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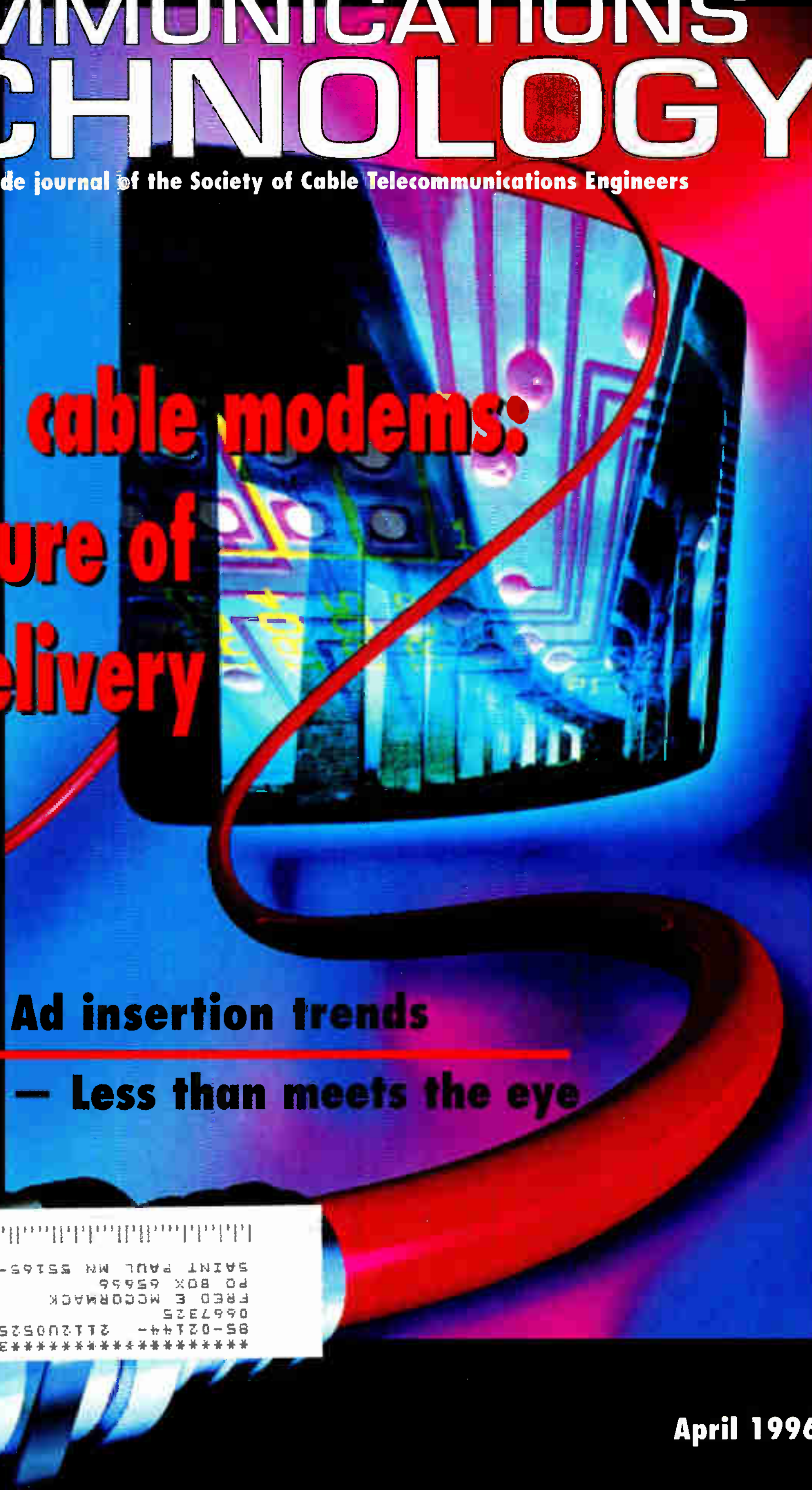
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Telecommunications Engineers



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Now a brief message: Ad insertion trends

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April 1996

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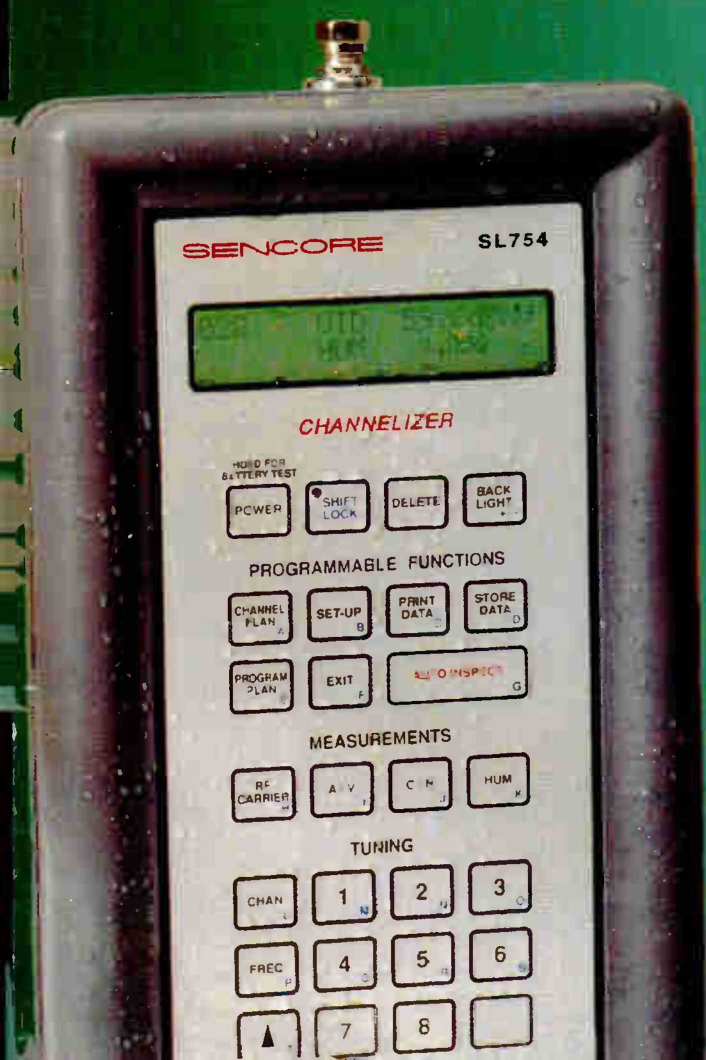

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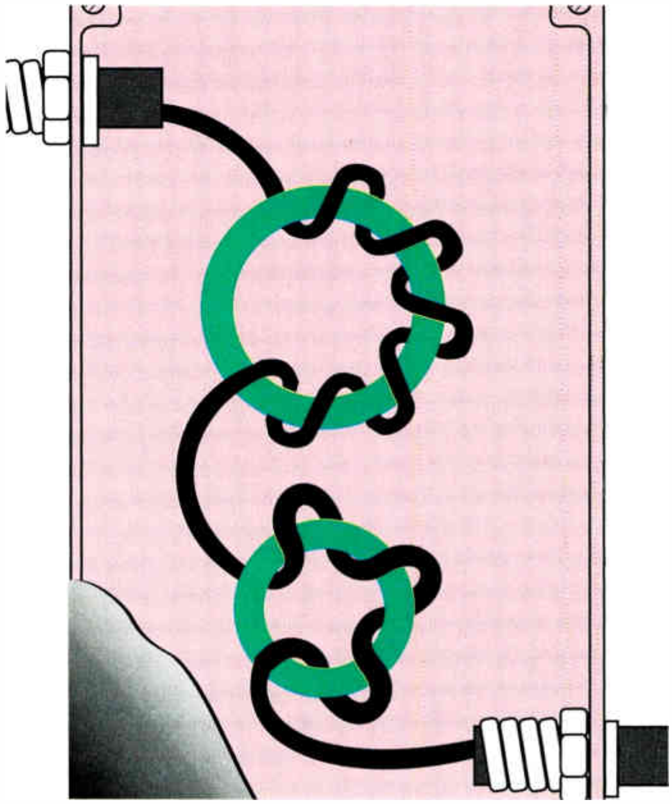

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FEATURES

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Reader Service Number 5

EDITOR'S LETTER

Data delivery and conduits to cash

Today, I watched a commercial on network TV. A mother sat with her daughter in front of a personal computer. The daughter asks, "What did you do for entertainment when you were my age?"

"I watched television," the mother replies.

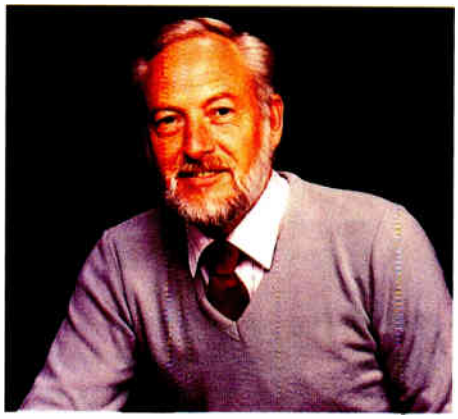
"Why?" asks the daughter.

"I can't imagine why," the mother answers.

Guess who wants computers and all of the information they can provide? We all do. It seems there is something that could interest everyone in every age group and in almost every walk of life. Even those who abhor television and would not subscribe to cable TV seem to love the idea of surfing the Net. Some do it for the magnitude of information they can retrieve, while others love the active role of contributing information on the Internet — quite different from the passive role of the couch potato in front of a TV set.

"Cable must not lose its edge by failing to improve return path reliability."

Data delivery means every household without cable today has a new reason to become a customer. This of course means new revenue opportunities for operators. But as Hewlett-Packard's Ilja Bedner and Daniel Pitt discuss in our lead story, there is more to broadband data delivery than a cable modem. Turn to page 30 for their take on a system based on Internet protocol (IP) traffic operating over a hybrid fiber/coax (HFC) network.



The need for speed

What about the speed of data delivery? Computer manufacturers have long known the need for speed and have responded with improved chips. Now comes the requirement for speed into and out of the Net. While cable systems may hold the answer to high-quality graphics and computer games across the Net with their high-speed modems, problems do exist.

According to recent surveys, almost all cable systems will have to be upgraded for a secure two-way capability. Cable operators have a recognized lead in the race for supplying computer data around the world. Cable must not lose its edge by failing to improve return path reliability. When the public realizes that cable systems can increase data transmission speed by a factor of a thousand (or more), a cable system's value will be hard to fathom. Then independent system operators won't part with their new and improved "conduits to cash" for any price!

Rex Porter
Editor

a separate connection to a host computer at the call center.

A database within that host computer contains information about the caller, such as name, address, phone and (possibly) last purchase. This information is sent to the customer service representative's video display terminal at the same time he or she is answering the phone. With the information on the screen just as the call is answered, the service representative can give a personal response to the customer.

While these two examples are prevalent uses of CTI, not all CTI requires ANI. Many of us have gone through an automated attendant to reach our favorite insurance company. In this case, a voice response unit integrated with the PBX or Centrex system provides us with choices that allow us to route our own call. The integrated system translates our one-digit touch tone responses into the phone number of the intended called party. This type of CTI requires consideration of human factors. Studies in this area show that three branches before reaching a human are the maximum that should be used.

Transaction processing is another example. With this type of service, a caller can access information in a remote computer without human intervention. This is what occurs when you bank by phone. In this case, security becomes an issue, and the integrated system must include the capability for input of PIN numbers prior to proceeding with a connection to the database.

Cable implications

What does this mean to the cable industry? It depends on what you do for a living. If you are a service rep, you will probably find your job becoming more challenging. Because you now have more information available to you when you answer the call, you may be required to become more sales-oriented.

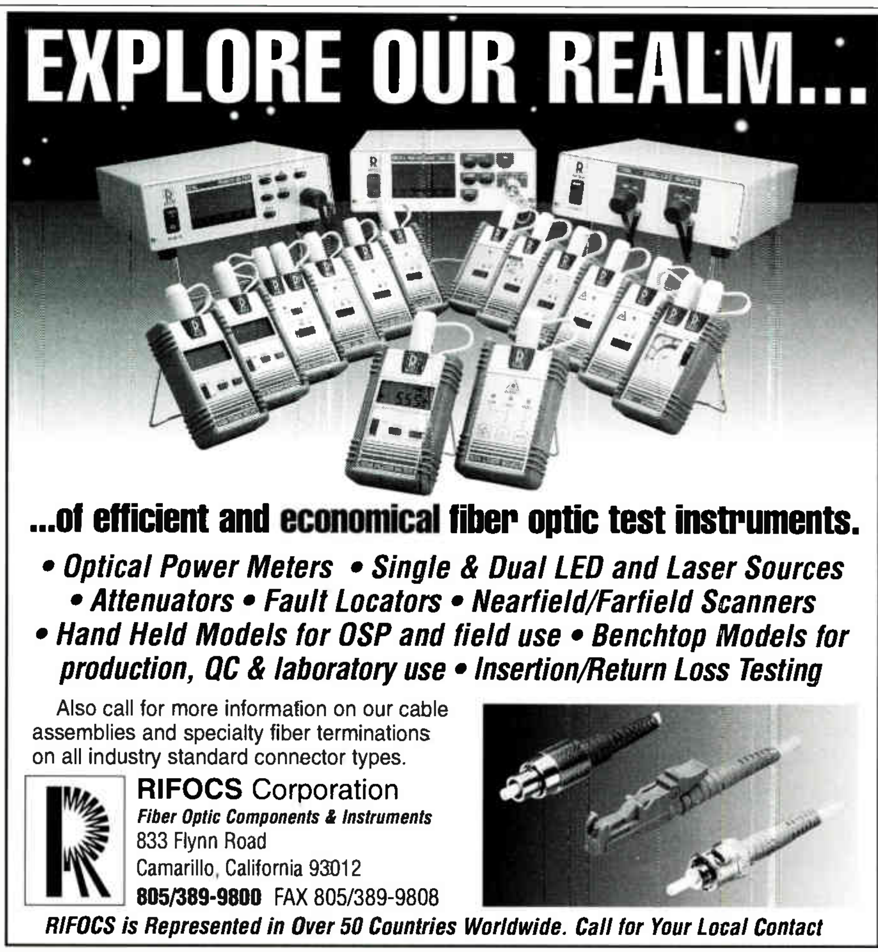
If you are a headend technician or engineer, you will need to become trained in engineering and maintenance of messaging systems. Just like a telecommunications switch, these systems are traffic-sensitive. The number of input ports required is based on expected traffic into the system, and you will need to provide your vendor with call statistics to properly size the system. As the number of customers subscribing to the services increases, you will need to add components to the system to prevent blockage and delays. In addition, you will need to maintain the ANI interface to ensure calls are routed correctly.

The line installer who services the customer's premises needs to understand the way voice messaging is supposed to work. In a telephony installation, he or she and the service rep will need to work together to ensure the customer's messaging features work properly. For example, a problem in the line to the subscriber could cause a false message waiting indication.

Like all our new businesses, CTI can be a source of new revenue and a way to leverage ourselves against our competition. To take advantage of the benefits, however, cable people will need to add CTI to the list of required telephony job skills. **CT**

Reader Service Number 201

Reader Service Number 20



COMMUNICATIONS TECHNOLOGY

A CT Publications Product

The big merge: US West/Continental

Spawned by the 1996 Telecommunications Act, US West Media Group is seeking to merge with Continental Cablevision, the nation's third-largest cable operator, in what would be the biggest telco/cable merger in history.

Once the deal is closed, the US West Media Group will own or share management of cable systems in 60 of the top 100 U.S. markets and serve nearly one-third of all cable TV households. The deal will give US West the nation's largest cable ownership interest with 4.7 million owned cable subscribers and shared management of an additional 11.5 million domestically, rivaling that of Tele-Communications Inc.

The merger spells out the telco's conviction that the hybrid fiber/coax broadband network is the most economical platform for the delivery of video, data, telephony and multimedia services.

In the merger transaction, US West will purchase all of Continental's stock for $5.3 billion and will assume Continental's debt and other obligations, which amount to $5.5 billion.

The transaction, which is expected to close in the fourth quarter, is subject to regulatory approval and a vote by Continental's shareholders.

Motorola, Sun form alliance

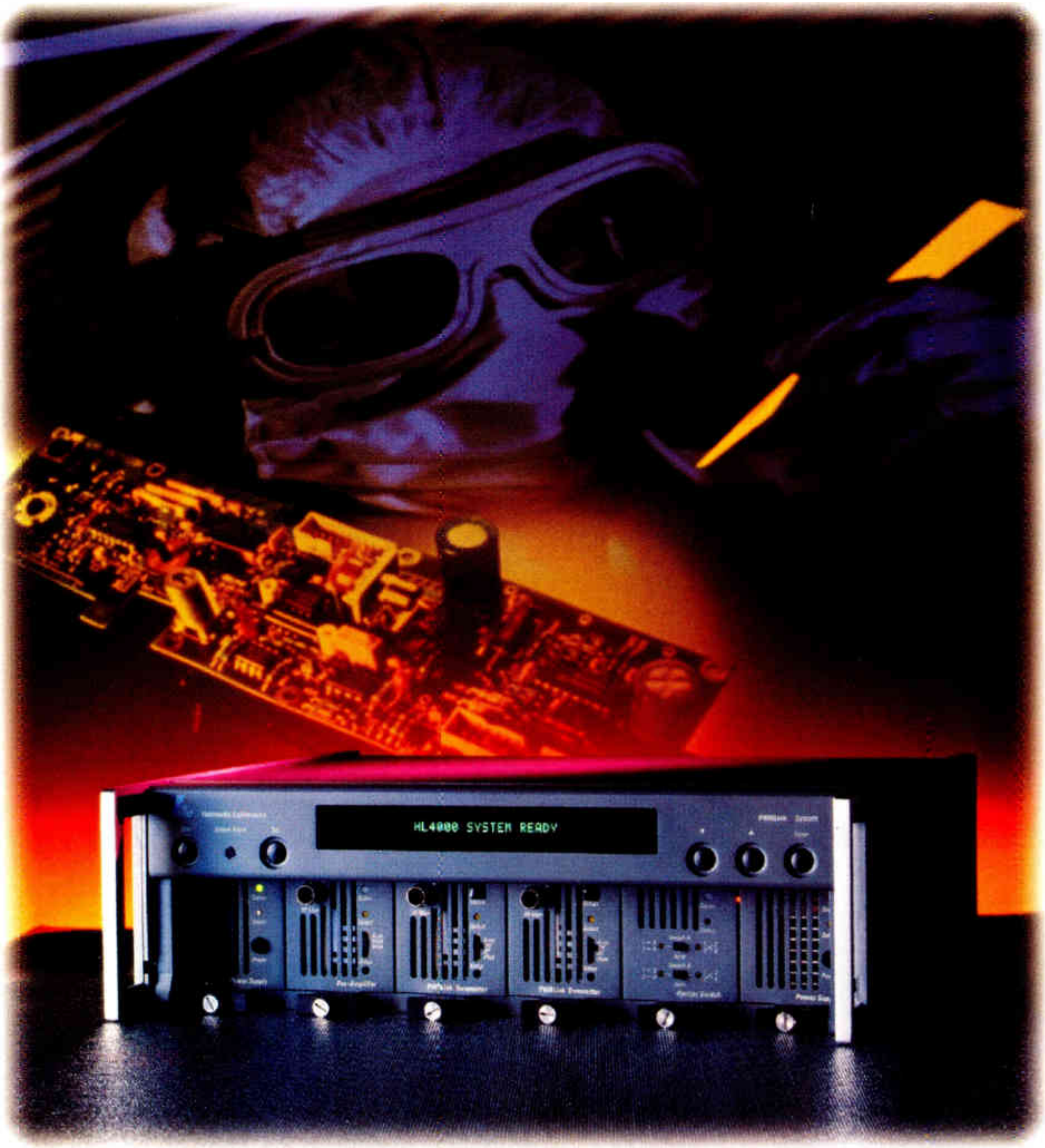
First it was the CableLabs working group. Then came the Broadband Link Team. Now, the latest lineup of companies developing interoperability specifications for broadband data transmission is "The Cyberspace Alliance."

Comprised of Motorola Inc.-Multimedia Group and Sun Microsystems Inc., The Cyberspace Alliance was announced at the end of February. The two companies plan to jointly develop new capabilities, to allow cable operators to deliver high-speed data communications and Internet services to the home.

The Cyberspace Alliance will develop end-to-end solutions integrating Motorola's CyberSURFR cable modem technology with Sun's headend server and Internet server, as well as its Java software products. Sun's Solstice Enterprise Manager software will be used for telephony and data network management; Motorola will work to optimize its CableComm and CyberSURFR data systems for current and future Java applications.

The two companies also plan to establish guidelines for interoperability, installation and maintenance for open systems-based solutions, and will work with industry leaders and standards bodies to promote open broadband protocols.

Every One's a Hero



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Reader Service Number 62

Check your mail for Expo packs

March signals not only that the end of winter is in sight, but also that Cable-Tec Expo registration packages are being mailed to all Society of Cable Telecommunications Engineers members. There's also a registration and information form starting on page 63 of this issue of *CT*.

This year's Expo will be held June 10-13 at the Opryland Hotel in Nashville, TN, with preconference tutorials to be held June 9. This year marks the Society's 14th annual Cable-Tec Expo and celebrates its 20th Annual Engineering Conference.

Over 4,000 attendees are expected to participate in the various activities taking place at Expo, including the Engineering Conference's panel discussions: "Fiber-Related Issues," "Video Transport," "Data Over Cable" and "Return Spectrum Issues." This year's conference will be held Monday, June 10, and will feature leading telecommunications industry engineers sharing their insights on the paths cable technology will follow in the immediate future.

The annual awards luncheon will be held June 10. Remember that several SCTE awards, including its Member of the Year, Field Operations, Personal Achievement and Special Recognition Awards, in addition to the SCTE Hall of Fame, are open to member nominations, so if you would like to nominate someone or want more information about the awards process, call national headquarters at (610) 363-6888 and speak with our membership services department.

The SCTE Annual Membership Meeting will be conducted June 10, followed by the welcome reception and national Cable-Tec Games.

Expo workshops will be open on Tuesday, June 11, and Wednesday, June 12. Ten different workshops will be offered, and the schedule is designed to enable each attendee to participate in six of these workshops.

The exhibit hall also will be open on both days, with Tuesday hours of 11 a.m. to 6 p.m., and Wednesday hours of 11 a.m. to 5 p.m. Over 350 industry hardware vendors and service providers are expected to exhibit at Cable-Tec Expo '96.

