meter is connected to the upstream amplifier and not the LE under test.

Demonstrate measuring, calculating and installing the reverse equalizer, and then have students do the same.

Repeat this method for the reverse attenuator pad.

If your system uses more than one type of line extender, have the students practice the procedures to rough balance the reverse signal on all types.

Verify that each student can rough balance the reverse RF signal in your system's line extender(s). **CT**

CATV/VIDEO TECHNICIAN

Responsibilities include the maintenance and some operations of the University's two Cable-TV systems along with maintenance in other video and audio areas of WKU's Educational Television Service including WKYU-TV, Ch-24.

Qualifications: Good organizational, communication, and writing skills; the ability to work independently; working knowledge of DOS/Windows, IBM compatible PC's; two years of formal training in electronics or equivalent experience in electronics. Experience with Data Networking and the Internet preferred.

Applications for this position are available at the Department of Human Resources, Wetherby Administration Building, Room 42, Western Kentucky University, 1 Big Red Way, Bowling Green, KY 42101-3576. Applications must be received by November 5, 1996. *Women and minorities encouraged to apply. Western Kentucky University is an Affirmative Action/Equal Opportunity Employer.*

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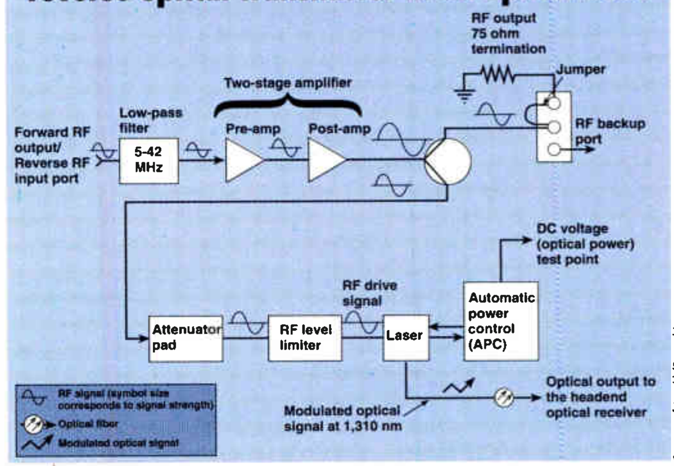
By the National Cable Television Institute

Reverse optical transmitters: Part 1

Last month's installment provided a quick quiz (with questions culled from several NCTI courses) to test your knowledge on a variety of aspects involving the return path. The answers are provided below. This month begins the first part of a series on reverse optical transmitters. Its purpose is to provide useful information complemented by training suggestions to reinforce the material in a classroom setting. The top portion is excerpted from a lesson in NCTI's Fiber Optic Technician Course. The hands-on training suggestions are modeled after NCTI's new facilitator training courses for administering the hands-on labs. © NCTI.

Signal flow to and from Jerrold AM-RPTD reverse optical transmitter in an optical node



Courtesy of Jerrold/General Instrument

For a CATV system with an optical fiber link and return path requirements, the reverse optical transmitter is a vital transition point because it converts the reverse RF signal received over coaxial cable into the reverse optical signal transmitted over optical fiber to the headend optical receiver. Understanding the theory of operation, passives and controls, test points, and specifications of the reverse optical transmitter is crucial in performing optical node setup procedures and in repairing or replacing a reverse optical transmitter.

Theory of operation

Reverse RF signals may be video signals, or status monitoring, addressable response or data signals using modulation techniques, including frequency shift keying (FSK) and quadrature phase shift keying (QPSK). Different brands of reverse optical transmitters are similar in the way they receive and convert these reverse RF signals to optical signals.