Broadband Communications Technician/Engineer (BCT/E) and Installer Certification testing will be offered June 11 and 12 from 10 a.m. to 2 p.m. and also on Thursday, June 13, from 9 a.m. to 12 p.m.

Always a highlight of any Cable-Tec Expo, this year's Expo Evening will be based on the theme, "country street fair." The festivities will be held Tuesday, June 11. Wednesday's social activities include an exhibitors' reception, a ham radio operators' reception and an international reception.

The annual golf tournament will take place Thursday, June 13, from 8 a.m. to 2 p.m. It's only open to 144 players, and because it fills up quickly, don't delay in registering for this event. Also conducted on the last day will be a studio tour of The Nashville Network and Country Music Television from 9 a.m. to 12 p.m. that should provide some interesting behind-the-scenes glimpses of the workings of a cable TV network.

You don't want to miss what is certain to be the biggest and best Expo yet, so look for your registration package and send your attendee registration and housing request in right away. For further information, contact the SCTE special projects department at (610) 363-6888.

Annual member meeting: June 10

The Society's 1996 Annual Membership Meeting will be held June

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The DIR-747 Satellite Receiver

Reader Service Number 86

10 directly following the 1996 Annual Engineering Conference at the Opryland Hotel's Delta Ballroom from 4:30 to 5:30 p.m. All SCTE members are invited to attend this meeting, which will feature discussion among the membership, board of directors and national staff on issues of vital interest to anyone active in SCTE or interested in getting involved in the Society's activities.

In-home wiring guide now available

A new SCTE publication, *The Consumer's Guide to In-Home Wiring*, is now available from the Society. Cable systems can purchase this 22-page booklet for subscribers to educate them on how to best utilize wiring materials and electronic products when performing their own cable TV wiring installations.

Development of the guide began several years ago when members of the SCTE and National Cable Television Association engineering committees joined forces to correct a problem that continues to plague our industry — the connection of inferior RF components to cable systems by building contractors and subscribers.

The result is this new booklet, which will inform subscribers on the vast differences in the quality of wire and electronic components available through Radio Shack and other electronics retail outlets. It emphasizes the importance of using proper wiring materials and demonstrates the effects caused by improper equipment.

Throughout its contents, the publication consistently encourages subscribers to contact their local cable company for further guidelines on cable-related equipment and its installation.

SCTE wants to help local systems get the word out on this important issue by making copies of the brochure available to subscribers, as well as to building contractors working in their area. This 3-1/2-inch wide by 8-inch high brochure was designed to fit into standard envelopes, and can be custom printed with a system's name and logo.

"The Society hopes this brochure will help address some of the problems experienced by general managers at the system level," commented SCTE President Bill Riker, who added, "As a second step in this consumer education effort, the Society is working with the Electronic Industries Association to develop measurement procedures and technical performance specifications for cable and related components. Soon, manufacturers of equipment that meet the jointly established performance standards will carry an 'approved for cable system use' seal on its packaging."

Companies interested in purchasing copies of the SCTE *Consumer's Guide to In-Home Wiring* or obtaining a sample brochure can contact Dorothy at SCTE headquarters by calling (610) 363-6888.

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Reader Service Number 55

By Ron Hranac

Books, books and more books

I am frequently asked about important reference materials to have on hand, especially those that can be used for the Society of Cable Telecommunications Engineers Broadband Communications Technician/Engineer (BCT/E) Certification preparation. So the other day I looked through the books in my office, and came up with the following list of what I have found to be the ones I refer to most often. Keep in mind that this list is by no means conclusive. Some of these publications are out of print and may be difficult or impossible to obtain. In a few cases there may be more recent editions of some of the titles shown. Furthermore, your own reference needs maybe quite different from mine. With those disclaimers out of the way, here's the list:

• *NCTA Recommended Practices for Measurements on Cable Television Systems, Second Edition* (1989, National Cable Television Association, ISBN 0-940272-17-2). This is the industry bible when it comes to cable system tests and measurements. Other excellent references to supplement this include a variety of CATV-specific application notes from Hewlett-Packard and Tektronix.

• *HBO Transmission Test Manual* (1992, Home Box Office). Guidelines for testing your earth station's RF, video and audio performance.

• *Outage Reduction* (Cable Television Laboratories). A must-have when it comes to managing outages. See my column in last month's issue of *Communications Technology* on page 22.

• *CATV System Analysis* (Cable Television Laboratories). Ron Cotten wrote this. It covers everything you want to know about the mathematics of CATV.

• *Technical Handbook for CATV Systems, Third Edition* (Ken Simons, 1974, Jerrold Electronics Corp.). An oldie but a goodie.

• *Cable Construction Manual for CATV and Broadband Systems, Fourth Edition* (1994, Comm/Scope). Good information on testing, handling and installing coaxial cable. I have a couple MSO construction manuals that are good supplements to this topic, too.

• *Cable Television, Third Edition* (William Grant, 1994, GWG Associates). This latest edition added 200 pages to what was in the second edition. Available from SCTE.

• *Cable Television Technology and Operations* (Eugene Bartlett, 1990, McGraw-Hill, ISBN 0-07-003957-7). Good stuff!

• *Installer Certification Manual* (SCTE). Good guideline for subscriber installations. Some companies have even adopted this book as their corporate policy for drops.

• *1993 National Electrical Safety Code* (IEEE, ISBN 1-55937-210-9). This is a must-have. It covers your outside plant: clearances to other utilities, grounding and bonding, etc. Available from IEEE.

• *1993 National Electrical Code* (National Fire Protection Association, Delmar Publishers Inc.). Another must-have. This is the standard for wiring the house.

• *Fiber Optic Cable — A Lightguide* (James J. Refi, 1991, Abc Tele-Training, Inc., ISBN 1-56016-043-8). Excellent tutorial on fiber and fiber cable.

• *Fiber Optics Handbook* (Hewlett-Packard, First Edition 1983; Second Edition 1988). Both of these handbooks provide a good background on optical communications.

• *Reference Data for Engineers: Radio, Electronics, Computer and Communications, Seventh Edition* (Howard W. Sams & Co., 1989, ISBN 0-672-21563-2). Good general technical reference.

• The Wiley Engineer's Desk Reference (Sanford I. Heisler, P.E., 1984, John Wiley & Sons, Inc., ISBN 0-471-86632-6). Intended primarily as a reference guide for the professional engineer, it contains a lot of

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

useful general engineering information.

• *NAB Engineering Handbook* (National Association of Broadcasters). I think they are up to the eighth edition. (Mine is the seventh edition.) Excellent resource, and a valuable reference for some of the BCT/E categories. Expensive, but worth it.

• *Engineering Considerations for Microwave Communications Systems* (1975, GTE Lenkurt, Inc.). Out of print, but if you can find one, hang on to it. When it comes to microwave engineering, this book is hard to beat.

• *Passive Repeater Engineering* (1984, Microflect Co. Inc.). Fairly specific topic, but a good reference on microwave path engineering.

• *AML Seminar Maintenance Manual* (Hughes Microwave Communications Products). If you ever attended one of Hughes' microwave seminars, this was among the handouts. Good information.

• *The Grounds for Lightning and EMP Protection* (Roger R. Block, 1993, PolyPhaser Corp.). Super resource on grounding and lightning protection.

• *The ARRL Handbook for Radio Amateurs* (American Radio Relay League). I refer to various editions of the handbook more frequently than almost any other technical publication. In 1995, ARRL completely revised the handbook. The 1996 edition includes a diskette of useful amateur radio software.

• *Radio Frequency Interference* (American Radio Relay League, 1994, ISBN 0-87259-375-4). Contemplating two-way operation? While not specific to CATV, this book will enlighten you about interference sources that can potentially affect two-way cable operation. A must-have.

• *Interference Handbook* (William Nelson, 1981, Radio Publications, Inc., ISBN 0-933616-01-5). The author was for many years the RF interference investigator for Southern California Edison. Like ARRL's *Radio Frequency Interference*, this book is a must-have.

• *Proceedings manuals: NCTA Technical Papers; SCTE Cable-Tec Expo; SCTE Conference on Emerging Technologies.* These are published every year by the respective organizations. They contain many useful papers on technical topics applicable to your day-to-day operations.

• Back issues of *Communications Technology* and other technical trade publications. I don't know of anyone who doesn't save back issues of their favorite trade publications. Excellent references!

There are many other very good technical publications that I haven't listed here. For example, the manuals from the National Cable Television Institute's training courses are useful references, especially its fiber-optics course. Don't forget a dictionary and a good world atlas. And there are a few books such as Jeff Thomas' *Cable Television Proof of Performance* (Prentice Hall) that I have yet to add to my own library. So many books, so little time! **CT**

By Justin J. Junkus

Data communications spotlight

April is National Data Communications month. (April Fools! But it should be, given that data communications is so widely used, and that the Society of Cable Telecommunications Engineers is introducing a new "Data Communications" course this month.)

So what does data communications have to do with telephony? The answer is just about everything. You'll remember from last month's column on signals that much of the signaling in the public switched network is now digital. As a matter of fact, much of the voice transmission also is digital. Where there's digital, there's data communications.

"Where there's digital, there's data communications."

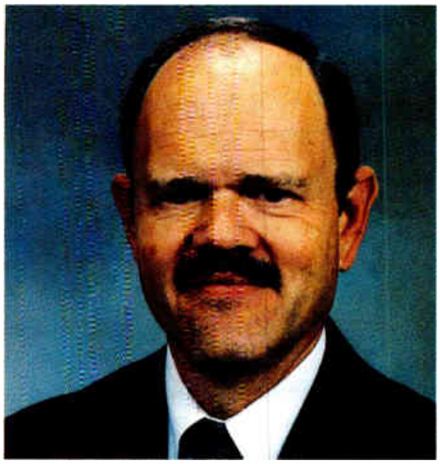
Data communications originated with telephony. Probably the first data device that used telephone lines was a combined telegraph and telephone in the mid-1800s. It was created because the engineers of the time didn't feel voice transmission was reliable enough to stand on its own. Obviously, the phone proved its ability to stand on its own, and the concept of integrated voice and data went back into the wings of the telecom theater.

In more recent history, telephone engineers in the 1960s began looking at ways to make existing trunk lines connecting central office switches more efficient. They invented the first of several multiplexing technologies, called T-1 carrier. Multiplexing technology is based on a mathematical proof by Harry Nyquist that states you can recover the full information content of any signal if you measure and code the value of the signal at twice the frequency of its highest sinusoidal component. Since voice telecommunications frequencies are between 300 and 4,000 Hz, the entire content of a voice call can be maintained by sampling the signal on a telephone line at 8,000 times per second.

After sampling, the voltage level of the signal is coded into an 8-bit binary number and placed in one of 24 "slots" or channels on the multiplexer output line. (Bits, you may remember, are another name for binary digits. They can be either a 1 or a 0.) The multiplexer adds one more bit, called the framing bit, to denote the end of the full package of 24 channels, and sends the aggregate signal down the line to a demultiplexer on the other end. Demultiplexing reverses the multiplexing process so an analog voice channel can be received at the other side. The total amount of information that can be carried on the line between the multiplexer and the demultiplexer is 24 x 8 bits x 8,000 samples per second + 8,000 x 1 framing bit per sample set, or 1.544 Mbps.

While the telephone engineers were designing digital multiplexing for the connections between central offices, computer manufacturers were designing equipment that operated on binary logic. The output of their systems needed to be converted to an analog format to be transmitted over analog voice lines to another location. To do this, the data world invented the data set or modem.

A modem does the reverse of the digitization that occurs in a multiplexer. It uses a digital input signal to modulate an analog carrier so



that the digital information can be carried on an analog voice grade line. On the receiving end, the analog signal needs to be converted to a digital signal once again so that the receiving computer can see its input as a string of binary digits.

If you think this sounds like a system that is performing the same operation several times, you're right! The problem was that until all parts of the telecommunications network became digital, it was necessary to go back and forth to analog multiple times as the information in the call traveled over the call path.

This situation is rapidly changing. Shortly after the transmission facilities between central offices became digital, the switches in the central office followed. The "last mile," or the path between the central office and the end user, is rapidly being upgraded for direct digital service, and now there are even voice-only station sets providing digital output.

So now that you know about digital's role in the telephone network, what is this discipline known as data communications? The complete answer could fill a graduate level university program, but for now, I'll provide the short overview version. To begin, data communications is the set of rules that specify how data will be transferred from one location to another. These rules are known as protocols. The most com-

Justin Junkus has over 25 years experience in the telecommunications industry. Previously the AT&T cable TV market manager for the 5ESS switch, he is currently president of KnowledgeLink Inc., a telecommunications training and consulting firm.

mon standard protocol for data communications is the open systems interface (OSI) seven-layer model. While most of the layers of the model are concerned with data in digital form, the lowest layer is where the rules are implemented for converting analog data to digital (bit) form. This layer is called the physical layer.

The physical layer also specifies standards for electrical interfaces, such as RS-232 for the connector to your desktop PC. It's at this layer that we specify media, frequencies, bandwidths, maximum distances for transmission, and speeds. For most cable engineers, this level of the OSI model will contain the information you need to do your job.

Layers 2 and 3 of the model are concerned with organizing the bits that were defined in Layer 1 into groups of data known as frames and packets. These layers were defined to provide error checks on data moving from point to point in a network. They also merge routing information with the data so that paths through the network and end points may be specified. This is where flow control is accomplished so that data is sent at rates that can be received at the other side. These layers define technologies like X.25, frame relay and asynchronous transfer mode (ATM).

Telecommunications equipment located at headends or telco central offices typically operates at Layers 1 through 3 when moving information in a voice or data call from one location to another. At the end points, user equipment known as customer premises equipment (CPE) implements Levels 4 through 7 of the model. These layers are used for information processing and are known as the transport, session, presentation, and application layers, respectively. This is where end user applications like e-mail interface with the communications transport mechanisms used to carry information to them.

Of course, the digital switch at the headend or central office is actually a special purpose computer similar in many ways to the end user's CPE. The digital switch must process call progress messages, for example, and interface maintenance inputs and outputs with its own central processor. When this occurs, the switch is internally using the higher level protocols within the model, separate from the Level 1 to 3 protocols used to move end user information through the network.

A final word about the OSI model. It is the most widely known, and the most commonly implemented model, but it is not the only set of rules for defining data communications. There are other protocol models that define different layers, but the overall purpose is the same: provide an orderly method for moving data from one point to another, allowing for conversions of form, error correction, prioritization and interfaces with user applications.

Want to learn more about data communications? The SCTE is introducing a new course this month, which will be available periodically throughout the year. For details, contact the SCTE at (800) 542-5040 or send me an e-mail at JJunkus@aol.com. CT

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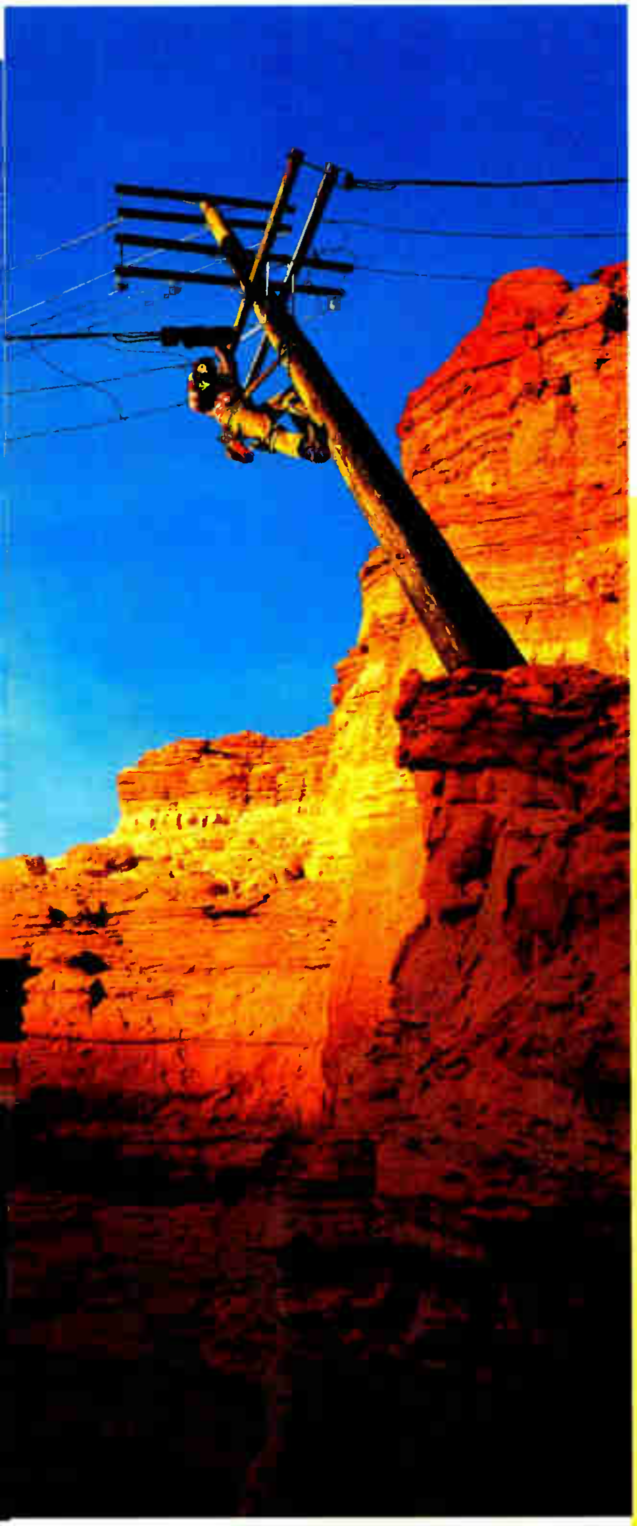

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Reader Service Number 10

By Heather Fleming

Telecommunications reform: What exactly does it mean?

Ending more than 15 years of political wrangling among industry players, President Clinton signed into law Feb. 8 the most sweeping rewrite of communications law since 1934. The Telecommunications Act demolishes the "Berlin Wall on telecommunications," as Senate Commerce Committee Chairman Ernest Hollings (D-S.C.) put it, allowing the industry to "go forward to an era, now of competition, rather than monopoly."

"The reform act is anything but one-sided in favor of the cable industry."

Heather Fleming is the Washington reporter for "Communications Today," a Phillips Business Information newsletter that provides daily news on the business of telecommunications.

The crux of the legislation is breaking up the local telephone monopoly — and who better to do it but cable companies, which already serve about 65% of American households today?

The legislation requires Bell companies to face a facilities-based competitor providing residential and business service in the local loop before allowing them into the long distance market. To encourage cable companies to compete in the lucrative local telephone market, the act loosens their price controls, freeing up capital.

The Telecommunications Act maintains federal regulatory controls on upper tier cable rates for most subscribers until March 1999 and keeps federal regulatory controls on basic cable rates.

Price regulations for small cable operators are immediately lifted for the upper tier and for those companies who only offered basic tier service as of Dec. 31, 1994. A small operator is defined as a company that serves in the aggregate fewer than 1% of all subscribers in the U.S. and is not affiliated with any company that has gross annual revenues in the aggregate that exceed $250 million.

The reform also sunsets the uniform rate structure requirement for cable operators whose video programming is facing "effective competition." Video programming of-

Reader Service Number 44

fered on a per-channel or per-program basis also is exempt from the uniform rate structure requirement.

In addition to relaxing price controls, cable companies also should be pleased with a provision that grants flexibility for mergers and joint ventures between cable and telephone companies in rural communities where head-to-head competition is unlikely to develop. But the reform act is anything but one-sided in favor of the cable industry. It lifts the telephone companies' prohibition on offering video services in its service area, setting them up to be a formidable competitor with the cable industry. They will be regulated according to the way they provide video programming (common carrier, wireless or cable).

Telcos and cable companies also can choose to be regulated as an "open video system." Two-thirds of the channel capacity on the system would be reserved for unaffiliated video programming providers if demand exceeds capacity.

The shakedown of the industry has already begun. The most significant development as of this writing was the announcement Feb. 28 that US West Media Group would pay $5.3 billion to buy Continental Cablevision, the third largest cable company in the United States. (See "News" on page 10 for more details.) The acquisition gives US West access to millions of homes outside of the 14-state region where its sister company, US West Communications, provides local telephone services.

Rich D'Amato, spokesman for the National Cable Television Association, said the US West deal signifies the cable industry's ability to attract capital in a new environment where there is "regulatory certainty." Previously, cable operators had been forced to slash rates, decreasing their cash flow and raising concerns among financial institutions that cable companies could not accomplish some of their business goals. The Telecommunications Act of 1996 puts these worries to rest.

Cable companies and telephone companies each have unique concerns as they consider entering each others' markets.

As Peter Price, President of Liberty Cable Television, put it, cable companies are "girded for battle" with the telcos. "They have secured themselves very well against competition and have been doing that continuously for a number of years," Price pointed out. On the other hand, telcos have been "wearing a competitive strait jacket" since the beginning of the 20th century.

Cable companies also have an advantage of having newer broadband coax cables in the ground, compared to the copper of the telcos that is considerably expensive to maintain.

But telcos have advantages of their own. They have lines going into 99% of households in the country, name recognition, and an impeccable customer service reputation. In addition, it will be much trickier for cable companies to operate a switched network than it will be for telcos to offer video programming.

Who will come out on top is anybody's guess. **CT**

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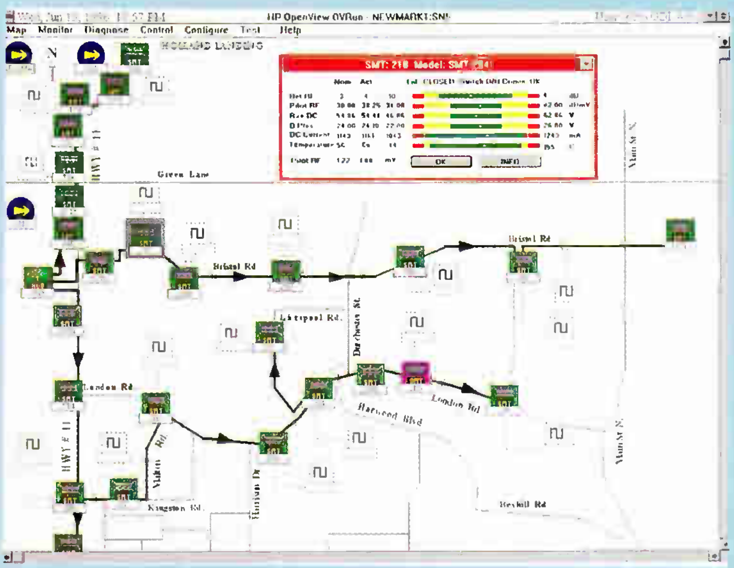
Reader Service Number 146

By Esteban Sandino and Corinna Murphy

High-speed data services and HFC network availability

In December 1995, Rogers Cablesystems in Canada launched an Internet-access-over-cable service in its 16,000-subscriber Newmarket, Ontario, system under the commercial name Rogers WAVE. In this article, we will focus on the service availability statistics collected during the first year of delivery of this service, with particular emphasis on the primary causes of hybrid fiber/coax (HFC) network failures and their effect on service availability targets. We also will take a brief look at the state of the current network management process at Rogers, planned improvements, and their expected impact on current Rogers WAVE service availability.