The block diagram in the figure illustrates signal flow to and from a Jerrold AM-RPTD return path transmitter in an optical node. The reverse RF signals enter the optical node through the "forward RF output/reverse RF input" port. A low-pass filter in the reverse transmitter module prevents the reverse (5-42 MHz) RF signals from interfering with the forward (50-750 MHz) RF signals. The reverse RF signals are amplified (approximately 6 dB) by a two-stage amplifier. The amplified signals are then split, with one signal routed to the RF backup port for operational redundancy. This signal is normally terminated inside the node. The other signal is routed through an attenuator pad to reduce the signal level. The reverse RF signals are then routed to an RF level limiter, which protects the laser against an RF input signal level exceeding +15 dBmV.

Next, the RF drive signal amplitude modulates the laser, typically a Fabry-Perot (F-P) laser. The laser emits a modulated optical signal, usually 1,310 nm in wavelength. The automatic power control (APC) regulates the optical output power level of the laser by compensating for temperature changes and slight variations in the received RF signal level. There is also a DC voltage (optical power) test point to measure transmitted power. The laser output signal is transmitted over an optical fiber to the headend. There the signal is demodulated and sent to the appropriate receiver.

Next month, reverse optical transmitter controls and DC voltage test point will be covered.

Hands-on performance training

Proficiency objective: *Identify major components on a block diagram showing signal flow to and from a return path transmitter in an optical node.*

Provide each student with block diagram(s) showing signal flow to and from the return path transmitter(s) used in your system's optical nodes.

Use the diagram(s) to identify the following components and describe their functions: forward RF output/reverse RF input port, low-pass filter, two-stage amplifier, RF backup port, attenuator pad, RF level limiter, laser, automatic power control, DC voltage (optical power) test point, and optical output to headend.

Verify that each student can identify the major components of your return path transmitter(s) and understands their functions. **CT**

Answers to quiz: 1) - C; 2) - B; 3) - D; 4) - A; 5) - E; 6) - B; 7) - E; 8) - C; 9) - A.

WOMEN IN TECHNOLOGY AWARD NOMINATION FORM

This award is co-sponsored by the Society of Cable Telecommunications Engineers, Women in Cable & Telecommunications, and Communications Technology.

Objective:

The annual Women in Technology Award will recognize and honor leading women in technology positions within the cable and telecommunications community, and will create visibility for all women in technical careers within the industry. Each year it will identify and acknowledge the achievement of an individual woman within the industry's technical community who has demonstrated significant personal and professional growth, and has contributed significantly to the industry.

Eligibility:

- Open to all women in a technical field of cable TV and telecommunications
- Current national SCTE member
- Current national WIC&T member
- Demonstrates meaningful contribution to the industry
- Exhibits high level of knowledge, skills and professionalism
- Commitment to community and/or professional activities that serve to enhance the perception of the cable industry in general, and women in technology specifically
- BCT/E program involvement or equivalent

To nominate a person for this award, please provide the following information:

Name of Nominee: ______________________________
Title: ______________________________
Company: ______________________________
Address: ______________________________
____
____
Telephone: ____________ SCTE Member#: ____________ WIC&T Member#: ____________

Why are you nominating this person? (Attach additional sheets if necessary.)
____
____
____
____

Name of Nominating Person: ____________ Title: ____________
Company: ______________________________
Address: ______________________________
Telephone: ____________ SCTE#: ____________ WIC&T#: ____________

Mail or fax to be received by November 1, 1996, to:

Bill Riker/SCTE
140 Philips Road
Exton, PA 19341-1318
Phone: (610)363-6888
Fax: (610)363-5898

By Bill Riker

"The survey says ..."

In an effort to determine the changing needs of the Society's members, we have conducted a wide-scale membership survey and four regional training surveys, in addition to collecting information from our own membership data. I'd like to review the results.

It is important for the staff at national headquarters to be aware of what SCTE members want. I would like to point out, however, that out of the entire membership of over 15,000 people who received the annual membership survey, only 1,221 returned surveys to national headquarters. To better serve the members, we need to know what they want, so I urge all SCTE members to respond to future surveys and questionnaires.