Figure 1: INMS terminal display of trunk stations



The provisioning of high-speed data communications services over HFC networks presents a unique set of challenges to today's cable operators. Physical network failures (including equipment and plant failures) that prevent the delivery of data services are detected by cable data customers immediately. This requires the definition and implementation of procedures to ensure the tracking and subsequent prompt servicing of all physical network failures and adherence to strict control procedures for scheduling these maintenance and repair activities during the times of lowest customer activity to minimize service interruptions.

Service availability targets

The goal for service availability of Rogers WAVE is 99.9% after accounting for all service interruptions, or a maximum of 525.6 minutes of downtime per user per year as stated in the Canadian Cable Television Association's service quality guidelines. Eventually, the goal is to reach a service availability level of 99.99%. The key to achieving this target is having a short mean time to restore (MTTR) after a fault is detected.

Service availability is determined by the following:

- *Physical network availability.* This is determined by the reliability of the cable plant components, their failure rates and MTTR of the physical network.
- *Service data network availability.* This is determined by the reliability of nontransport-related network components, such as Internet servers and data routers and their corresponding MTTR.

The relative contribution to the overall service availability is apportioned to each of the previous components as follows:

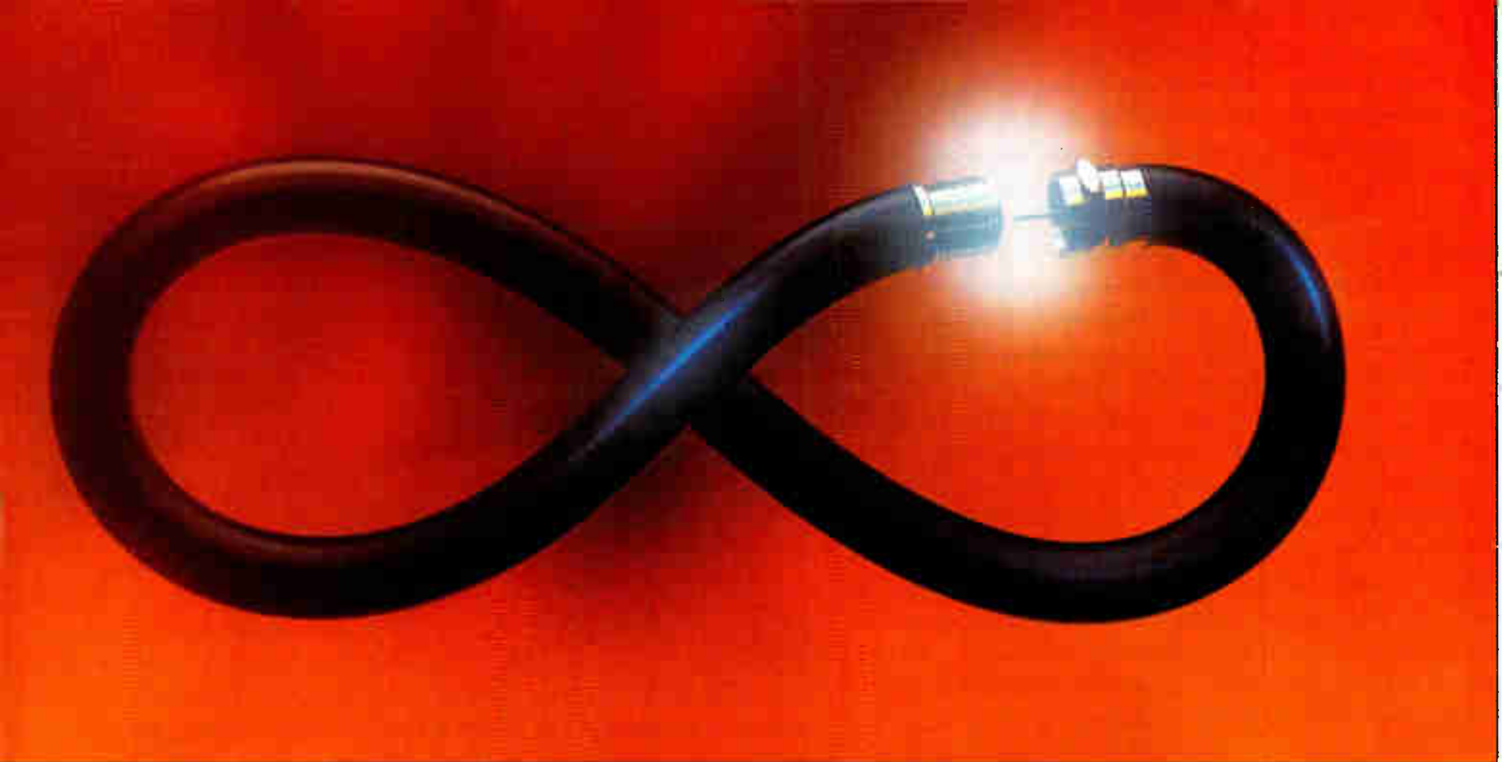
- 99.94% for HFC physical network availability, or a maximum of 315.36 minutes of downtime per user per year.
- 99.96% for data service network availability, or a maximum of 210.24 minutes of downtime per user per year.

Technical Action Center

The WAVE Technical Action Center (WTAC) was established with the mandate to monitor continuously the status of all physical and data network components. Such a mandate included the following tasks:

- *Problem alerting and downtime notification.*

Esteban Sandino, P. Eng., is manager of Rogers Engineering's WAVE and Corinna Murphy is an engineering technologist with the company.



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Cable Access Unit (CAU)

Located at the subscriber premises, the CAU bridges the cable and separates the telephony from video signals on the downstream and injects signals on the upstream.

Cable Control Frame (CCF)

Located at the cable headend, the CCF provides a connection between the local phone switch and the cable system, supporting both wired and wireless cable telephony.

Operations and Maintenance Center (OMC)

The OMC allows the cable operator to manage and maintain all elements and functions of the system from one centralized location.

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Reader Service Number 214

What you never thought possible.™

By Ilja Bedner and Daniel Pitt

Broadband data: More than a cable modem

The following was adapted by the authors from a paper presented at the Society of Cable Telecommunications Engineers 1996 Conference on Emerging Technologies.

The marriage of CATV networks and broadband data promises new services for subscribers and new revenue for operators. Home users are attractive customers for broadband data services because they are willing to spend significant sums on these services. They spend thousands of dollars on home computer hardware and software, they often view the Net and Web as educational resources for their children, and their employers frequently subsidize the cost of home access to the office for telecommuting.

Ilja Bedner is a software engineer at Hewlett-Packard's Telecom Platform Division and Daniel Pitt is a research scientist at H-P's Laboratories. They can be reached at their respective e-mail addresses: ilja@cup.hp.com and pitt@hpl.hp.com.

The plethora of cable modems demonstrated at the 1995 NCTA show indicates the feasibility of carrying high-speed data to homes over hybrid fiber/coax (HFC) cable plants. With downstream link speeds in the tens of Mb/s and upstream in the Mb/s range (even shared), user-perceived performance — response time to keystrokes and downloads — improves dramatically compared to dial-up modems or even ISDN. But high-speed link transport to the home, or even through to the Internet, is not enough.

There is a lot more to offering a broadband data service than link transport. Moving bits is only a means to an end, the end being the offering of local content services, plus operational services such as configuration, addressing, security, management and billing. In our opinion, it is the services that hold the real value for subscribers and, therefore, for operators.

An interactive broadband data system based on Internet protocol (IP) traffic operating over an HFC network is feasible — one has been operational since July 1995 to subscribers of Time Warner's Paragon Cable in Elmira, NY.

Data transport

The cable modem and signal conversion system cooperate to move data bidirectionally between the server complex and the customer premises over a typical shared-medium HFC network. Downstream traffic can fill one or more 6 MHz channels (with 25-30 Mb/s in each), according to the demand and the acceptable level of contention. Upstream data traffic needs to fit in the 5-42 MHz band (unless a high-split system is used), along with upstream telephony and interactive video traffic.

The main advantages of HFC are

Broadband data delivery systems (like Time Warner's Linerunner on-line service) have captured the cable industry's collective imagination. But data delivery means more than a cable modem. Also required are data networking, remote content access, local content provision and service operation.

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the inherent multiplexing at the headend of all traffic for a fiber service area over a single fiber port, and the natural coexistence between data services and other services when each resides in its own set of 6 MHz channels; thus the interactive data traffic does not interfere with broadcast TV. The main disadvantages of HFC for data are its need for security and its multiple-access upstream channel, which requires special framing, signaling and timing. These functions, plus modulation, are the main tasks of the cable modem and signal conversion system (SCS).

Within the customer premises, the home computer attaches to the cable modem via a 10BaseT Ethernet. Numerous service problems are avoided by not having the cable modem actually in the home computer, especially when the cable modem is owned by the operator, plus different types of home computers can be accommodated via software.

"This new pool of subscribers perhaps is willing to pay a great deal more than anyone pays today for even the combination of basic, enhanced and pay-per-view services."

Data network at the headend

The data network at the headend routes packets between the access network and the server complex, and allows the server complex to support one or many headends. The operator can site the server complex in a headend or at another site connected to one or more headends via high-speed facilities such as SONET rings. The design of the data network depends tightly on the data capacity the operator wants to offer subscribers, in either dedicated or shared channels. Since almost 100% of the traffic is individually destined, there is no economy to be gained by broadcasting. The data service is inherently connectionless, so once subscribers turn on their cable modems and log on (i.e., become authorized), they do not need to dial up or establish connections, just send packets. The data network relies on LAN and packet switching technologies, such as Ethernet, FDDI and ATM.

Server complex

The server complex is the brain of the interactive data service, whose nature is determined by the applications and features the operator chooses to deploy on the servers. While the servers are mainly business computers, operators would use these servers differently than typical enterprises. Operators need to support control of the service for individual users rather than for only their home computers. They also wish to keep tabs on who is logged in, or what capabilities users are authorized to exercise.

The following servers comprise the server complex:

- Application servers that provide local services, such as local content, locally stored nonlocal content (such as encyclopedias or national magazines), Internet news and e-mail.
- Network servers that enable network operation, such as naming, address mapping, routing, client authentication, encryption key management and distributed computing environment services.
- Operational support servers for support of billing, subscription management, and fault, performance and configuration management for the network, the systems and the applications.
- Fire walls to provide protected access to the Internet.
- Corporate access servers to allow telecommuters to connect to their offices, and people in their offices to reach the same services they would from their homes, with appropriate security and with compatibility with the corporate network. In addition, a data communication network enables communication among the servers as well as to the Internet and third-party on-line service providers.

The server complex also contains other components such as uninterruptible power supplies, a printer to generate work orders, a remote console device to allow control of the servers in the event of a network outage, X-terminals to interact with services, and local PCs on the access network for interaction with the service. Service downtime can be minimized if every element in the system can be replicated, and the data on the servers is protected.

High-speed access

Client software in the home computer allows the user to send and receive data via the cable modem and to interact with the server complex and its applications. Client software handles the direct interaction with a subscriber, and initiates and receives requests to send and store information to and from the respective server applications.

At a minimum, the broadband data network enables higher speed access to remote services that many people currently reach using dial-up modems or, if they are lucky, ISDN. When speeds exceed those of ISDN by a factor of 100 and dial-up modems by 1,000, and applications are developed to take advantage of such speeds, subscribers will find themselves using these services more and doing more things with them, even given the statistical sharing of the bandwidth. At present, the remote services consist of the Internet and third-party on-line service providers. Our server complex allows operators to control subscribers' external access or to make it transparent, and provides access control and encryption from the server complex both to the subscribers and to the external services.

Access from the server complex to the Internet, on-line service providers and remote management consists of the internal data path and the external transport links. For subscribers to gain the full value of their high-speed access network, the external links must have sufficient capacity as well. Alas, most on-line service providers cannot yet support links to the server complex at speeds beyond 1.5 Mb/s, so the compelling value of the cable network's high speed is reduced. In the meantime, full-speed local services can be supported, including local instantiation of a remote on-line service, collocated with the server complex. →

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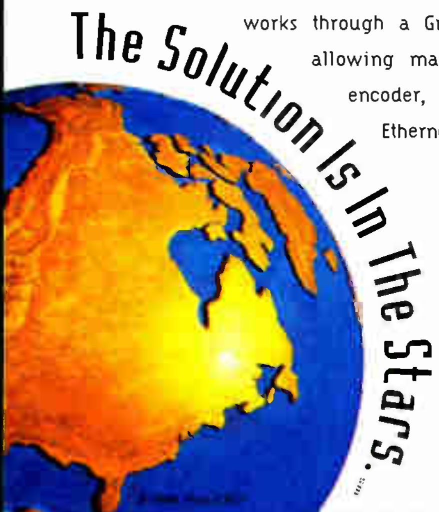

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Serving the community

Local services provide an operator with the ability to tailor the service to the local community and probably will provide the key competitive advantage. Remote-access services such as file transfer protocol, telnet, e-mail and World Wide Web are the services most subscribers will sign up for initially. Subscriber retention, however, likely will depend on true local services, such as local bulletin boards, local commerce, local e-mail, involvement with schools, libraries and government offices, and interactive games. Operators must attract producers of this content and perhaps train them in its production.

Local content can reside entirely within the application servers or at local organizations linked to the server complex. We believe that the server complex described above is a solid foundation for supporting many types of local services, including multimedia ones.

Network management

A key goal of the management solution should be to allow a system administrator to determine end-to-end system performance from a single management console accessible from different locations such as the server complex, the headend and a remote network operation center.

System support may be one of the most difficult, yet important, aspects of providing a data system. All of the technologies should work together to provide a self-maintaining system. The only time an administrator should have to get involved is in planning additional deployments or growth of existing deployments, or in dealing with error events, which are graphically presented on the operational support servers.

Billing

For a cable company, the most common billing model is a flat fee for basic local service, and an additional fee for Internet access. Another model is billing on a service-by-service basis, i.e., 5 cents per mail message, 10 cents per megabyte of traffic, or 50 cents per hour of connect time. Note that the type of access network can affect the billing model. For example, in HFC the SCS maintains traffic metrics for each modem, which allows an operator to bill for the amount of traffic, whereas an ISDN switch maintains the length of a connection, and hence an operator can bill for connect time.

This new pool of subscribers perhaps is willing to pay a great deal more than anyone pays today for even the combination of basic, enhanced and pay-per-view services. The variety of applications, all delivered at superhigh speeds, presents a compelling opportunity to the astute operator. Given the cable industry's historical strength in content, adding this new type of content seems a natural direction.

The first step is using a small portion of cable spectrum for two-way cable data to and from a cable modem at a home computer. Yet a broadband data service operated over a cable network indeed consists of much more than a cable modem. Also required are data networking, remote content access, local content provision and service operation. **CT**

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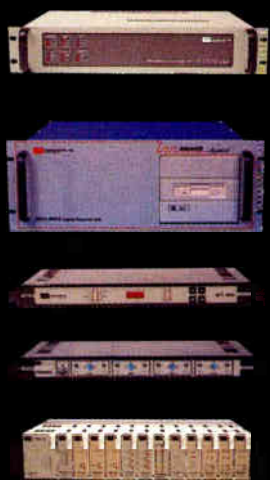

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Reader Service Number 120

By Alex Zavistovich

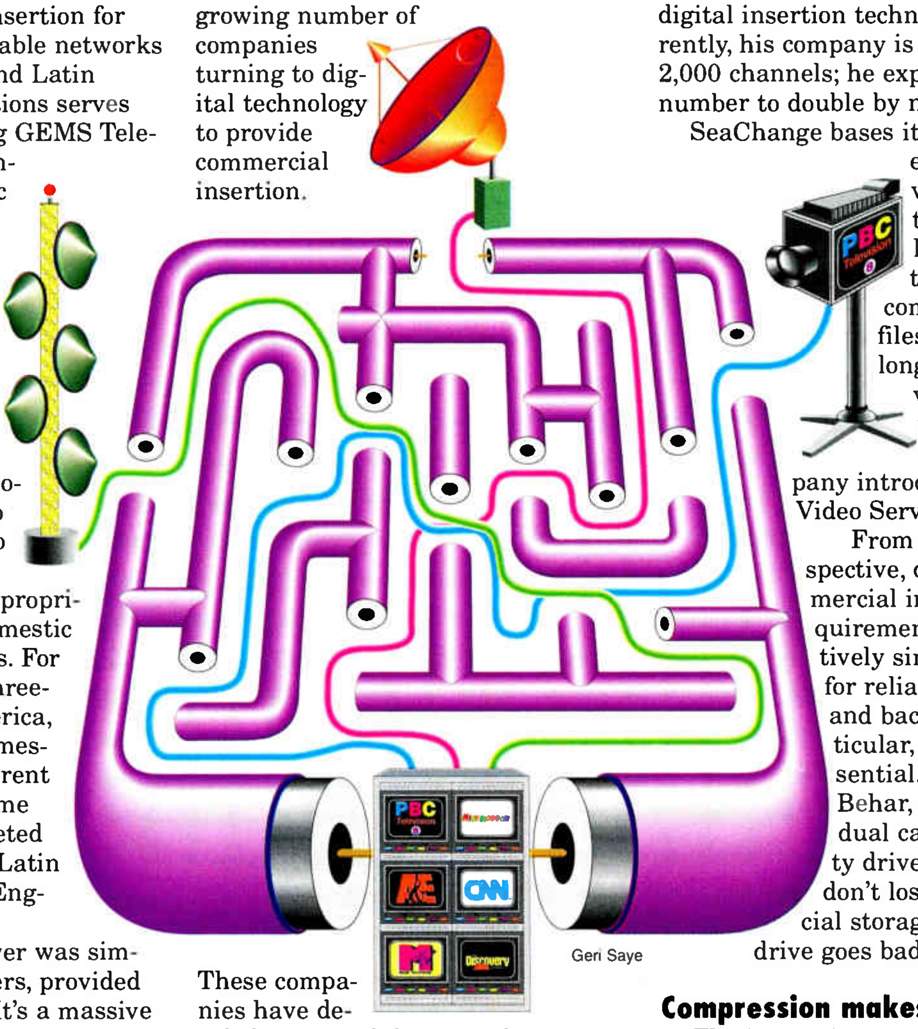
A word from our sponsor: Digital/analog ad insertion trends

When it comes to commercial insertion, Bob Behar has his hands full. Behar is president of Hero Productions, a full-service production facility and international teleport based in Medley, FL. Behar's company, which opened its doors in 1993, provides commercial insertion for satellite services and cable networks in the United States and Latin America. Hero Productions serves programmers including GEMS Television, the Travel Channel and the HTV music channel.

At four breaks per hour, two minutes per break, that's some sixteen 30-second spots per hour per network Behar's company has to keep track of, depending on the network. Besides domestic insertions, Hero Productions also has to make sure that advertising messages are appropriately routed among domestic and international feeds. For example, GEMS is a three-region feed: Latin America, Argentina and U.S. domestic. Insertions are different for each region; the same message could be targeted to both American and Latin American viewers, in English or Spanish.

For Behar, the answer was simple: Digital video servers, provided by Virtual Recorders. It's a massive undertaking. "We run 22 video servers with storage capacity of up to 48 hours on hard drive," explained Behar. "We use them to store all the interstitials and filler material for the different clients we serve." The ad trafficking system for the VR servers was written in-house by Hero programmers.

Hero Productions is one of a growing number of companies turning to digital technology to provide commercial insertion.



Geri Saye

These companies have decided that hard-disk based storage, coupled with trafficking software, give them the flexibility they need to provide specially tailored placements for advertisers using cable networks to deliver their messages. While a market still exists among small- to medium-sized operators for tape-based analog gear, the digital alternative has quickly taken hold.

How quickly? According to John Coulbourn, director of communications for the commercial insertion vendor SeaChange Technology, more than 60% of the market today is in digital insertion technology. Currently, his company is serving some 2,000 channels; he expects that number to double by next year.

SeaChange bases its insertion equipment on video server technology, allowing MSOs to manage commercial data files and other long forms of video. This past November, the company introduced the Video Server 100.

From Behar's perspective, digital commercial insertion requirements are relatively simple. "We look for reliability, quality and backup." In particular, backup is essential. According to Behar, "We look for dual cache and parity drives, so that you don't lose the commercial storage even if one drive goes bad."

Compression makes strides

The increasing acceptance of digital video servers for commercial insertion can be attributed in part to the strides made in compression technology, which has made storage affordable. Vela Research and Scientific-Atlanta, for example, provide MPEG video compression encoders

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and decoders to other vendors, who incorporate the companies' technology in their video servers. According to Rick Chile, Vela's director of sales, digital commercial insertion has become virtually as cost-effective as using tape-based analog methods. "All ad insertion vendors are migrating from a tape format to a server or computer format. The quality is there now."

Vela also markets its own video server, the Perspective 2000. Content is stored on a disk array, and RAID technology allows the drive modules to be "hot swappable," so if a drive should go bad, a parity drive would still be able to access that information. The bad drive then can be rebuilt with information from the parity drive. Each drive's capacity is 4 Gbytes. Chile said there are three ad insertion vendors that are developing systems around the server, controlling it with their own administrative device.

Scientific-Atlanta is another firm that provides video compression for commercial insertion vendors. Chris Brechin, S-A's manager for digital storage and retrieval, said both SeaChange Technology and Starnet Development Inc. use S-A MPEG encoders and decoders in their insertion equipment.

Brechin noted that companies are moving to MPEG-2 compression technology to make video storage more cost-effective. The next step, Brechin said, "is to do true digital insertion into a digital stream." When digital set-top boxes are in place in the home, he said, a logical question would be how to do an insertion in the digital domain. Still, he conceded, it may be three to five years before enough digital set-tops are in place to address that question.

Vendors are turning to MPEG-2 compression because it was designed specifically to solve compression problems for video, according to Chris Bennett, product planning manager for the video communications division of Hewlett-Packard. "It allows us to pack a lot of channels in a single box." H-P's Broadcast Video Server uses MPEG-2 compression, yielding maximum storage capacity of 40 to 50 hours of storage. The company is working with a variety of other vendors, including Alamar, Columbine and ProBell Software, to provide user interface and trafficking software for a complete insertion system.

"In four years, there will not be analog equipment for anyone serious about doing ad insertion."

— Peter Martin, DEC

Scalability

The move toward MPEG-2 encoding is a clear trend among digital insertion vendors, agreed Bill Robertson, vice president of engineering and product development for SDI. MPEG-1 was only a video standard, he explained; MPEG-2 is a more standardized way of handling both audio and video. Robertson's company manufactures the SDI 1600, which comprises both the server and user interface. SDI also sells an ad trafficking package with the product.

Of even greater importance to customers than compression, Robertson noted, is system scalability. "Ad sales reps are getting more requests for varying spot lengths — everything from single spots to long-form insertions," he explained. That requires flexibility in spot storage, and maximum and minimum number of channels.

John Boland, vice president and general manager of Texscan, concurred. He added, however, that the main innovation leading to scalable digital insertion equipment was the server itself.

"The first generation of digital insertion products was one PC per channel," Boland explained. "Server technology is more effective and effi-

• *Problem isolation and escalation to the appropriate technical support group*. For example, this could mean having cable technicians address physical cable network problems and data analysts address data network and server problems.

• *Tracking and scheduling of all network maintenance activities such as cable upgrades and system reconfigurations to minimize service disruptions (change control).*

• *Tracking of all network failures and issuance of network problem reports and recommendations to help meet established service availability targets.*

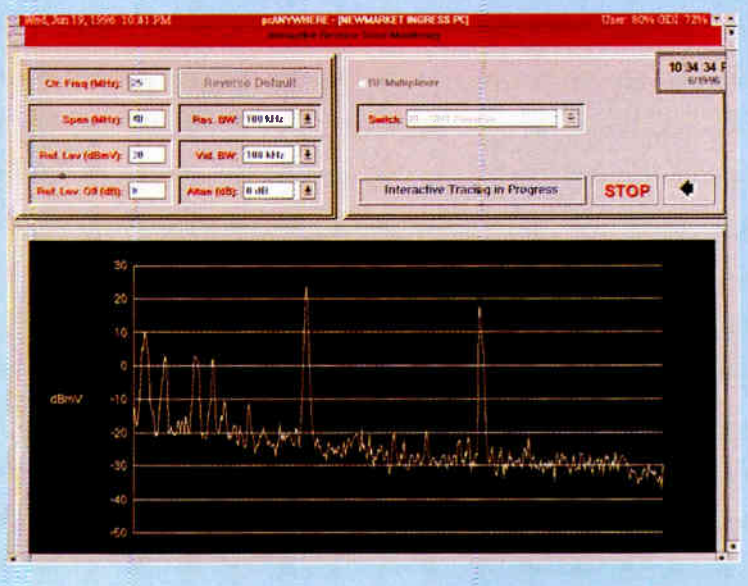
Troubleshooting tools

The main tools that WTAC employs to detect, isolate and track physical and data service network problems are:

• *Rogers integrated network management system (INMS) terminals*. They perform the following two functions: 1) they monitor the data generated by each of the status monitoring transponders (SMT) located in the coaxial trunk amplifiers; and 2) they control the reverse bridger switches at the coaxial trunk level. Alarms are automatically generated whenever the operational levels of the trunk amplifiers deviate from pre-set thresholds. Figure 1 illustrates how trunk station status is displayed on an INMS terminal.

• *A set of independently controlled bridger switches in the 5-18 MHz and 21-42 MHz return bands*. These allow for control over which trunk or feeder areas should feed reverse signals back to the headend. This capability allows for quick isolation of problem feeder areas, and, in turn, expedites troubleshooting and service restoration activities. In addition, INMS terminals allow switching of in-line 6 dB attenuators in the reverse path at the trunk level to aid in the isolation of noise and other interference originating from the cable plant.

Figure 2: Spectrum analyzer utility



• *Reverse noise monitoring stations*. These allow for remote control of a spectrum analyzer directly connected to the reverse feed areas at the various WAVE service headends. The spectrum analyzer display at the headend is available on a video display at the WTAC for the continual monitoring of reverse noise levels as illustrated in Figure 2.

• *Simple network management protocol (SNMP) stations*. These provide the monitoring and control of SNMP devices, such as data routers, servers and the current generation of Zenith's cable modems used to deliver Rogers WAVE services.

• *Cable modem management utility*. This provides remote control of functions such as modem frequency and power output level settings.

HFC network availability

The Rogers WTAC has been collecting service availability statistics daily for Newmarket since January 1996. Figure 3 illustrates the Rogers Newmarket HFC network availability for the period of January to October 1996. These statistics include all instances of service interruptions arising from the following sources:

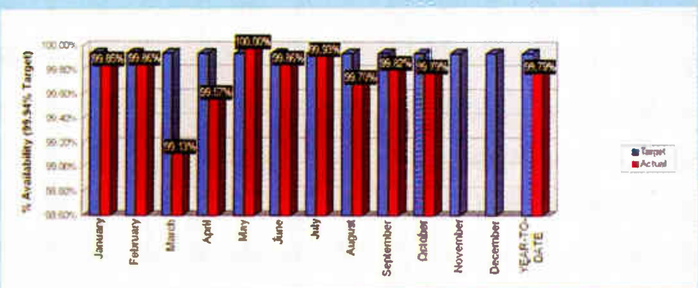
• *Network maintenance activities (both scheduled and unscheduled)*. For scheduled maintenance, the maintenance window for Rogers WAVE service is restricted to Sundays between 2 and 6 a.m. However, the related downtime is still included in the calculation of network availability.

• *New plant construction activity.*

• *Headend and fiber related equipment failures.*

• *Trunk and distribution failures.* No distinction is made at this time between trunk-specific problems and those arising from line extenders and other distribution equipment. →

Figure 3: Newmarket 1996 HFC network availability



cient. It's much easier to network, easier to write code for, and has more fluid graphical user interface." With server technology, operators can work not only with 30-second spots, but longer form infomercials, as well. Texscan's server, the 3200 DS, is scalable from four channels, and is based on Windows NT networking software.

In general, the commercial insertion business is growing rapidly, clamoring for a sales solution that's more efficient, easier to use, and less costly to maintain. Peter Moran, president of SkyConnect, said his customers are emphasizing system stability and an easy-to-use front-end.

SkyConnect, primarily known as a software company, is a value-added reseller of the Mediaplex ad insertion platform from Digital Equipment Corp. The UNIX operating system uses Oracle with Windows NT for data base management to integrate into trafficking, and recording and monitoring system performance.

DEC's Peter Martin, marketing manager for video advertising systems, said selling the benefits of digital commercial insertion to cable operators is comparatively easy. "You usually spend quite a bit of time with customers to justify costs. With this product, we haven't had to spend that kind of time. The benefits are pretty clear to cable companies at the MSO level — or even the individual budgeting level."

Many customers are looking for modularity, flexibility and "future-proofing," which is understandable, considering the dollar value of their investment, said Jerry Berger of Sony. Berger is manager of video server technology for Sony's business and professional products group.

"Customers want to be assured that their capital investment allows for new business opportunities," Berger explained. "They need to know products can be expanded in modular fashion. They're looking for interoperability with other systems and other manufacturers' devices. Some have even asked for an end-to-end digital transmission system from program originator, through commercial insertion and networking to the customer's home with all signal managed and decoded at the set-top box." For these customers, Sony offers the VideoStore multichannel video file server, paired with the BitStream MPEG-2 encoder. The system operates under software control, provides multiple output streams via a network, and allows for random and instant access to any stored video data.

Channelmatic's senior vice president marketing and sales, Mike Watson, said customers' requirements for a flexible system boils down to operating efficiency. "Operators want to manage the process — whether ad insertion or content playback — and do it efficiently. They want reliable technology; they can't afford catastrophic failures that will affect all channels. To that end, Channelmatic has been working closely with Sony, combining its Video Store product line with a new front-end management and switching system called the MVP (for "managed video playback").

Like Boland, Watson agreed that video file servers have ushered in wider acceptance of digital technology. "Now that video file servers are on the market, it changes the game. Major cable players are looking at digital commercial insertion and making commitments to it."

For Dave Elder, vice president of marketing at Digital Video, a division of Antec, this commitment means "a rethinking of the way (MSOs) approach the whole issue of commercial insertion." Digital Video's offering is called Digital Video, a file server connected to a proprietary decoding, monitoring product that automatically inserts the filed information into whatever programming channel is selected.

"Customers are interested in being able to upgrade the system," said Elder. "They are looking for ways to expand or to fit multiple applications on one system."

Multiuse applications

As video server technology develops, and the per-minute cost of video storage becomes more affordable, it might be tempting to look at digital technology as the basis for a multiuse platform. Wouldn't it be easy — not to mention less expensive — to have one system for commercial insertion and near-video-on-demand (NVOD)? The idea makes sense to H-P's Bennett.

"Just about any application that you build tape decks for, a server will eventually take over," Bennett said. "In applications where you want to play the same thing more than once, or move information from one place to another, the advantages of server-based technology are compelling." Peter Martin at DEC added that video streaming has made pay-per-view applications possible. "It's not always intuitively obvious to cable companies, where independent capital budgets are managed separately by ad sales and programming departments, that a single piece of capital equipment can do both pay-per-view and insertion functions."

For the most part, however, industry observers cautioned against putting too many eggs in one basket. As SDI's Bill Robertson said, "It's easy to think that once you have a video server, you can do anything with it." Commercial insertion and NVOD each has its own specific requirements, he noted; it doesn't necessarily make sense to put them together. "Even with the largest hard drives, we haven't passed the equation of cost per megabyte to make NVOD affordable on video services."

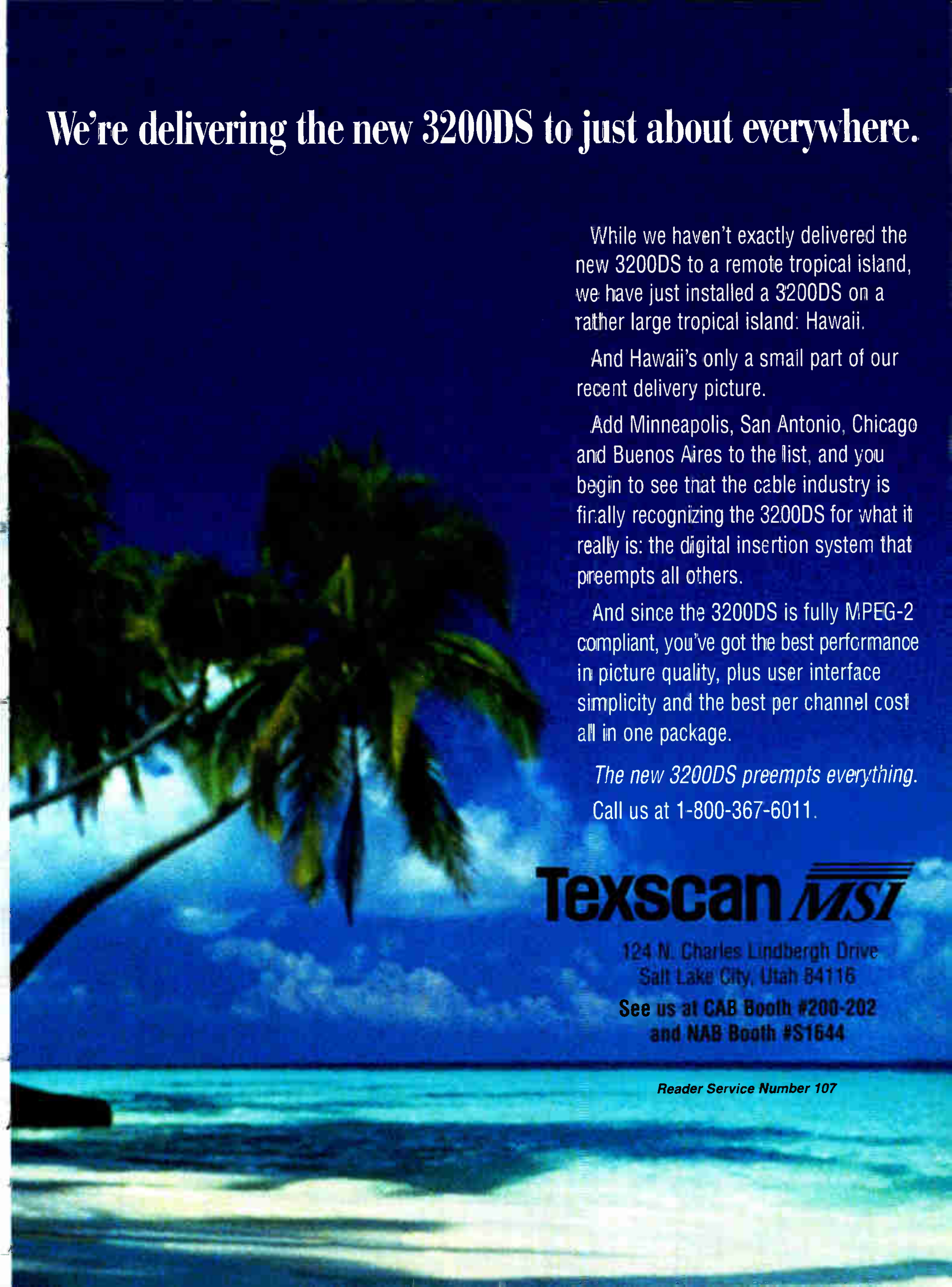
John Boland at Texscan also expressed caution about integrating commercial insertion and NVOD on video servers as an all-in-one solution. For Boland, the more practical advantage of digital technology is that it is "scalable with respect to interconnection among headends and remote control site, and easier to add inventory and channels." At Sony, Jerry Berger said he did note a U.S. trend toward multiuse applications of digital technology. He has heard customers inquire about the flexibility of video servers, but does not think they are gravitating to integrated applications as a trend.

In fact, some customers are skeptical about integrated functions. Hero Productions' Bob Behar said such multiuse applications will not work on file servers.

"First," said Behar, "you have to load the programming in real time. If you're going to load it in real time, you might as well play it on the air in real time. It's a time-consuming process to load programming, unless it's a piece that is played repeatedly." Behar does use disk-based video servers for his HTV music channel. "It makes sense in that case, but for movies or programming that changes every day, it doesn't make sense to dump the video onto disk and then pull it back up. Let the disk server do what it does best: provide interstitial, filler and commercial material."

Networking

One area that does make sense for commercial insertion vendors to pursue is networked operation via local or wide area networks (LANs or WANs). Cable's advertising base is expanding, which requires larger commercial inventory, which in turn requires larger storage capacity. The answer, for Sony's Berger, is WANs. →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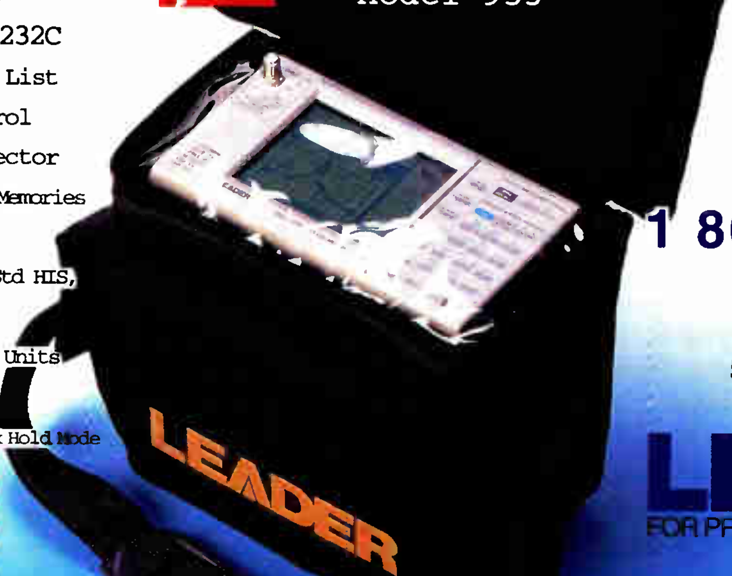

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"Advertisers used to provide their ads on video, then shipped them to a destination headend where they were copied and sent out," Berger said. "Now, companies are deploying centralized encoding facilities where analog videotape is transferred to digital MPEG-2 then sent over a WAN of the customer's choice to multiple distant locations." This hub-and-spoke arrangement for regionalized playback of commercials — or "zoning" — is the next big thing for commercial insertion over cable, Berger maintained. It's one area in which cable operators have a distinct advantage over their broadcast counterparts.

Vela's Rick Chile agreed. "There's business potential in having LANs or WANs encoding your content at a single location, then transmitting it over a high-speed network to a cable headend property for local playback."

Open systems and networked systems are coming trends, added H-P's Chris Bennett. "Networking gives you more zoning and control options," he said, "but it comes with its own host of new problems." To bypass some of the problems inherent in networks users can opt not to hook into the Internet — but then, Bennett pointed out, they will be missing out on some new benefits.

The future of analog

So if the industry is turning to digital technology for commercial insertion, where does that put analog products? While most industry observers agree that the manufacturing of analog equipment may be phased out over the next five years, some maintain that the analog option remains attractive for smaller operators who might not be able to afford digital technology.

Bob Hall, vice president of sales for Ad Systems, the Salt Lake City-based subsidiary of SkyConnect, said the trend toward digital hasn't drastically affected sales of their analog-based products. Ad Systems manufactures a line of insertion gear including the Ad Lieutenant (four-channel, one VCR), the Ad Commander (four-channel, four-VCR), and the Ad Admiral (a full-spot random system). The company is devoted to mid- to lower-sized cable systems of 1,200 to 30,000 households.

"These size systems don't see a future in digital right away," said Hall. "That's primarily because of cost, but also because some of these systems serve clusters of homes, which makes complete transition to digital infeasible." Hall said Ad Systems saw level sales this year, despite the number of digital systems sold.

According to Digital Video's Dave Elder, "There's still a place for analog systems. In less densely populated areas it may not make sense for smaller cable operators to migrate to the digital system." Elder pointed out that larger MSOs are reselling their older analog equipment to smaller facilities around the country. In time, however, as the price of digital systems comes down, analog will claim a smaller percentage of the marketplace, he maintained.

For Chris Brechin at S-A, that time is still a long way off. "In the U.S., we hold onto a TV set for at least 10 years. Those sets will require analog services," he said. "Even as digital set-tops are introduced into the home, remaining TV sets in the home will still require analog channels, and analog services, and therefore analog insertion. Servers will have to provide both analog and digital services, at least initially. Cable operators can't afford to buy one server for each service."

Texscan's John Boland noted that his company recently introduced a new generation analog system, the multichannel Prizm. Texscan continues to ship analog systems, Boland said, although he noted that the technology is beginning to be pushed down to secondary markets, with other used equipment.

Not all insiders acknowledge a trend toward reselling analog product. SDI's Bill Robertson said he sees more operators removing the analog gear from service, rather than reselling it. "Maintenance costs of analog are difficult to bear regardless of the size of the system," Robertson explained. "Also, tape decks used in analog systems are getting long in the tooth; it's difficult to find parts." Still, he acknowledged, "If you're going to transport video, tape is still the best medium for now." Peter Martin of DEC noted that while some small headends may for the moment move to analog systems, "in four years, there will not be analog equipment for anyone serious about doing ad insertion. Maintenance costs of keeping up analog systems will lead people to switch to digital systems, as digital technology drops in price."

When those prices finally come in line with operators' budgets, SkyConnect's Peter Moran said, operators will have to change the way they think about commercial insertion. "How are you going to have a 25-home node and be able to do the insertion without digital technology?" he asked. What's more, the efficiencies afforded by digital technology, especially flexibility in zoning, will cause a paradigm shift toward digital insertion in the cable industry, he said, "not because you're replacing tape decks, but because you've removed so many of the obstacles that have caused somewhat retarded revenue growth in the industry." **CT**

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By Edward J. McGrath

Transmission of digital ads

Digital insertion of local cable advertising has quickly emerged as a powerful tool for cable operators. It is the first practical application that captures the promise of digital video, and is a portent of the potential of many other new applications. Cable operators can easily realize the operational savings — and, more importantly, the new revenue opportunities — that this technology brings. Industry experts expect digital insertion to sweep the market in the next five years.

As cable operators quickly embrace digital advertising, it is important to understand the integral role that data networks play in capturing its full potential. This article outlines the different network options available and addresses the issues that engineers and general managers should consider in the implementation of their data networks.

Data decisions

Deciding on an appropriate communication infrastructure is as much a business issue as a technical one. Several prominent trends or considerations factor into cable advertisers' data network decisions. One major influence is the trend toward consolidation within the cable industry. There is much jockeying of operator ownership as MSOs acquire smaller operations and trade properties, striving to increase their coverage in particular markets. In addition, the desire to cut costs and gain efficiencies as well as to further refine advertising delivery areas into smaller zones (ZIP code zoning) is leading consolidation of several headends in into "superheadends."

Another influence arises from telecommunications legislation and the provision of new services, once strictly the domain of telephony providers. As operators gear up for these services and accumulate more fiber, the increased bandwidth and/or communication infrastructure poses new opportunities.

"Industry experts expect digital insertion to sweep the market in the next five years."

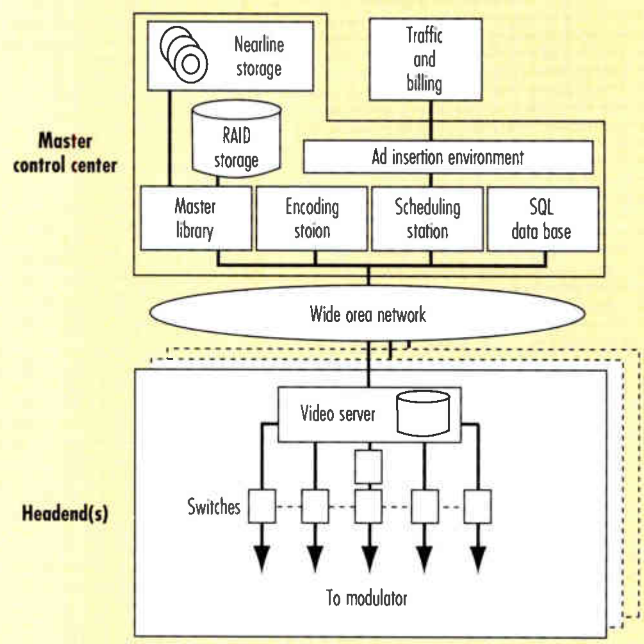
Finally, there is often the need to provide data communications networks for internal administration and operational control interconnecting sites in a region. Together, these business factors as well as the technical requirements described later form a basis for network considerations.