The benefits

When asked what membership benefits and training opportunities were taken advantage of, the most frequent response was the free subscription to *Communications Technology* magazine. Other responses were, in descending order: *Interval*; local SCTE chapter meetings; *Membership Directory and Yearbook*; Cable-Tec Expo; SCTE publications; Broadband Communications Technician/Engineer (BCT/E) Certification Program; SCTE videotapes; regional SCTE seminars; Conference on Emerging Technologies; Satellite Tele-Seminar Program; discounted magazine subscriptions; Installer Certification Program; technical standards; corporate rate discount card; tuition assistance; group life and health insurance; and Field Operations Award.

This information is extremely useful to the staff as we explore the development of new programs and services to offer to the membership. It also informs us about any benefits that may not be of much value to the members.

It has been my experience that often after the release of an *Interval* article or promotion piece on SCTE member benefits, the telephones at national headquarters ring with reports from members who had been unaware of these benefits. To inform members about all of the many services they do receive by joining SCTE, we are developing a membership folder.

The folder will explain the latest benefits and provide general information on regional training seminars, national conferences, publications and videotapes, local chapters and meeting groups, the BCT/E and Installer Certification Programs, free and discounted magazine subscriptions, chapter and meeting group events, the technical tuition assistance program, certification testing sessions, Satellite Tele-Seminars, SCTE-developed standards, SCTE standing committee activities, the Society's group health and life insurance plans, cable telecommunications industry contacts, SCTE's travel discount card, awards, honors, industry scholarships and the SCTE web site.

The folder should be completed and mailed out within the next few months. It will be a useful reference guide that members can use to collect information on Society programs and services.

Improvement suggestions

When asked how SCTE could improve its membership benefit package, the top response was to develop incentive programs encouraging companies to support SCTE training opportunities. Resumé posting on the Internet was a benefit that also received a large response, with personal networking opportunities close behind.

The remaining suggestions (in descending order) were: offer more free subscriptions to industry trade publications; maintain industry-wide demographic information; create newsletters addressing special segments of the membership; offer a cellular telephone discount plan; facilitate used equipment exchanges; provide long distance telephone discounts; and offer an SCTE credit card.

The membership survey indicated that 42% of the respondents' companies support videotape training, which is encouraging because the Society is presently developing more technical training videotapes to meet the needs of training programs.

The survey also showed that 37% of the respondents have been able to receive support when participating in the BCT/E program. I'd like to see this percentage increase significantly over the next few years as companies continue to recognize the value of technical training and certification.

We have been making a concerted effort to change the views of industry managers who are reluctant to support training activities. It will take time, but I am confident that eventually these attitudes will improve.

Regional seminars and shows seemed to get better company support, with 40% of the survey participants reporting that their employers offer some kind of financial assistance and/or time off from work to attend.

I was very pleased to see that respondents were quite satisfied overall with the Society's programs, conferences, seminars, publications and videotapes. The annual membership survey is extremely important and useful to the SCTE staff because it is through your comments and participation that we can continue to support your career goals. **CT**

Please take the time to complete the Women in Technology Award Nomination Form on the preceding page (117), and return it to the address provided or by fax. Your participation makes a difference. Thank you for your time

Bill Riker is president of the Society of Cable Telecommunications Engineers.