Five site configuration types

A primary consideration in establishing an ad insertion system is the physical location of the ad sales office and the insertion locations or headends. Five common configuration types are in use today. The first is the "consolidated configuration," in which the master control center (ad sales operation) and the headend share the same location. In this scenario, video libraries (ads) are easily transmitted as data over local area networks (LANs). The practical networks for this configuration include Ethernet, Fast Ethernet and FDDI (fiber distributed data interface). Time Warner's Manhattan site provides a good example of this type of configuration, which is practical given the lack of real estate and consolidated population there.

The second configuration type consists of a master control site and geographically distributed headends. This is a common configura-

Ad insertion system architecture



Edward McGrath is vice president of engineering and chief technology officer of SeaChange Technology, Inc., in Concord, MA.

However, drop-related problems have been excluded from this analysis.

• *Power failures affecting both trunk and distribution that result in service downtime.*

• *Reverse noise.* This source of service interruption includes all impulse and ingress-related events that result in the degradation of the service.

For the purposes of performing network availability calculations, each episode of network downtime has been normalized to the total cable subscriber base in Newmarket of 16,000. Individual downtimes are multiplied by the number of customers affected and divided by the total cable subscriber base. Total downtime for any period is the sum of normalized downtimes for the measurement period. HFC network availability is then given by the total time in the measurement period less the sum of normalized downtimes for the same period. It is expressed as a percentage of the total time.

Figure 3 on page 31 indicates HFC network availability ranging from a low of 99.13% in March (i.e., 390 minutes of downtime) to a high of 100% in May. The major contributor to the March figure is maintenance activities that resulted in a network downtime of 250 minutes. From Figure 3 on page 31, the year-to-date HFC network availability is 99.79%, or a total normalized downtime of 1,094 minutes. This exceeds the maximum allowable downtime of 315.36 minutes required to ensure 99.94% availability.

Figure 4: Contributions to network unavailability

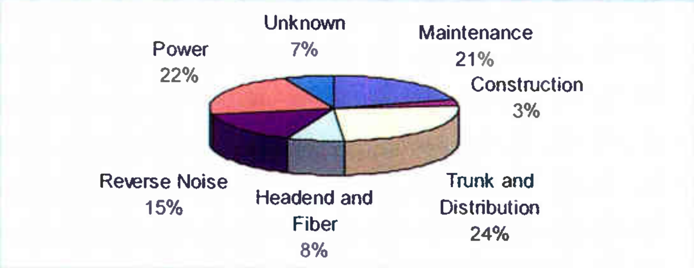
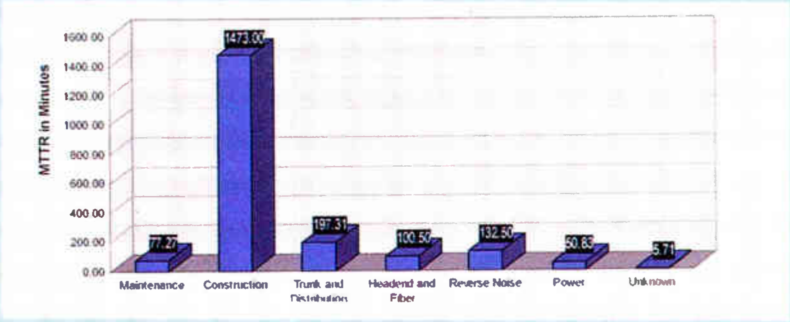


Figure 5: Mean time to restore



Network downtime

What are the sources of network downtime and how can they be minimized? Figure 4 illustrates the relative contributions to HFC network unabailability from all of the sources previously mentioned.

Overall, maintenance activities account for 21% of all incidents resulting in network downtime. Other major contributors are trunk and distribution problems (24%), power outages (22%), and excessive reverse noise levels caused by ingress and impulse noise events (15%). →

tion and may utilize several types of data networks, depending on the number of headends, their geographical separation and the availability of fiber or telco data services between them. T-1 lines currently are the most common solution providing an economical balance between cost and bandwidth. Where private fiber is available, extended LANs using a cable company's existing fiber is another alternative. Ethernet, Fast Ethernet and FDDI over single-mode fiber are relatively low-cost in terms of hardware but expensive in terms of fiber usage. For operators with fiber but multiple data applications, a private wide area network (WAN) can serve many purposes including the internal data communications requirements, local access and data communications services.

A SONET-ATM ring connecting distributed headends can provide significant capacity for ad distribution, and can provide capacity for other applications as well. In Boston, Continental is running a heavily zoned operation distributing spots over an ATM network connecting several widely-distributed headends.

The third configuration type is the superheadend. This configuration is becoming increasingly common. It provides the advantages of equipment consolidation while still permitting ad zoning. In this scenario, much of the operation of a remote headend is consolidated in a central location. Satellite dishes, receivers and ad insertion systems are required in only the central control site. With the ad insertion system residing at the superheadend there is no need for control and insertion data to be transmitted back and forth from the headends. Instead, this option relies on fiber to distribute the network programming, complete with local advertising, to the various headends for retransmission. Time Warner Albany is an example of a small superheadend. It has three zones, each with 10 channels of insertion, emanating from a single location.

Sometimes headend sites cannot be connected to the master control center, due to cost, geographical constraints or because there are too few subscribers to justify the network investment. These remote headends comprise the fourth type of configuration. In this case, the headends stand isolated. The digitized spots are delivered manually on digital tape or writable CDs. Scheduling, verification and management control use standard dial-up telephone lines.

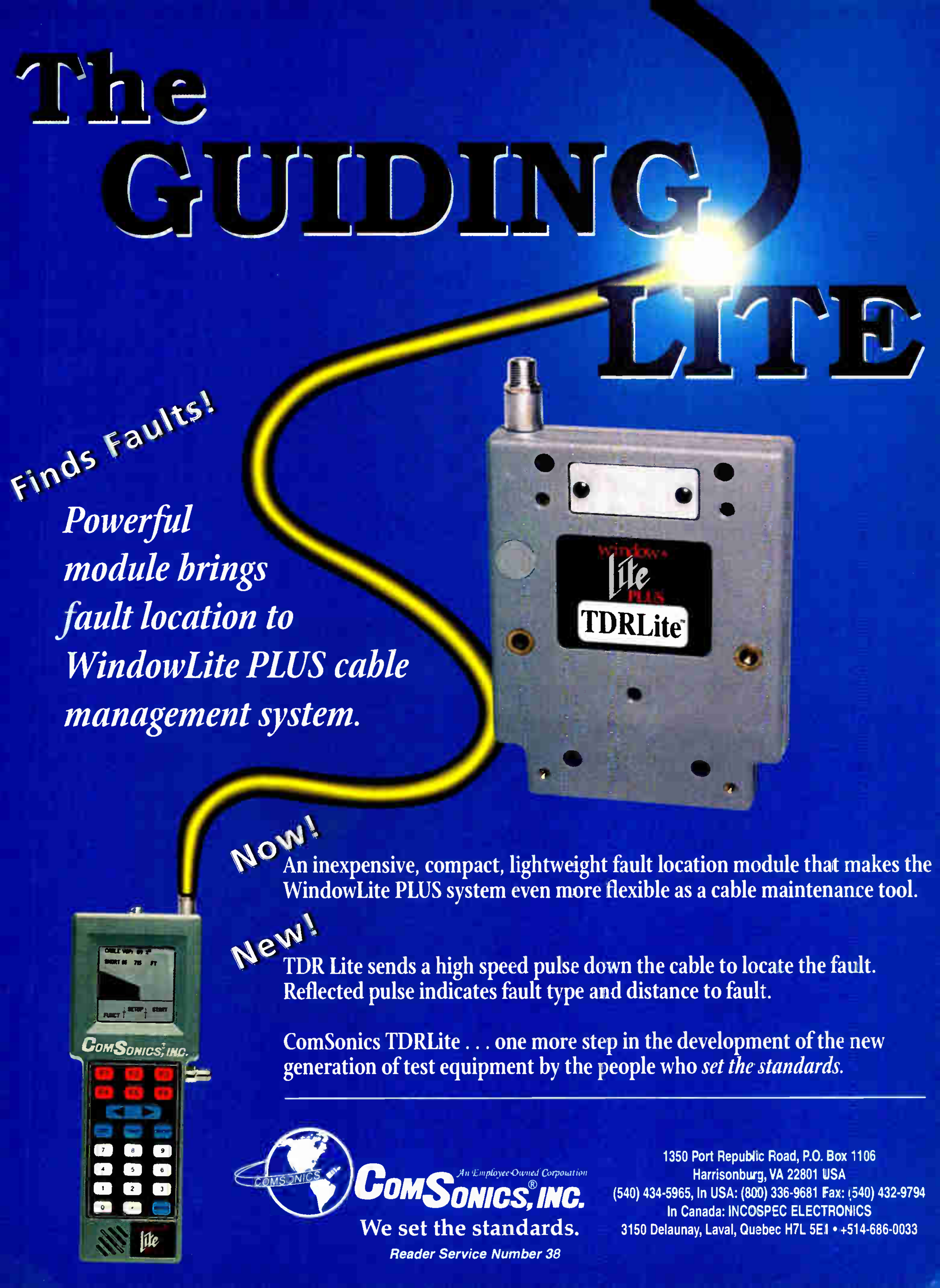
Although the delivery method seems like a step back to the days of analog insertion, the automated digital system still provides video quality, operational and scheduling advantages that cannot be achieved with tape decks, and requires far less space in the headend. Cable Adcom in Hershey, PA, has six disconnected headends and derives significant benefits from its digital insertion systems.

Finally, the fifth configuration is the hybrid, a mix of headend configurations and data networks. This is the configuration type for cable operations that do not fit neatly into the other categories and require a different solution. TCI's Pittsburgh site is a good example of this. It has 10 zones in a superheadend connected by a fiber backbone running FDDI and four more sites linked by T-1 or cable modem.

Network load considerations

To evaluate data network alternatives, it is essential to address the advertising load requirements of the ad insertion system. The primary question is: How much network bandwidth is required? To begin to answer this, the advertising load must be considered. This is a function of the number of unique ads required, how often they change and the length of the ads. Some cable operators maintain a high "churn rate," or frequency of ad turnover, as a result of their ad sales strategy. The length of the commercial video can range from 15-second clips, five-minute "Headline News" (local edition) programming, to 30-minute infomercials.

Additionally, the advertising load is dependent on the importance of quickly inserting last-minute spots. Networked digital insertion systems permit ad sales to better target politicians, retailers and others that depend on responsive messages to immediate situations and business opportunities. Often, it is incumbent on the data network to meet this requirement. →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Finally, the load on the network depends on the amount of storage available at the point of insertion. For example, consider the two extremes. In one case, all of the active ads reside at each headend location and only the new ads are moved over the data network. The downside to this is the cost of storage, which today is approximately $20 per 30-second ad. The other extreme is one in which there is no storage at the headend and every ad needs to move down the network.

For most sites, a few hours to a day's worth of ads residing at the headend is a good compromise in the storage/bandwidth trade-off. These stored ads mitigate the need for constant video traffic from the control center and allow operators to make bandwidth trade-offs. Vast storage capacity permits the insertion system to store thousands of ads and permits many networks to devote more time to the transportation of new ads. Alternatively, some operators with fast, high-transport networks can maintain the bulk of their storage at the master control center. Clearly, the storage capacity influences network decisions.

Technical dimension

A clear understanding of the different network capabilities and the digital systems' requirements is imperative. Some digital insertion systems can support any of the various network topologies and permit operators flexibility in choosing their network type. For a typical ad insertion see the figure on page 46.

Telco-provided data services range from 56 kbps to ISDN at 128 kbps, to T-1/E-1 at 1.5-2 Mbps. T-1 connections can take a variety of forms, including point-to-point service, frame relay, etc. Telco-provided services above T-1 quickly become cost-prohibitive. To get above T-1, most operations use their own fiber. Whether it's a private, multipurpose high-speed data network or a single-purpose extended LAN, the final decision rests on the financial considerations.

With existing fiber and a modest equipment investment (that is, approximately $10,000), operators are able to run Ethernet at 10 Mbps. When practical — and with investments of hundreds of thousands of dollars — ATM networks can provide bandwidth of 150 Mbps and can serve multiple purposes. Broadband modems can provide network connectivity at Ethernet speeds at the cost of two 6 MHz channels in a fiber broadband connection.

As a rule of thumb, most cable operations are running their ads at 8 Mbps to achieve Beta SP quality. MPEG data encoding techniques provide an optimum balance between video quality and data compression. The time it takes to move a spot over the network depends on several factors. A 10 Mbps Ethernet network typically will not move a spot in fewer than 30 seconds. In fact, the effect of other network limitations may cause the transfer rate to be reduced by a factor of two.

The three variables to consider in selecting a transmission system include: 1) overhead in packetizing and addressing the spot for transfer; 2) the bandwidth available over the WAN network connection; and 3) load on the LAN and servers (computers) at each end of the WAN.

Physical considerations

One of the most obvious points of consideration is the distance between sites. This plays a role in cost and practicality. For extended LANs and private WANs, intersite distances of 30-50 kilometers can be accommodated using moderate cost 1,300 nm laser equipment. Larger distances can be accommodated with repeaters or more expensive 1,550 nm gear.

As the industry positions for the ongoing digital revolution, digital ad insertion is providing new business opportunities today. By encoding advertisements into bits, the complex systems are simplifying the insertion of ads onto multiple channels over various zones. The digital systems are part of cables growing preeminence in technology application. Increasingly, advanced data networks are being deployed to harness the power of digital information. The carefully planned networks of cable operators are providing new benefits and positioning them for the future. **CT**

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By Arun Ramaswamy

MPEG for video compression

Video, computer and telecommunication applications increasingly are being integrated on a single platform. This requires the signal to be scalable, platform-independent and to provide hooks for interactivity and editing. It also must be robust and error-resilient. Analog video signals, unfortunately, fail to address these requirements. Moreover, the quality of the analog signal deteriorates with multiple reproductions.

Going digital not only eliminates most of these problems but also opens the door to a whole range of sophisticated processing techniques. The migration to digital has been accompanied by an evolution of standards. CCIR Recommendation 601 defines the standard for the TV industry while VESA is for the computer industry.

Although digital video addresses most of the drawbacks of its analog counterpart, it too has its share of bottlenecks. For example, digital video has huge bandwidth requirements. In spite of being digital, it still needs to be stored on magnetic tapes.

Consider a CCIR Rec 601, 720 x 485, video signal at a frame rate of 30 Hz. Assuming a 24 bits/pixel resolution, the requirements are approximately 250 Mbps. For a two-hour movie, the storage requirement would translate to an astronomical 225 Gbytes! Such a number poses a serious problem for the slower communication channels and computer buses, and is quite impractical for most multimedia, computer or telecommunication applications.

The logical solution to this problem is digital compression. Compression aims at lowering the total number of parameters required to represent the signal while maintaining perceptually good quality. These parameters are then coded either for storage or transmission.

Arun Ramaswamy is a scientist for Vela Research, in St. Petersburg, FL.

If in the compression process all the information is conveyed using the subset of parameters, the compression is called "lossless." On the other hand, if less than the complete information is conveyed, it is termed "lossy."

It is important to recognize the different redundancies in video signal data: spatial, temporal, psychovisual and coding. Spatial redundancy occurs because neighboring pixels in each individual frame of a video signal are related — in other words, have some degree of correlation. The pixels in consecutive frames of a signal also are correlated, leading to substantial temporal redundancy.

The human visual system does not treat all visual information equally. This leads to psychovisual redundancy. For example, the eye perceives changes to a greater extent in luminance than in chrominance. The eye also is less sensitive to high frequencies. So, a more meaningful criterion is to study how the human eye and brain really perceive an image as opposed to the actual intensity value of the pixels. Finally, not all parameters occur with the same probability in an image. They would not require an equal number of bits to code them, leading to coding redundancy. For any compression algorithm to be effective, it must exploit these redundancies.

Several compression standards have emerged to address diverse applications at various bit rates. For example, CCITT Recommendation H.261, also known as the p x 64 standard, has emerged for videoconferencing. Another example comes from the Moving Pictures Experts Group, a joint committee of the International Standardization Organization and International Electrotechnical Commission. The committee has been responsible for MPEG-1 and MPEG-2 standards and is developing MPEG-4.

MPEG standards are generic and universal in the sense that they merely specify a compressed bit stream syntax. This unambiguously defines the decompression process. The standard, however, does leave room for smart implementations of the encoder, compression algorithm and the decoder.

There are three main parts of the MPEG-1 and MPEG-2 specifications: systems, video and audio. The video part defines the syntax and semantics of the compressed video bit stream. The audio part defines the same for the audio bit stream, while the systems part addresses the problem of multiplexing the audio and video streams into a single system stream with all the necessary timing information. Timing information is necessary to synchronize the playback of the stream by the decoder without any overflow and underflow of the decoder buffers.

MPEG-2 consists of a fourth part called DSMCC, which defines a set of protocols for the retrieval and storage of MPEG data from and to a digital storage medium.

At the highest level of the hierarchy, the video bit stream consists of video sequences. MPEG-1 allows for only progressive sequences, while MPEG-2 allows for both progressive and interlaced sequences. Each video sequence consists of a variable number of groups of pictures (GOP). A GOP contains a variable number of pictures. A picture can either be a frame picture or a field picture.

In a frame picture, the two fields are coded together to form a frame, while field picture is a coded version of an individual field. Pictures can be either of frame-type or field-type in MPEG-2; MPEG-1 allows only frame pictures. Mathematically, each picture is really a union of the pixel values of three pixel matrices: one luminance and two chrominance components.

Because the human eye is not very sensitive to the chroma region changes as compared to the luminance region, chroma matrices are usually decimated or reduced in size by a factor of two in both the hori-

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Reader Service Number 94

zontal and vertical directions. So, there are one-fourth the number of chrominance pixels to process as there are luminance pixels. This format, referred as 4:2:0 format, is employed in MPEG-1. MPEG-2 allows for either no decimation or only horizontal decimation of the chroma component. These two formats are referred to as 4:4:4 and 4:2:2 formats, respectively.

Pictures can be categorized into three main types based on their compression schemes: I or intra pictures; P or predicted pictures; and B or bidirectional pictures. I pictures are coded by themselves. The coding technique for these pictures falls in the category of transform coding. Each picture is divided into 8 x 8 nonoverlapping pixel blocks. Four of these blocks are arranged into a bigger block of size 16 x 16 (a macroblock).

A discrete cosine transform (DCT) is applied to each 8 x 8 block individually. The transform exploits the spatial correlation of the pixels by converting them to a set of independent coefficients. Low-frequency coefficients contain more energy than high-frequency ones. These coefficients are quantized with a quantization matrix. This process allows the high-energy, low-frequency coefficients to be coded with a greater number of bits, while using fewer or zero bits for the high-frequency, low-energy coefficients.

High-frequency coefficients can be dropped because the eye lacks the ability to detect high-frequency changes. Retaining only a subset of the coefficients reduces the total number of parameters needed for representation by a substantial amount. The process is identical for the luminance and the chrominance pixel blocks. However, since the human visual sensitivity to the luminance and chroma varies, the quantization matrices for the two differ. The quantization process also helps in rate control, allowing the encoder to output bit streams at a specified bit rate.

DCT coefficients are coded employing a combination of two special coding schemes: Run length and Huffman. The coefficients are scanned in a zigzag pattern to create a one-dimensional sequence. MPEG-2 can additionally provide a different scan pattern. The resulting sequence usually contains a large number of zeros due to the lowpass nature of the DCT spectrum and the quantization process.

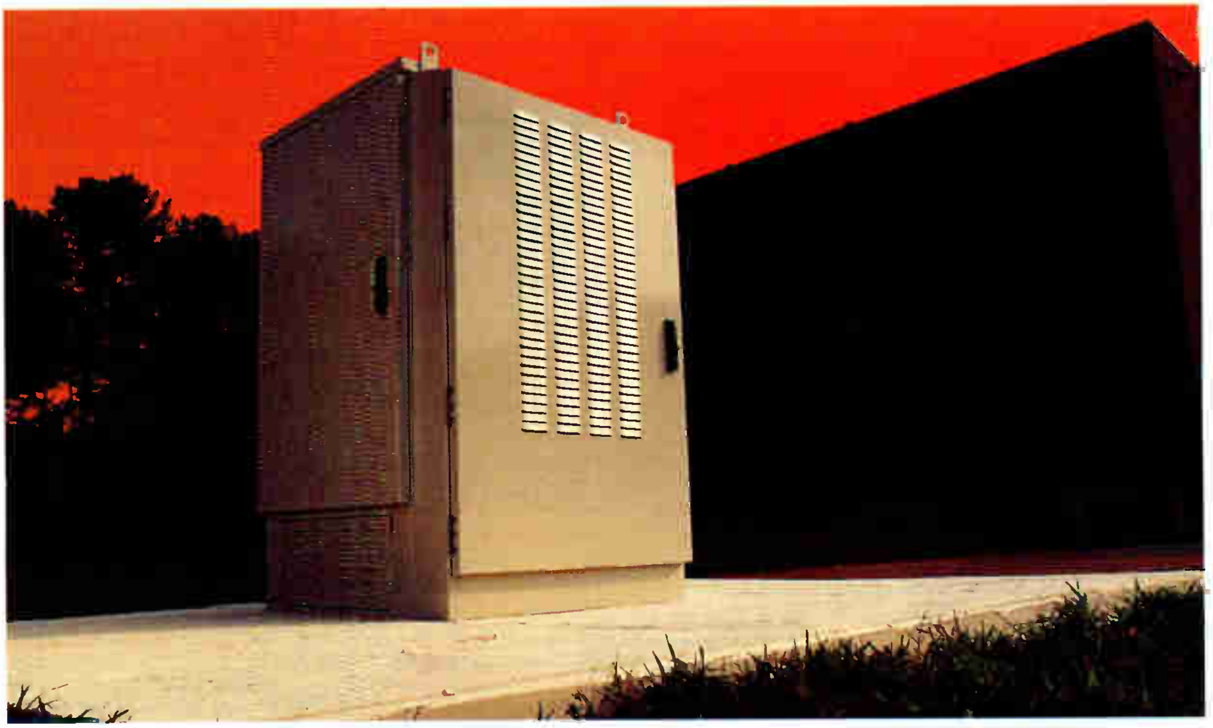
Each nonzero coefficient is associated with a pair of pointers. The first pointer is the coefficient's position in the block, indicated by the number of zeros between itself and the previous nonzero coefficient. The second pointer is its coefficient value. Based on these two pointers, it is allotted a variable length code from a lookup table. This is done in a manner so that a highly probable combination gets a code with fewer bits, while the unlikely ones get longer codes.

Adopting this lossless coding technique, the total number of bits is kept down. However, since spatial redundancy is limited, the I pictures provide only moderate compression. These pictures provide important hooks for random access into the digital bit stream for editing purposes. The frequency of I pictures is normally once every 12 to 15 frames.

The P and B pictures are where MPEG derives its maximum compression efficiency. It does that by using motion compensation (MC) based prediction, which exploits the temporal redundancy. Because frames are closely related, it is assumed that a current picture can be modeled as a translation of the picture at a previous time. It is possible then to accurately represent or "predict" the data of one frame based on the data of a previous frame, provided the translation is estimated.

The process of prediction helps in the reduction of bits by a huge amount. In P pictures, each 16 x 16 sized macroblock is predicted from a macroblock of a previously encoded I picture. Because frames are snapshots in time of a moving object, the macroblocks in the two frames may not correspond to the same spatial location. Hence, a search is conducted in the I frame to find the macroblock that most closely matches the macroblock under consideration

(Continued on page 84)



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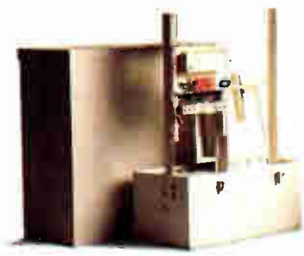

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Reader Service Number 8

By Glyn Bostick, Ronald E. Mohar, and Vince Cupples

Suppressing DPI — Part 3

This is the last in a three-part series that examines the problem of direct pickup interference (DPI/DPU). Part 1 ran in December 1995 and Part 2 ran in February 1996.

Most of the symptoms of DPI also are symptoms of other problems. Assuming that the problem is not emanating from the distribution system, there are a number of other problems (at the subscriber installation) that can produce DPI-like symptoms. Compound problems are entirely possible. Chances are good that any equipment defects will complicate DPI in strong ambient RF fields. When a converter box test produces a complete solution (Possibility 3) pure DPI is indicated. However, if a converter box test produces an improvement (but not a complete solution) one can suspect a compound problem (Possibility 1).

A number of component problems at the subscriber installation should be checked. Poor grounds, high-resistance grounds, bad connectors, damaged connectors, defective splitters or damaged shields can cause DPI-like symptoms. Ground bonds that are acceptable at power line frequencies can sometimes be high-resistance bonds at VHF.

Coaxial shielding can range from 53% to 95% depending on cable quality. The coaxial jumper cables usually supplied with TV sets and VCRs are notoriously poor. Many of the interconnecting cables sold in retail outlets are equally poor. They usually have inexpensive "push-on" connectors and utilize coax with minimum shielding. Complex subscriber setups with several VCRs, poorly shielded (plastic) A/B switches, distribution amplifiers, and a variety of interconnecting cables frequently have many ground-loops.[1] It is wise to simplify a complex setup before troubleshooting.

Remedies

Six different remedies have been used on pure DPI. Although most of these have proven effective at some time, few if any of them work when applied indiscriminately to any interference problem. Let's take a look at each.

• *TV receivers:* Using a receiver with more selectivity, more shielding, and balanced input circuits could help remedy certain specific problems provided that such a receiver can be found. Unfortunately, few subscribers will buy a new TV set or VCR to solve a problem that they consider the fault of the cable operator. Further, virtually all of the TV receivers currently being made have the same problem.

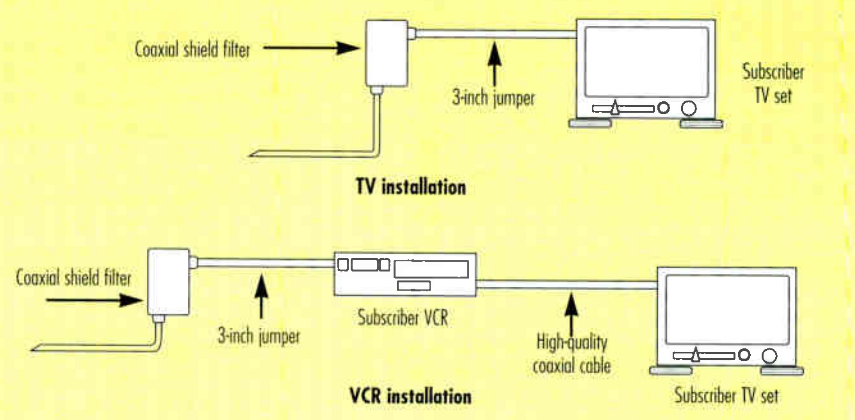
• *Set-top converters:* Because most set-top converters have tuners capable of discriminating against common-mode interference, DPI seldom occurs when converters are used. However, installation of an otherwise unnecessary set-top box totally defeats the purpose of "cable-compatible" receivers. Few subscriber are likely to pay additional rental fees for a box that makes some of the functions on their receiver irrelevant. If the converter is provided free, this of course pushes up costs for the system operator. Further, under the right circumstances, DPI can occasionally occur even in installations that use a converter. VCRs and converters output on either Ch. 3 or 4. In an installation in close proximity to a TV transmitter, the receiver could still pick up interference. Such DPI involves either co-channel ingress or adjacent channel ingress on either Ch. 3 or 4.

• *Ferrite beads:* Some technicians have used ferrite beads to remedy DPI. The beads are taped onto the coaxial input cable. This represented the first attempt to add inductance to the coaxial shield. In theory, additional shield inductance should help. In some circumstances ferrite beads have been useful. However, some cable installers report never being able to make them work. One of the difficulties is that you have to keep adding them to determine the right amount of inductance needed. Another difficulty is that some subscribers perceive them as "inconvenient" and "unsightly." Ferrite beads are not the only method of blocking signals on a shield.

• *Coaxial decoupler:* The cable is passed through a cylindrical tube at least 18 inches long filled with steel wool.

• *Coaxial baffler:* Passing a cable through a metal baffle (plate) also can be an effective way of blocking signals.→

Figure 1: Coaxial shield filter installation



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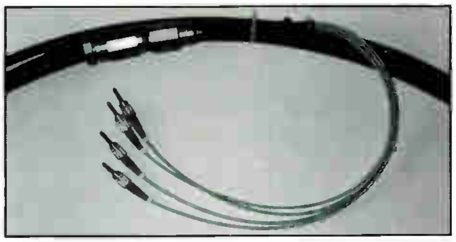
Ronald E. Mohar is CEC's director of technical publishing.

Vince Cupples is a senior applications engineer with CEC.

The authors can be reached at (315) 452-0709.



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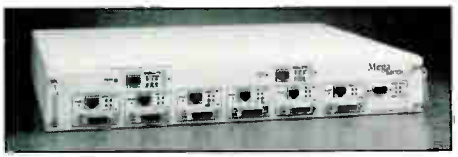
Reader Service Number 233



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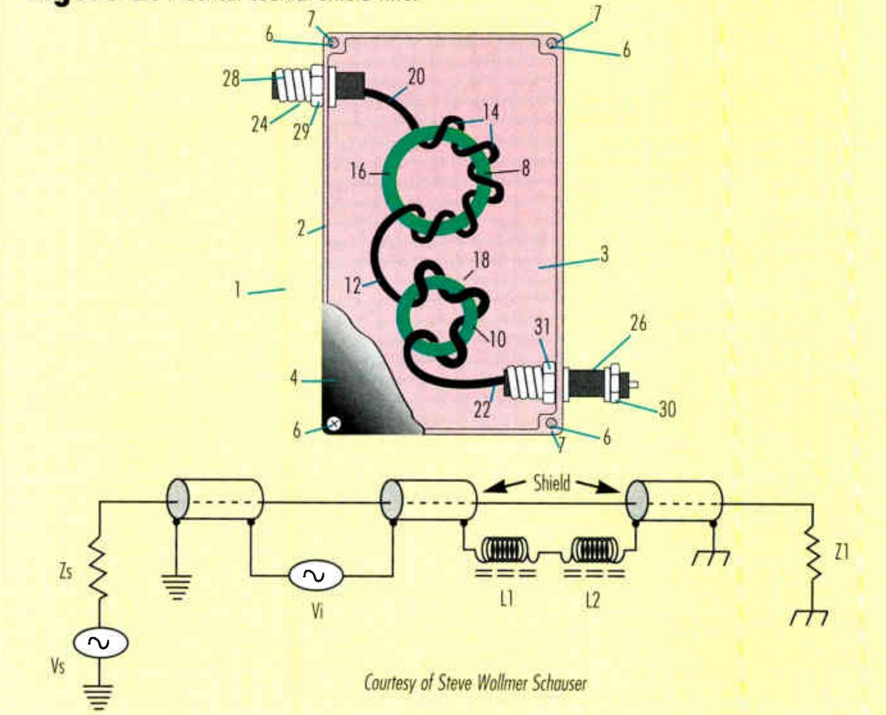
Reader Service Number 235

But the plate would have to be some 9 feet in diameter in order to block signals in the VHF low band. Unfortunately, both decouplers and bafflers are even more awkward, inconvenient, unsightly and difficult to implement than ferrite beads.

• *Coaxial shield filters:* Coaxial shield filters have a number of advantages over all other remedies. First, they are easier to implement and involve less guessing than ferrite beads. Second, they are less unsightly than beads, tubes or baffles. Third, they are less expensive than either a converter box or a new TV receiver (presuming that a better receiver can be found). Fourth, passive filtering devices are more reliable than active devices with complex circuitry. They seldom wear out and can be reused indefinitely. Figure 1 on page 56 illustrates applications with a TV set and a VCR.

Inductive grounding is one method of breaking up ground loops. Such circuits are effective in discriminating against common-mode voltages and currents. The patented coaxial filter illustrated in Figure 2 utilizes this principle to suppress DPI on coaxial shields.[2] Further, it has actually been used in large quantities to solve DPI problems.[3] Similar devices have been recommended for years in amateur radio publications for suppressing interference on audio input cables,[4] 300-ohm and 50-ohm (RG-58) transmission lines.[5] Similar filters have been used to suppress both ingress and spurious emissions. However this particular device is unique in that it represents an application of well-understood principles to 75-ohm coaxial cables.

Figure 2: Practical coaxial shield filter



Courtesy of Steve Wollmer Schauser

As we have said in this series of articles, virtually all TV receivers currently on the market suffer from DPI. Practical solutions to the problem involve appropriate diagnostic testing and the implementation of proper practical devices. **CT**

References and notes

[1] Federal Communications Commission, *Interference Handbook*, U.S. Government Printing Office, 1993, page 53.
[2] Steven M. Wollmerschauser and David M. Mundy, U.S. Patent No. 5,091,707A.
[3] The Millennium Hotel in New York City has reportedly used several hundred of these patented devices in its MATV system.
[4] Charles L. Hutchinson, *The ARRL Handbook for the Radio Amateur, 62nd Edition*, American Radio Relay League, 1985, page 4-9; and Ed Doubek in Ed Hare and Robert Schetgen, eds., "Troubleshooting," *Radio Frequency Interference: How to Find It and How To Fix It*, American Radio Relay League, 1991, pages 3-7, 3-18.
[5] Hutchinson, page 4-7.

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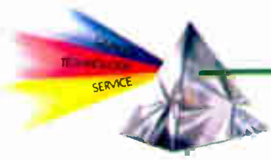

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Reader Service Number 3

By Brian Bauer

Drops for the digital frontier

Cable TV is about to enter a new world — several new worlds, in fact. The first is a new technological realm of digital signal transmission. The second is regulatory and essentially will allow providers to offer any services they choose.

The architecture of choice today is hybrid fiber/coax (HFC). It's flexible and economical and with a relatively small investment, today's cable companies can become tomorrow's voice, data and video suppliers.

There will be new challenges:

• *Compressed signals using a variety of high bit-rate modulation schemes.* Theoretically they are more robust, but in reality they require much stricter control of signal-to-noise ratios.

• *Two-way services.* Upstream service brings a host of new problems, including funneling, the summing of noise from multiple locations on a cable run.

• *Power delivery.* The immediate impact of added power on the network will be to speed up the corrosion of vulnerable connections.

• *Lifeline services.* While disruption of a favorite program may feel like tragedy, the loss of 911 service — even briefly — could actually cause one.

• *Instant competition.* Your customer may already be wired to another full-service vendor — a telco for example. A phone call is all that will be needed to make a service switch.

Buttoning up the system

Research shows that the vast majority of today's service calls — 60% to 80% is a widely quoted figure — are due to problems in the drop.[1] Drop problems can be traced to cables, jumpers, splitters or other devices, but if the drop itself is the leading source of network problems, the F-connector is usually the prime suspect. Besides being an inherent break point in the network, it is subject to more handling by technicians than other components. Further, it is readily accessible to customers who usually have little experience with proper connections. Every time the connector is opened, there is a finite risk that it will not be properly tightened or that it will be damaged. Multiply that risk by the number of connections in a single drop and the number of drops in the network. Add damage to in-house cable and problems caused by poor quality, consumer-purchased fittings, and it can start to look unmanageable.

The good news is that many problems can be cleared with a simple tightening of a connector. The bad news is that tomorrow's digital, multiservice network will be affected by smaller irregularities, and that a service call — even a simple one — can take a painful bite out of revenue.

Components

There are three critical steps in keeping drops functioning properly: proper components, correct installation and protection from damage.

The biggest single problem with substandard passives is low return loss. Wall plates, connectors and splices can be a source of disruptive reflection. Splitters also can be a problem if they fail to isolate individual TV sets; reflections caused by "surfing" on one TV set can disrupt the signal to other sets on the drop. Typical port-to-port isolation of splitters is greater than 20 dB. However, for optimal isolation a directional coupler (better than 30 dB) is preferred.

Lower-quality customer-supplied components are a frequent cause of problems. However, vendor-supplied components also can cause problems. The industry has been slow to establish standards, but as it does it is critical that they be adhered to.

Installation

Proper installation includes:

1) Proper grounding or bonding to protect the system from low-frequency impulse noise, such as electrostatic discharges, arcs and surges. If needed, surge suppression devices also can be used.

2) Care to maintain shielding of the system. This is particularly critical on two-way systems because longer wavelengths are harder to shield. Proper shielding protects against both high-frequency impulse noise and ingress noise, such as FM radio, pagers and cellular phones. The most common cause of shielding loss is poorly tightened connections. This can leave separations in the outer conductors, causing an "antenna effect."

3) Careful routing of cables. Punctures, kinks or deformities due to improper cable handling can affect cable impedance, cause reflections and affect the bit stream of digital signals.

Protection

Drops can be damaged at any time after installation. Careful placement can prevent physical damage due to movement or chewing by pets. Corrosion presents a particular problem because it takes place invisibly and over time. Since it could be aggravated by network upgrades or maintenance, it deserves careful consideration.

Three factors contribute to corrosion: galvanic action at the interface between dissimilar metals, the presence of electrical current and moisture. Without all three, corrosion is, for all practical purposes, impossible.

Today, dissimilar metals are a fact of life. Future designs may reduce the problem, but today's installations, and those in the foreseeable future, will involve mixed metals. Electrical current obviously is inherent in signaling on cable. Today, some problems can be reduced by proper grounding, but as service providers add telephony services they will have to provide power to telephone devices, increasing the amount of current on the network.

(Continued on page 72)

Brian Bauer is senior product manager of the integrated drop management system at ADC Telecommunications' Broadband Connectivity Group.

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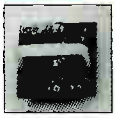

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$12.00*

Passband = 330, 400, 450, and 550 MHz
Flatness = ± .15 dB
Return Loss = ≥ -17 dB
Insertion Loss = ≤ 1 dB
Values 0, 3-30 in 1.5 dB increments

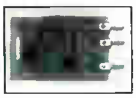
SXP-T-TOPS

For Scientific Atlanta Equipment
SXP T-Top Blue 600 MHz–**$1.75**
0-20 dB in 1 dB increments

SXPTY-Top Yellow 860 MHz–**$2.14**
0-13 dB in 1 dB increments

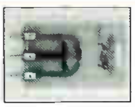
SXPTY-Top Yellow 860 MHz–**$2.64**
14-20 dB in 1 dB increments

QSYL



PATHMAKER
$10.00
Available in the following bandwidths:
300, 330, 400 and 450 MHz
Nominal Values:
4, 7, 10, 13, 16, 19, 22, 25 dB

QSYL-P



PATHMAKER
PADS
$4.50
0 to 6 dB
9, 12 and 15 dB

QRCA

EQUALIZER $8.00
300, 330 & 350 MHz
3, 6, 9, 12, 15, 18, 21 dB

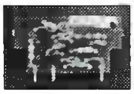
QRCA-P

PADS $5.50
0, 3, 6, 9, 12, 15, 18 dB

***DISCOUNTS AVAILABLE FOR QUANTITY**

QMAG

QMAG – 62E Series
Replacement EQ's for Philips
(330, 400, 450 and 550 MHz)
$10.00
330 MHz – 2, 5, 8, 11, 14, 17, 20, 23 dB
400 MHz – 2, 5, 8, 11, 14, 17, 20, 23, 26 dB
450 MHz – 2, 5, 8, 11, 14, 17, 20, 23, 26 dB
550 MHz – 2, 5, 8, 11, 14, 17, 20, 23, 26, 29 dB

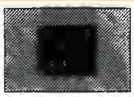


QMAG – 5EE Series
(Fixed Values)
(330, 400 and 450 MHz)
$10.00
330 MHz – 5, 8, 11, 14, 17, 20 dB
400 MHz – 5, 8, 11, 14, 17, 20 dB
450 MHz – 5, 8, 11, 14, 17, 20 dB
Return Loss = 16 dB All Values
Insertion Loss = =1.0 dB All Values

QMAGV

Replacement Equalizer For Magnavox 5CE Series Adjustable
(330 and 450 MHz)
$14.00*
330 MHz – 0, 5, 8, 11, 14, 17, 20, 23 dB
450 MHz – 5, 8, 11, 14, 17, 20, 23 dB
Return Loss = 16 dB All Values
Insertion Loss = =1.2 dB All Values

QMAG-P



4-A Pad **4.50**
6-A Pad **1.75**
7-A & 9-A Pad **2.75**
4-A – 0, 3, 6, 9, 12 dB
6-A, 7-A, 9-A – 0-20 dB in 1 dB increments

QTEX

TEXSCAN 'T SERIES'
$10.00
Available in the following bandwidths:
330, 400, 450, 475
330-400 MHz – 4, 8, 12, 15, 18 dB
450 MHz – 4, 6, 8, 10, 12, 14, 16, 18, 20 dB
475 MHz – 4, 6, 8, 10, 12, 15 dB

QTEX-P

TEXSCAN 'T SERIES'
PADS – $5.50
0 to 6 dB
9, 12 and 15 dB

QLX

Equalizer for Jerrold JLX
(Replaces Jerrold EQ & SEA)
$6.75

(330, 350, 400, 450, 500 and 550 MHz)
330-450 MHz – 0-30 dB 500 MHz – 2-22 dB
550 MHz – 0-24 dB

600 MHz **$7.50** 750 MHz **$11.00**
(0-24 dB, in 2dB increments)

QEP-ADP

Fixed Value Equalizer System

Allows QLX to Replace SEP's

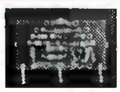
QEP-ADP - **$7.00** Plus QLX - **$6.75**
TOTAL - **$13.75**

QEP

Trunk Equalizers (Replaces SEP by Jerrold)
(ST 20 and SJ Chassis Compatible - Available in one-way or two way...4's and 5's)

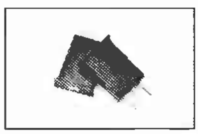
TL - 5 thru 11 dB
L - 10 thru 16 dB
H - 16 thru 22 dB
ST - 18 thru 25 dB
(300 through 450 MHz Bandwidths)
$15.00 all values

QEE

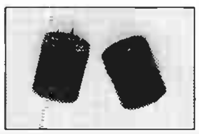


Line Extender Equalizers
(Replaces SEE by Jerrold)
270 MHz, 300 MHz, 330 MHz, 350MHz, 400 MHz
$5.00

450 MHz - **$6.00** 550 MHz - **$7.00**
600 MHz - **$8.00**
Values: 6 dB, 12 dB, 18 dB, 24 dB



JXP PADS
$2.90
(0 to 24 dB in 1 dB steps)
Also available
JXP A's–750 MHz



SXP PADS
$1.75
(0 to 20 dB in 1 dB steps)

Quality RF Services is not a Sales agent for Jerrold, Scientific Atlanta, Magnavox, Texscan, or RCA

QUALITY RF SERVICES, INC.
850 PARK WAY
JUPITER, FL 33477

(800) 327-9767

(407) 747-4998
FAX (407) 744-4618

Reader Service Number 68

AD INDEX

SCTE®

SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS

CABLE-TEC EXPO® '96

THE FACTS ABOUT CABLE-TEC EXPO® '96

DATES

Registration and Pre-Conference Tutorials, June 9, 1996
Annual Engineering Conference, June 10, 1996
Technical Workshops and Exhibits, June 11-12, 1996
Certification Testing, June 11-13, 1996

LOCATION

Opryland Hotel
Nashville, Tennessee

HISTORY

Cable-Tec Expo® '96 is the 14th annual convention/trade show sponsored by the Society of Cable Telecommunications Engineers Inc. The show has proven to deliver the latest information on technological advancements and applications in a format that provides training through technical workshops and instructional hardware exhibits.

The Annual Engineering Conference will be SCTE's 20th yearly conference dedicated to current engineering issues, FCC compliance, technical management and issues focusing on cable and telephony as converging industries. 1996 marks the 27th anniversary of the Society as a leader in technical training for the broadband telecommunications industry, with this year's Expo offering additional opportunities for exposure to the newest trends in the expanding telecommunications arena.