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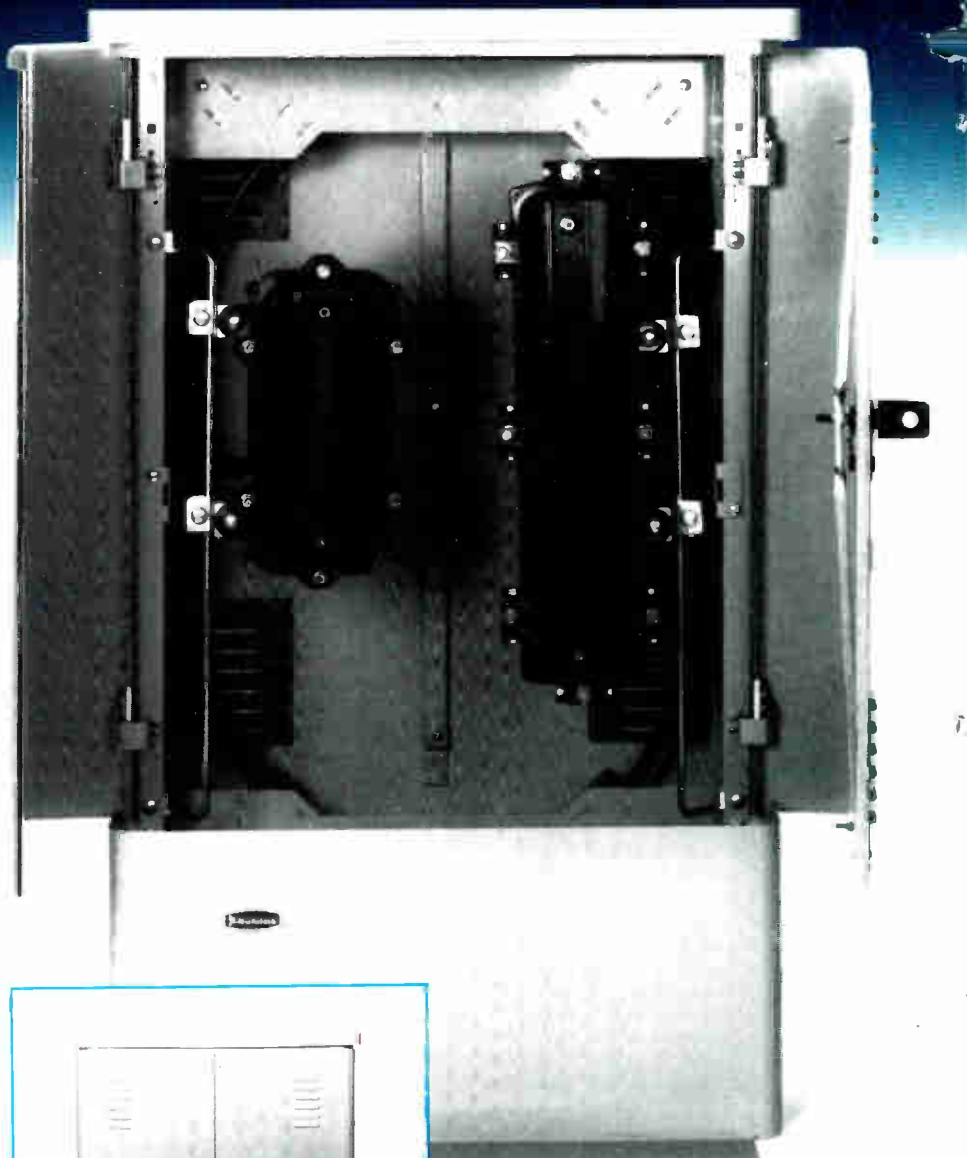

Above Ground Fiber Node Cabnet

- Pedestal consists of one piece continuous frame made up of 12 gauge G-90 galvanized steel and a top, four doors and skirts made up of 16 gauge G-90 galvanized steel.
- Pedestal parts are coated with 2-3 mils of polyester powder after undergoing 5 pretreatment processes.
- All four doors and domed top are detachable using stainless steel slide off hinges (8).
- Front doors are locked with a rod-roller system including a flush mounted 1 piece lock.
- Back doors are also locked internally and can only be accessed from inside the pedestal.
- All door ventilation louvers are backed with fiberglass bug screens.
- The total storage capacity of fiber optic cable is up to 300 feet.
- Pedestal can either be concrete pad mounted or mounted below ground level. Base has a front mounted attached 4" flange with gussets to insure stability.
- All vertical seams are sealed with synthetic rubber seal. Entire cabinet is raintight.
- Built-in universal mounting hardware and accessories made of 12 ga. Galvaneel with polyester powder to withstand all environments.

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