ATTENDANCE

Attendance is open to individuals within the CATV industry as well as those involved in broadband and telecommunications who wish to capitalize on the opportunity to learn about the latest industry developments. Over 4,000 registered attendees are expected from all levels of cable TV, telco and related businesses, including non-technical professionals.

PROGRAM

The Annual Engineering Conference consists of six hours of technical papers including such topics as fiber optics, digital video and the convergence of cable, telco and data services. Speakers will include many of the industry's engineering leaders. The annual membership meeting, held at the conclusion of the conference, will afford attendees the opportunity to meet with members of SCTE's national Board of Directors.

The two-and-one-half day Cable-Tec Expo® that follows the Engineering Conference is comprised of practical workshops offering interactive technical training combined with hardware displays on the exhibit floor. The workshops, technical in nature, feature presentations dealing with the proper design, operation and maintenance of broadband telecommunications systems. No other activities are scheduled during these sessions in order to guarantee maximum attendance and participation.

TOURS

Tours of The Nashville Network and Country Music Television production facilities will be conducted on the final day of the Expo. Tickets will be available during the Expo in the Registration Area on a first come-first served basis.

TRAINING

As with all SCTE programs, the main purpose of Cable-Tec Expo® '96 is to provide the maximum amount of training opportunities for the lowest possible cost. The event has been coordinated to fulfill this purpose, as it offers a wide variety of informative, up-to-date technical training programs. Additionally, Expo '96 will give attendees the opportunity to prepare for and participate in the Society's Broadband Communications Technician/Engineer (BCT/E) and Installer Certification Programs, gaining valuable knowledge and practical skills in the process.

EXHIBITS

The exhibit floor has a focus on education, with many industry suppliers presenting live technical demonstrations of their products. Over 350 hardware exhibitors are expected to reserve space on the Expo '96 Exhibit Floor. Exhibits will include all types of products, supplies, services and equipment used in the design, construction, installation, repair, maintenance and operation of broadband telecommunications systems. The exhibit floor will also feature a Technical Training Center for further equipment demonstrations.

CABLE-TEC EXPO® '96 REGISTRATION FEES

	PRE-REGISTRATION Until May 1, 1996		ON-SITE** After May 1, 1996	
	Member	Non-Member	Member	Non-Member
Engineering Conference and Expo*	$240	$340	$290	$390
EXPO only	$190	$290	$240	$340
Engineering Conference only*	$145	$225	$195	$275
Spouse Registration*	$95	$95	$95	$95

* Includes ticket to the Awards Luncheon on June 10. Additional luncheon tickets are available for $25 each.

** Admittance to the Awards Luncheon is not guaranteed, but will be made available as seating permits.

ADMISSION

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

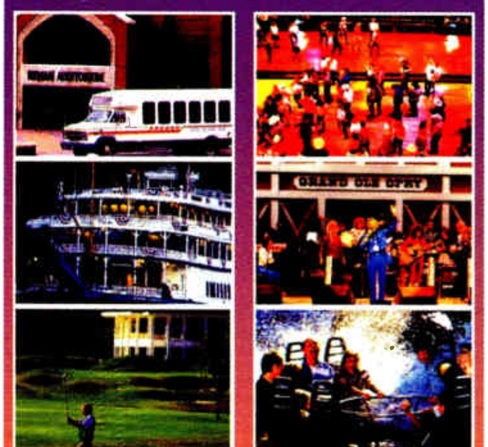
TRANSPORTATION

SCTE has made special arrangements for discounted airfares to Cable-Tec Expo through Opryland International Travel using American Airlines and US Air. American and US Air are offering zone fares, and discounts on both restricted and unrestricted fares to Nashville are available through US Air. Opryland International Travel is conveniently located in the Opry-land Hotel, provides $200,000 flight insurance at no cost and free airport shuttle service.

OPRYLAND INTERNATIONAL TRAVEL: 1 (800) 677-9526
REFER TO "SCTE MEETING"

BUDGET RENT-A -CAR—REFER TO MEETING #U009653

ENTERTAINMENT



The Opryland Hotel Guest Services Desk can make reservations for area attractions, dining, nightlife and sightseeing activities.

NASHVILLE AREA ATTRACTIONS

- Ryman Auditorium
- Grand Ole Opry
- Vanderbilt University
- Music Row
- Opryland USA Theme Park
- Championship Golf Courses
- Wild Horse Saloon
- General Jackson Riverboat
- The Nashville Network
- The Parthenon
- The Hermitage
- Jack Daniels Distillery
- Gibson Guitar Factory
- Percy Priest Lake

EVENT SPONSOR

SCTE®

Society of Cable Telecommunications Engineers Inc.
140 Philips Road, Exton, PA 19341-1318
(610) 363-6888; (800) 542-5040
Conference Fax: (610) 363-7133

PRELIMINARY PROGRAM

Pre-Conference Tutorials—Sunday, June 9, 1996

- *Achieving BCT/E Technical Certification*—Marvin Nelson, SCTE
- *Audio Quality in the Multi-Channel Universe (Part II)* with Russ Murphy, The Family Channel
- *Consumer Interface and the New Telecommunications Bill* with Walt Ciciora, Ph.D., Consultant for NCTA
- *Justifying Technical Training in Your Company's Annual Budget* with Don Oden, NCTI

Engineering Conference—Monday, June 10, 1996

SESSION A: *Fiber-Related Issues* with Tony Werner, TCI (Moderator); John Chamberlain, Norscan; Pawan Jaggi, Pirelli Cable Corp.; and Pete Wagener, ANTEC Corp.

SESSION B: *Video Transport* with Nick Hamilton-Piercy, Rogers Cablesystems (Moderator); Mark Davis, Cox Communications; Charles Kennamer and Olis Nesco, TCI; Keith Kreager, ANTEC Corp.; Jack Terry, Nortel; and John Thomas, ADC Video Systems

SESSION C: *Data Over Cable* with Ken Wright, Intermedia Partners (Moderator); Frank Cotter, Rogers Cablesystems; and Bob Cruickshank, CableLabs

SESSION D: *Return Spectrum Issues* with Alex Best, Cox Cable (Moderator); Brian Bauer, ADC Telecommunications; Jerry Green, HP/CaLan; Dean Stonebeck, General Instrument; and Bill Xenakis, Wireless and Cable Products

Expo Workshops—Tuesday and Wednesday, June 11-12, 1996

- *Cost Analysis of System Rebuilds* with Dale Lutz, ETG; and Scott Shupe, Intermedia Partners
- *Data Transmission "Byte by Byte"* with Richard Covell, Texscan
- *Digital Technology 102* with Megel Brown, Comcast; and Don Gardina, Hewlett-Packard
- *In-Premise Wiring Issues* with Barry Smith, Texscan; and Neal Tinggaard, TCI
- *Making Two-Way Work* with Ron Hranac, Coaxial International; and Tom Staniec, Time Warner
- *Network Architectures 102* with Kenneth Metz, Integrated Technology; and Jeffrey Sauter, C-Cor
- *Network Management (OSS, BSS)* with Pamela Anderson, CableLabs; and Terry Poindexter, Integration Technologies
- *Powering Issues* with Tom Osterman, Comm/Net Systems
- *Regulatory Issues* with Ralph Haimowitz, SCTE; Steve Johnson, Time Warner Cable; Jonathan Kramer, Communications Support Group; and Frank Lucia and John Wong, FCC
- *Telephony 102* with Jay Junkus, Knowledge Link; and Tony Gutierrez, Nortel

ATTENDEE REGISTRATION INSTRUCTIONS

Registration:

- Complete and return the Attendee Registration Form. Use a separate form for each attendee. Photocopies are accepted. SCTE will not accept registrations by phone.
- Payment must accompany forms in order to be processed. SCTE will accept registrations by FAX only when paid by credit card. If forms are faxed, DO NOT MAIL THE ORIGINAL.
- Non-members wishing to join SCTE may complete the membership application below and submit it with the registration form. Individuals submitting a completed membership application with payment are eligible for SCTE member registration rates. Annual member dues are $40 within the Continental US, $60 outside the US (including Canada).

Registration Types:

- FULL REGISTRATION: Includes Engineering Conference, Workshops, Exhibits, and Annual Awards Luncheon.
- EXPO ONLY: Admittance to Workshops and Exhibits only.
- ENGINEERING CONFERENCE ONLY: Admittance to full day conference and Annual Awards Luncheon.
- SPOUSE REGISTRATION: Includes all sessions, Exhibits, and Annual Awards Luncheon.

(All above registrations include evening hospitality events)

REGISTRATION DEADLINES, CANCELLATIONS AND SUBSTITUTIONS:

MAY 1, 1996— DEADLINE FOR PRE-REGISTRATION

★ Registration forms must be received at SCTE prior to this date.
★ Forms received after MAY 1 will not be processed and individuals must register on-site at the on-site rate.

MAY 10, 1996— DEADLINE FOR CANCELLATION/ SUBSTITUTIONS

★ All requests for cancellation must be received in writing prior to MAY 10. All requests for cancellation will be subject to a $50 cancellation fee.
NO REFUNDS WILL BE GIVEN AFTER MAY 10.
★ All requests for substitutions must be received in writing prior to MAY 10. After this date, substitutions must be processed on-site at the Registration Assistance Booth. Written company authorization and a $5 processing fee are required.

DRESS CODE:

★ Since the primary purpose of the Expo is education, we urge you to dress in a manner that is comfortable and conducive to your getting the most out of the program (slacks, jeans, short sleeve shirts—NO shorts or tank tops).

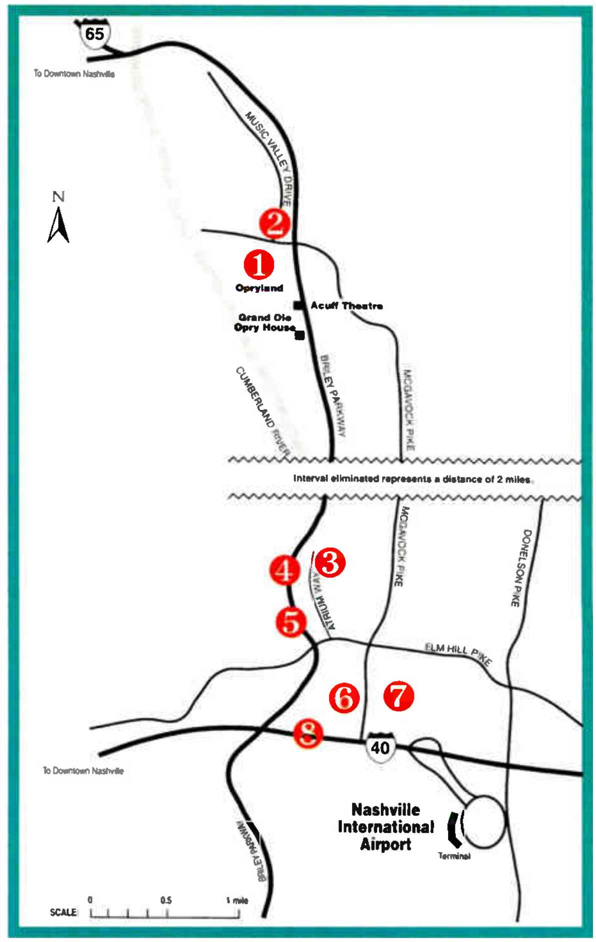
CABLE-TEC EXPO® '96 SCHEDULE OF EVENTS

	Registration	Training	Exhibits	Testing	Special Events
Sunday, June 9	Attendee Registration 1 - 7 p.m.	Pre-Conference Tutorials 2 - 5 p.m.			SCTE Engineering Subcommittee Meetings 2 - 5 p.m. Arrival Night Reception 6 - 8 p.m.
Monday, June 10	Attendee Registration 7:30 a.m. - 4 p.m.	Engineering Conference 8:30 a.m. - 4:30 p.m.			Awards Luncheon 12 noon - 1:30 p.m. SCTE Annual Membership Meeting 4:30 - 5:30 p.m. Welcome Reception and Cable-Tec Games 6 - 8 p.m.
Tuesday, June 11	Attendee Registration 7:30 a.m. - 3 p.m.	Expo Workshops 8 a.m. - 12:15 p.m.	Exhibit Hall Open 11 a.m. - 6 p.m.	BCT/E and Installer Certification Testing 10 a.m. - 2 p.m.	Expo Evening (Country Street Fair) 6 - 8 p.m
Wednesday, June 12	Attendee Registration 7:30 a.m. - 3 p.m.	Expo Workshops 8 a.m. - 12:15 p.m.	Exhibit Hall Open 11 a.m. - 5 p.m.	BCT/E and Installer Certification Testing 10 a.m. - 2 p.m.	Exhibitors' Reception 4 - 5 p.m. Ham Radio Operators' Reception 6 - 8 p.m. International Reception 6 - 8 p.m.
Thursday, June 13				BCT/E and Installer Certification Testing 9 a.m. - 12 noon	Golf Tournament 8 a.m. - 2 p.m. Studio Tour of The Nashville Network 9 a.m. - 12 noon

HOUSING

Attendee Housing Reservation Instructions

Expo Hotels (As Numbered on Map):



1. Opryland Hotel (Headquarters)
   Room Rate:
   Traditional—$99 Single, $115 Double
   Garden Terrace—$125 Single, $145 Double
2. Ramada Inn
   Room Rate: $99 Single/Double
3. Doubletree Guest Suites
   Room Rate: $89 Single/Double
4. La Quinta
   Room Rate: $92 Single, $97 Double
5. Holiday Inn Select
   Room Rate: $129 Single/Double
6. Embassy Suites
   Room Rate: $99 Single, $109 Double
7. Sheraton Music City
   Room Rate: $110 Single, $120 Double
8. Nashville Airport Marriott
   Room Rate: $133 Single, $152 Double

Hotel Information:

- The Opryland Hotel has just completed another major expansion, giving it three large atriums, five restaurants and six lounges. Traditional rooms face the exterior of the building. Garden Terrace rooms feature balconies that overlook an atrium.
- The Ramada Inn is located across the street from the entrance to the Opryland Hotel and features a dining room, lounge, sauna, indoor heated pool and whirlpool.
- The Doubletree Guest Suites is five minutes from the airport and the Opryland Hotel. This all-suite property features a restaurant, lounge, indoor/outdoor swimming pool and exercise room.
- The La Quinta Inn is located on Atrium Way, four miles from Opryland. It features a restaurant providing complimentary continental breakfast and a cocktail lounge.
- The Holiday Inn Select is located on Briley Parkway and features a restaurant and lounge with entertainment nightly plus a five-story atrium with an indoor heated pool, sauna, whirlpool and fitness center.
- The Embassy Suites is located on Century Boulevard, seven miles from Opryland. Guests receive a complimentary cooked-to-order breakfast each morning and complimentary open bar each evening.
- The Sheraton Music City received the Four Diamond Award from AAA and features a restaurant, nightclub, indoor and outdoor pools, jacuzzi, lighted tennis courts and jogging trail.
- The Nashville Airport Marriott is five minutes from the Opryland Hotel and Nashville International Airport. This 16-story hotel features a restaurant, lounge and indoor/outdoor pool.

Hotel Reservations:

- RESERVATIONS WILL BE ACCEPTED ONLY WITH PAID ATTENDEE REGISTRATION FORMS. NO RESERVATIONS WILL BE ACCEPTED BY PHONE.
- Hotels are assigned first come, first served based on availability. Every effort will be made to honor your hotel request. However, SCTE reserves the right to place your reservation where rooms are available (may include overflow hotels).
- Housing reservations (with accompanying attendee registration form) must be received by MAY 1, 1996. After that date, please call SCTE for housing availability information.
- Beginning MAY 10, 1996, reservations must be made directly with the hotels.

Confirmations:

- You will receive a written acknowledgment of your Expo attendee registration from SCTE. Confirmation of hotel reservations will be sent to you directly from the assigned hotel. Do not call SCTE for confirmation numbers.

Hotel Deposits and Guarantees:

- A deposit of one night's room rate by credit card only must be included with the hotel reservation. Credit card information to pay room deposit must be filled in completely on the housing form. Failure to fill out all information will delay processing of reservations. SCTE is not responsible for the cancellation of reservations due to failure to follow hotel deposit procedures.

Cancellations and Name/Date Changes:

- Hotel cancellations must be received in writing by SCTE prior to MAY 1. After that date, cancellations must be made directly with the hotel.
- Any requests for changes in arrival/departure date or substitutions must be made in writing and received by SCTE prior to MAY 1. After that date, all changes must be made directly with the hotel, subject to availability.
- PLEASE NOTE: CANCELLATION POLICY IS ONE WEEK (SEVEN DAYS) PRIOR TO ARRIVAL FOR ALL NASHVILLE HOTELS. If a reservation is canceled any time after the stated policy, NO REFUND OF THE DEPOSIT WILL BE GRANTED.

You can minimize maintenance- related downtime by ensuring that all activities affecting HFC networks are restricted to a single maintenance window. At Rogers, proper change control procedures are being established to ensure that service backup options are in place prior to performing any network maintenance. Furthermore, appropriate work releases are issued and scheduled work is completed on time.

Proper HFC network operation also involves the tracking of field equipment operation and failure trend analysis. This in turn enables forecasting of equipment failures and avoidance of costly network downtime that can be caused by power supply and trunk station failures. Lastly, directed physical plant maintenance is required to prevent excessive reverse noise levels on the HFC network that can result from defective passive components such as cable and connectors.

"You can minimize maintenance-related downtime by ensuring that all activities affecting HFC networks are restricted to a single maintenance window."

Time to restore

HFC network availability also is determined by the time it takes to restore network services after a fault has been detected and technicians have been dispatched to resolve the problem. Service MTTRs from various failure types for the Rogers Newmarket system are illustrated in Figure 5 on page 32.

A single construction-related incident resulted in overall slow downs in Internet access speeds for all WAVE customers. This particular fault took over three days to isolate and resolve, as the appropriate data monitoring tools were not in place to detect the resulting traffic overloads.

Therefore, even though Figure 4 on page 32 shows that construction-related incidents of HFC network downtime account for only 3% of all incidents, the excessive MTTR for a single incident contributes to an overall high MTTR of 1,473 minutes for construction-related downtime in Figure 5.

A much better measure of the network's capability to recover from a fault is given by the distribution of the actual time taken to repair that particular fault. An illustration of such a distribution is shown in Figure 6 on page 36. This data reveals that in 96 out of a total of 104 recorded incidents affecting HFC network availability, it was possible to restore the

CABLE-TEC EXPO® '96 EXHIBITORS
(as of February 1, 1996)

ABC Cable Products Inc.
ACT Communications Inc.
ADC Video Systems
AEL Industries Inc.
AM Communications
AML Wireless Systems
AMP
AT&T Micro
ATx Telecom Systems Inc.
Adtec Inc.
Advanced Custom
Albrit Technologies Ltd.
Alcatel
Alpha Technologies
America's Network
American Digital Cartography
American Polywater Corp.
Antec
Applied Instruments Inc.
Arcom Labs/Northern CATV
Arnco Corp.
Arrowsmith Technologies
Artel
Atlanta Graphic Solutions Inc.
Augat Communication Products Division
Authorized Parts Co.
Avantron Technologies Inc.
Avcom of Virginia
Barco Inc.
Belden Wire and Cable Co.
Ben Hughes/Cable Prep
Blonder-Tongue Laboratories
Broadband Networks Inc.
Broadcast Network
Budco
C-Cor Electronics Inc.
C-Pro
C.I.S. Inc.
CADD Services Group Inc.
CED Magazine
Cabelcon Connectors
Cable AML Inc.
Cable Constructors Inc.
Cable Converter Service Corp.
Cable Innovations Inc.
Cable Labs
Cable Leakage Technologies
Cable Link Inc.
Cable Spinning Equipment
Cable TV Supply Co.
Cable Technologies
Cable Yellow Pages
CableBus Systems Corp.
CableCom Specialists Inc.
Cabletek Wiring Products
Cadix International Inc.
Can-Am Services Inc.
Canusa-EMI
Channel Master
Channell Commercial Corp.
Channelmatic Inc.
Chyron Corp.
Coast CATV Supply Inc.
CommScope Inc.
CommSpec
Communications Technology Magazine
Comsonics Inc.
Condux International Inc.
Contec L.P.
Contech
DX Communications Inc.
Dawn Satellite Inc.
Design Extender/GLA International
Diamond
Diamond Communications
Dimensions Unlimited
DistriVision Development
E-Z Trench Manufacturing
Eagle Comtronics Inc.
Earthvision Systems Ltd.
Electroline Equipment
Enghouse Systems
Exide Electronics
FCC/EAS
FM Systems Inc.
Family Ware Inc.
Fiber Optic Network Solutions
Flight Trac Inc.
Fujitsu
GMP
GNB Technologies
General Instrument
Gilbert Engineering
Gold Communications
Gordon Publications/ FiberOptic Product News
Gould Fiber Optics Division
Graybar Electric Co. Inc.
Hall's Safety Equipment Corp.
Harmonic Lightwaves
Hennessy Products
Hewlett-Packard Co.
I.C.M. Corp.
IDK Technologies Inc.
ISC Data-Com Inc.
ITW Linx
Intertec/Telephony Magazine
Ipitek Inc.
Iris Technologies
Jackson Tool Systems Inc.
Jameson Corp.
Jebsee Electronics
Jerry Conn Associates Inc.
John Weeks Enterprises/ Signal Vision
Kamp Specialists Inc.
Kennedy Cable Construction
Keptel Inc.
Klein Tools Inc.
Knaack Manufacturing Co.
Lead Universal
Leaming Industries
Lemco Tool Corp.
Lindsay Electronics
Line Techs Inc.
Lode Data Corp.
MK Battery
Main Line Equipment
McGrath Rentelco
Mega Hertz
Metrotech Corp.
Midwest Cable Services
Mobile Tool International Inc.
Molex Fiber Optics
Monroe Electronics Inc.
Moore Diversified Products
Motorola
Multilink Inc.
NCA MicroElectronics
NCS Industries Inc.
NCTI
NST Network Services Inc.
NaCom
Nationwide Tower Co. Inc.
Network Construction
Norscan
Nortel
Novaplex Inc.
Noyes Fiber Systems
Oldcastle Precast Inc.
OptiVideo Corp.
Ortel Corp.
Ortronics Inc.
Osburn Associates Inc.
P-T Technologies Inc.
Paramount Designs Inc.
Pelsue Co.
PenMetrics Inc.
Pencell Plastics Inc.
Performance Cable TV Products
Philips Broadband Networks
Photon Kinetics
Photonic Components Inc.
Pico Products Inc.
Pioneer New Media
Pirelli Cable
PolyPhaser Corp.
Power and Telephone Supply
Power Conversion Products
Power Guard
Preformed Line Products
Prevue Express Inc.
Primus-Sievert Inc.
Private & Wireless
Production Products Co.
Progressive Electronics Inc.
Promax
Pyramid Industries
Quality RF Services Inc.
Quazite
Quintech Electronics & Communications
R.L. Drake Co.
RMS Electronics Inc.
RTK Corp.
Radiant Communications Corp.
Radiodetection
RELTEC
Ripley Co./Cablematic Division
Riser-Bond Instruments
Sadelco Inc.
Sawtre Electronics Inc.
Scala Electronic Corp.
Scientific-Atlanta
Scott Cable Communications
SeaChange Technology
Sencore Inc.
Siecor Corp./Corning Inc.
Sony Electronics Inc.
Sprint/North Supply
Standard Communications
Stanford Telecom
Sumitomo Electric Lightwave
Superior Electronics
Synchronous Communications
TTC Telecommunications Techniques
TVC Inc.
TW ComCorp.
Tailgater Inc.
Ted Hammers
Telecrafter Products
Telewire Supply
Teltone Corp.
Tempo Research
Texscan
Thomas & Betts
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Badge Information:

- Complete a separate form for each registrant. Photo copies are accepted. Type or print **CLEARLY**. Do not use this form to register exhibitor personnel.

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Title:_______________________ Company:_______________________

Address:____

City:_______________________ State:________ Zip:_______________________

Telephone:(_________)_______________________ Fax:(_________)_______________________

SCTE Member #:_______________________ Amateur Radio Code:_______________________

Registration Instructions:

- SCTE will accept registrations by fax ONLY when paid by credit card. DO NOT mail original if already faxed.
- Registrations received after May 1 will NOT be processed. After MAY 1, attendees must register on-site at the on-site rate.
- All requests for cancellation must be received in writing. A $50 processing fee is applicable to all canceled registrations. No refunds will be granted after May 10.
- Name substitutions must be received in writing at SCTE prior to May 10. After that date, substitutions must be processed on-site at the Registration Assistance booth accompanied by a $5 processing fee and written company authorization.
- Registration forms accompanied by a completed SCTE membership application and dues payment are eligible for the member rate.
- Sustaining membership qualifies only one representative from that company to register at the member rate.

Registration fees:

	PRE-REGISTRATION UNTIL MAY 1, 1996		ON-SITE AFTER MAY 1, 1996		
	MEMBER	NON-MEMBER	MEMBER	NON-MEMBER	
Engineering Conference & Expo	$240	$340	$290	$390	$________
Expo Only	$190	$290	$240	$340	$________
Engineering Conference Only	$145	$225	$195	$275	$________
Spouse Registration	$95	$95	$95	$95	$________
Spouse Name:_______________________					
Additional Luncheon Tickets—$25 each					$________
				TOTAL ENCLOSED:	$________

Method of Payment:

- Fees are payable to SCTE by **Check** (in U.S. dollars), **VISA or MASTERCARD. NO AMERICAN EXPRESS**. Registration fees or credit card information must accompany this form or registration processing will be delayed. DO NOT INCLUDE HOTEL DEPOSIT WITH PAYMENT.

❑ Check ❑ VISA ❑ MASTERCARD

Credit Card Number:_______________________ Expiration Date:_____/_____/_____

Cardholder Signature:_______________________ PRINT Cardholder Name:_______________________

FOR SCTE USE ONLY
SCTE Member: ❑ Y ❑ N
Date Processed:_______________
Amount Received:_______________
Member Included: ❑ Y ❑ N
Batch Number:_______________
Check #:_______________
❑ VISA or ❑ MASTERCARD

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140 PHILIPS ROAD, EXTON, PA 19341-1318
or FAX TO: (610) 363-7133

QUESTIONS? CALL (610) 363-6888

CABLE-TEC EXPO® '96
Attendee Housing Form

Attendee Information:

- Complete a separate form for each reservation. Photocopies are accepted. Type or print CLEARLY. Do not use this form if you are requesting an exhibitor room block.

Name:______________________________________ Title:___________________________________

Company:____

Address:____

City:_______________________________________ State:________ Zip:______________________

Telephone:(_______)____________________________ Fax:(_______)____________________________

Hotel Instructions:

- Housing reservations are accepted only with paid Expo registrations. Registration forms with payment and hotel reservation requests must be received at SCTE by **WEDNESDAY, MAY 1, 1996**. Hotels are assigned first-come, first-served based on availability.
- A deposit of one night's room rate must accompany reservation request. Credit cards only must be used to guarantee room. Please fill out complete credit card information below.
- SCTE will send written acknowledgment of your attendee registration. Confirmation of housing will be sent directly from the hotel.
- All cancellations, substitutions, or changes must be submitted in writing to SCTE prior to MAY 1. After that date, all changes must be made directly with the hotel, subject to availability. CANCELLATION POLICY IS ONE WEEK (SEVEN DAYS) PRIOR TO ARRIVAL FOR ALL NASHVILLE HOTELS. If a reservation is canceled any time after the stated policy, NO REFUND OF THE DEPOSIT WILL BE GRANTED.

Hotel Options:

- Please indicate first, second and third choices.

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_______ La Quinta _______ Holiday Inn Select _______ Embassy Suites

_______ Sheraton Music City _______ Nashville Airport Marriott

Arrival/Departure:

- Arrival Date: ____________________________ Departure Date: _________________________

Day: _______________ Time: ______________ Day: _______________ Time: ______________

Type of Accommodations:

Number of Persons:_________ ROOM TYPE REQUESTED✳: ❑ TWO DOUBLE BEDS ❑ KING BED

✳(Contact SCTE for Suite availability and pricing information)

- If sharing a room, print additional name here:____________________________________

Special Requests:____

Payment Instructions:

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

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Cardholder Signature:________________________ PRINT Cardholder Name:________________________

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Drops for digital

(Continued from page 60)

The component of the corrosion triad over which builders have the most control is moisture. It is, therefore, critical that it be addressed, particularly in the outside portion of the drop, and in moist or coastal areas. The key point of corrosion risk is at the F-connectors, where dissimilar metals meet and where moisture can easily enter at poorly tightened connections. Again, while grounding procedures are important, proper tightening of connections is critical.

Long-term solutions

The ultimate solution to drop problems will probably involve substantial redesign of components to be noncorrosive, tamper-proof, self-sealing and simple to use. Some of the proposed changes will require architectural changes in the overall system. For example, in order to allow the use of permanent connectors, there will have to be alternative methods of disconnecting and reconnecting service and drop testing. Proposals include addressable taps, which will allow remote service control, and placement of in-line passive test points.

Another approach would be to demodulate the digital signal before it enters the home. The signal would then traverse the most vulnerable segment of the drop, not as a sensitive digital signal, but as an analog signal. This would provide the benefits of digital transmission across the network, while reducing the risk of signal drop-out within the home.

Interim measures

Until the creation of new components and architectures, there are a number of steps that can be taken:

1) Start by carefully selecting high-quality drop components.

2) Define installation procedures to meet high bandwidth requirements, rather than today's lower requirements: Check braid for insufficient count and low shielding, and replace if necessary; Check connections with a 20-inch-pound torque wrench; Replace retail jumpers with system-made or quality premade jumpers. (See the accompanying figure.)[2] Where possible, modify in-home wiring to a home run configuration; Check end-of-line levels to the set-top.

3) Train techs to follow the new procedures.

4) Start educating subs on selection of components and proper handling of installations.

5) Implement a noise rejection plan, such as filtering out return frequencies for all drops that do not use upstream bandwidth.

6) Keep in mind that the most important time to address drop problems also is the most convenient: when you are already in the home for installation.

7) Support Society of Cable Telecommunications Engineers/American National Standards Institute standardization efforts.

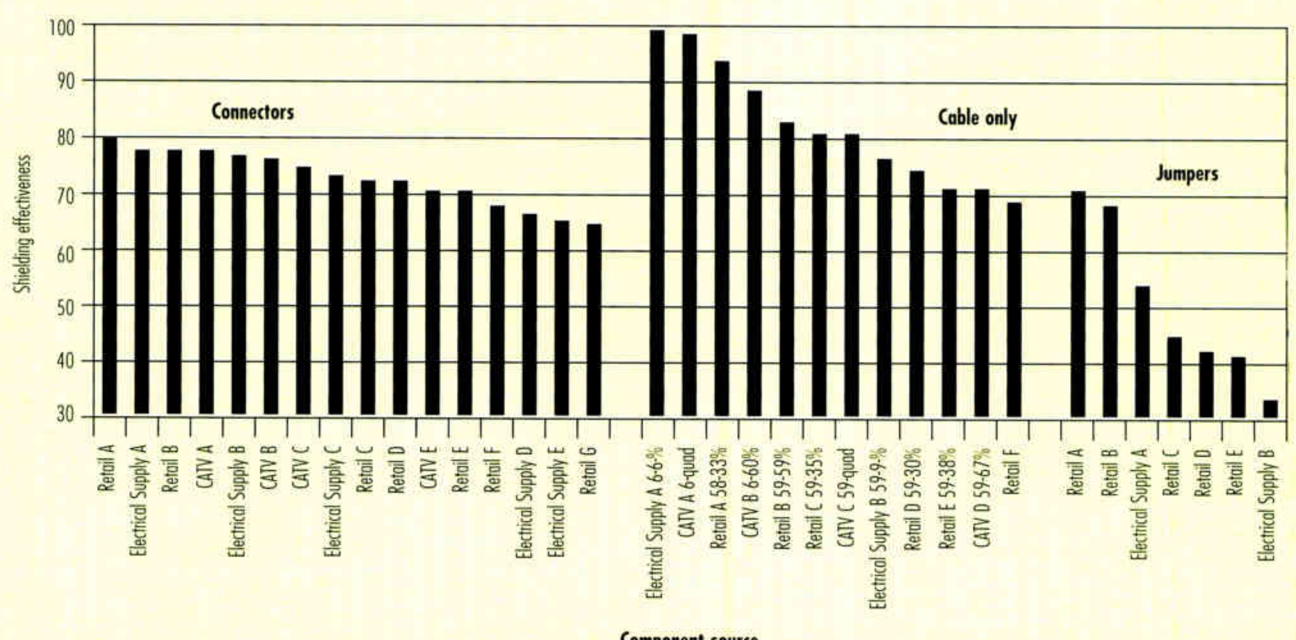
8) Start basing design and implementation decisions on compatibility with your future architecture. **CT**

References

[1] "The Indoor Challenge: The Rising Trend Toward Problems with In-Home CATV Wiring and Connectorization," Lemaire, J.; Smith, B.; Drumm, M.; *1990 NCTA Papers*; and "In-Home Cabling for Digital Services: Future-Proofing Signal Quality and Minimizing Signal Outages," Bauer, B., *1995 SCTE Conference on Emerging Technologies Technical Papers*.

[2] "Drop System and Component Performance: Emerging Requirements in a High Bandwidth, 64 QAM Digital World," Brian Bauer, *1993 NCTA Technical Papers*.

Shielding effectiveness comparison



When installed properly, most connectors perform very well. In the case of premade retail jumpers, the damage is already done, with shielding effectiveness dangerously low. The connectors, on the other hand, were installed by well-trained installers using quality cable. The culprit in the case of the jumpers: poor cable-to-connector termination.

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Number 51

By Doug Hartzell and Amy Borchert

Tackling digital with TDRs

Reflections due to point faults and distributed faults cause minimal distortion in analog signals. Digital signals are not as forgiving and they are very sensitive to microreflections.

What are the sources of reflections and microreflections? The cable itself can have small imperfections (repetitive impedance discontinues) distributed along the cable. These imperfections are very small, repeating reflections, and make up what we call structural return loss (SRL). Cable manufacturers have reduced SRL problems to a bare minimum and total cable lengths are generally less in HFC networks, so SRL should have only a minimal effect on the cumulative buildup of microreflections.

Cable can be damaged by rodents, construction and installation, wear and tear, or outside influences such as someone digging holes in the ground. These faults are considered point impedance problems because they cause single point reflections. They can be rather large and may contribute significantly to impairing compressed signals.

Components such as amplifiers, taps, splitters and connectors also create point impedance problems. They can look like distributed reflections because there are so many of them but they are actually point problems. (For example, a connector creates a reflection at the point it is inserted in the cable plant. Because of their vast number, their cumulative microreflections can start adding up very quickly.)

There are two ways to turn on cable plant and keep it going for years. One way is simply to build it and put it on-line. If it doesn't work now or in the future, you cross that bridge when you come to it. The second way to approach the new plant turn-on syndrome is to document and archive the plant after it is built but before it is put on-line. Then, if gremlins appear, either at turn-on or in the future, you already have the documentation you need to help solve the problem. An easy way to document plant is to use a time domain reflectometer (TDR) to store plant signatures. Most TDRs today have waveform printing or storage capability for such documenting and archiving.

When a particular cable segment affects a digital signal, you have the ability to analyze the waveforms in the office without taking the suspect cable segment (and customers) off-line.

Using a TDR with the waveform storage feature is an ideal way to document the cable. As mentioned, most TDRs today have waveform storage capability. But most TDRs store only the waveform on-screen. To see the whole cable you must zoom out, reduce the vertical gain and store the whole cable in one memory slot (bin). Next, to get more detail, you must zoom in, increase the vertical gain to see the small details and store again. To see all the detail you must store multiple waveforms of the same cable.

To reduce the quantity of stored waveforms, you might be tempted to store the whole cable in one storage bin. But, because of the long lengths of cable and small discontinuities in the cable, you should not skimp on the number of waveforms stored.

At least one TDR on the market today stores the whole cable, from beginning to end, with full horizontal and vertical resolution. You can zoom in to see sections in greater detail, increase or decrease vertical gain, or change the velocity of propagation. You can move the independent cursors to measure the distance between any two points along the cable and archive the waveform files. This storage capability allows you to search the stored waveform to avoid taking service off-line. **CT**

Doug Hartzell is vice president of engineering and Amy Borchert is media specialist at Riser-Bond Instruments in Lincoln, NE. They can be reached at (402) 466-0933.

Discontinuities and ghosts

Figure 1 is a typical, simple cable segment. Each of the components (amplifiers, taps/splitters, and connectors) can cause discontinuities. As shown in the waveform (Figure 2) these discontinuities can become ghosts (the little "S" curve in the middle of the waveform) reflecting and re-reflecting between the components. This ghost only shows up when trying to TDR test the whole cable segment at one time.

Figure 1: Typical CATV segment

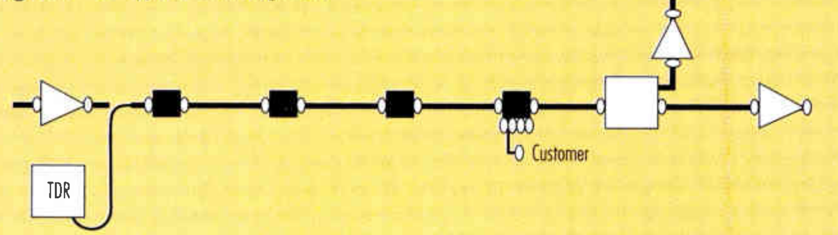
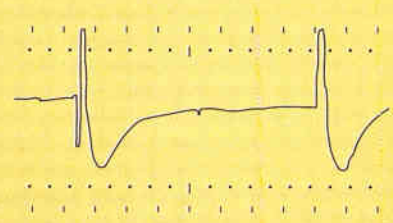


Figure 2: Waveform indicating ghosts



Fault locator

Wilcom unveiled the FRS-10 single-mode fault locator, which utilizes optical time domain reflectometer technology to identify cable faults and other events to distances greater than 10 km. Features include single-button operation, read-out in feet or meters, 1,300 nm wavelength operation, and accuracy of ±2 meters (6 feet) with an IOR of 1.5, +0.02% of cable length.

The unit can be used in continuous update mode or one-shot (single) mode. An optional fault locator program upgrade captures and analyzes data via laptop computer. The unit can be equipped with an ST, FC or SC connector, is powered by rechargeable NiCad batteries, and features an auto power-off function.

Reader service #311

Cable support

The Dymetrol Co. has developed a lashed cable support for use in outdoor telecommunications applications. The Dymetec system is lighter and stronger than conventional plastic or metal lashed cable supports, according to the company. Because the product is 17% thinner, it is more flexible and easier to cut and install than existing plastic supports.

Proprietary orientation technology acquired from DuPont provides a strong (400 pounds loop tensile strength), creep-resistant strap. Outdoor life expectancy of the product is 20 years or more.

Reader service #312

Oscilloscope

Tektronix announced the TDS 700A series and TDS 500B series digital storage oscilloscopes (DSOs). The units' proprietary InstaVu signal acquisition technology lets users capture up to 400,000 wfm/s (waveforms per second), which the company says makes these digital scopes as fast as the fastest analog scopes.

The TDS 700A series units feature color displays, bandwidths up to 1 GHz, sample rates up to 4 GS/s and acquisition rates up to 400,000 wfm/s. The TDS 500B series includes four-channel and two-channel models, both featuring 500 MHz bandwidth, up to 2 GS/s sample rate, monochrome displays and up to 100,000 wfm/s acquisition rate.

InstaVu acquisition technology is designed to quickly pinpoint and capture unpredictable, rapidly changing signals — infrequent glitches, metastable behavior and time jitter — that may never be detected by conventional analog or digital scopes or specialized triggering. The technology combines high-speed acquisition memory with high-speed display rasterization to increase acquisition performance and ensure instantaneous live display of all signal changes.

Reader service #310

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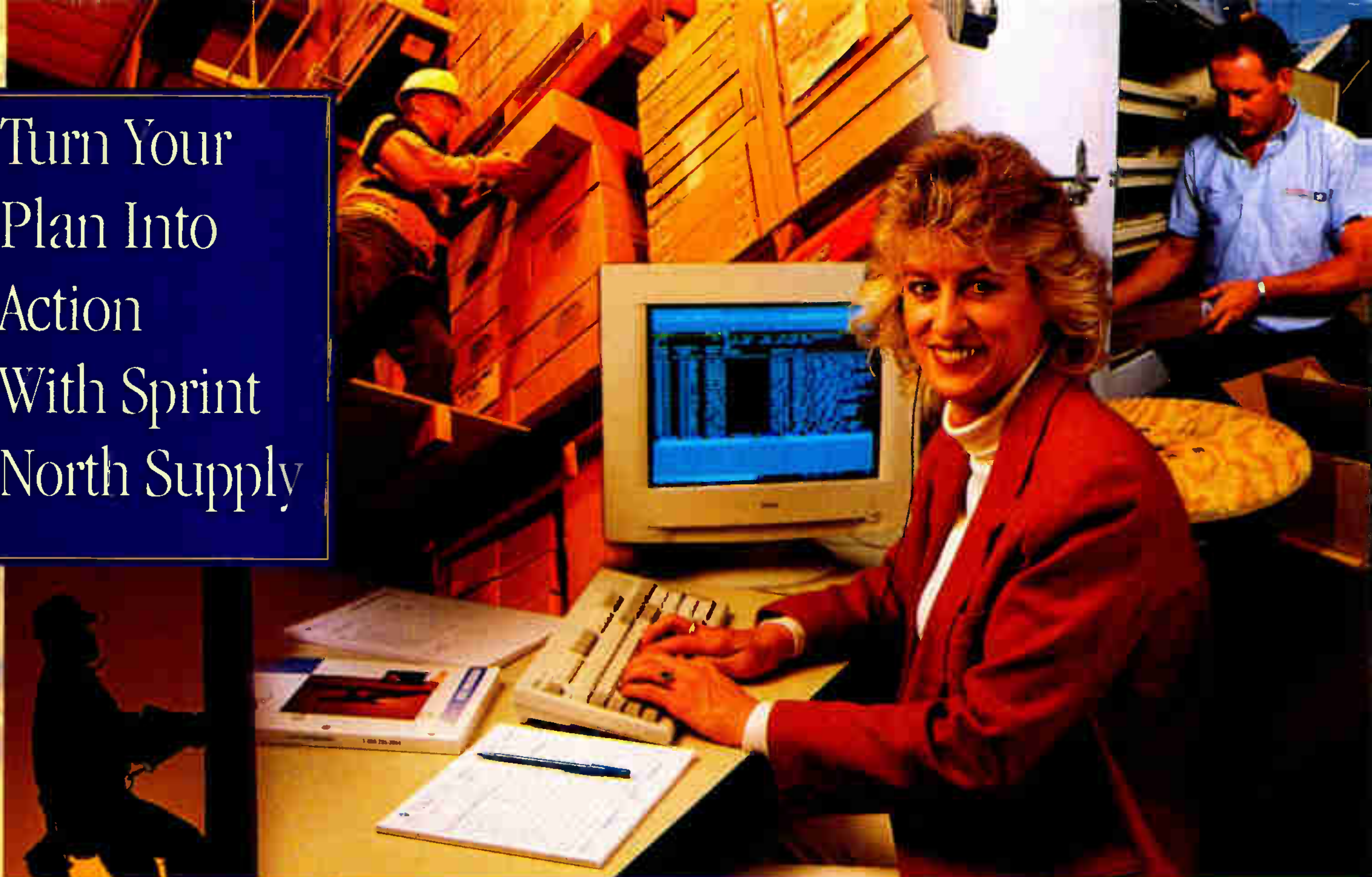

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The following is a listing of some of the videotapes currently available by mail order through the Society of Cable Telecommunications Engineers. The prices listed are for SCTE members only. Nonmembers must add 20% when ordering.

☛ *Outage Reduction Techniques* — Featuring Scott Bachman and Robert Moel, this presentation provides point-by-point discussion of the findings of the CableLabs Outage Task Force. It covers topics such as how consumers view cable service, the impact of outages with respect to frequency and duration, outages vs. downgrades, outages vs. plant powering and fusing/plant protection policies. (65 min.) Order #T-1119, $45.

☛ *Standards Deviations* — This program features the Federal Communication Commission's Michael Lance and John Wong. It provides a current update on the status of CLI filings and a paragraph-by-paragraph discussion of the new FCC regulations. (1 hr.) Order #T-1120, $35.

☛ *The Basics of Telephone* — Noted author Bill Grant provides an understanding of U.S. telephone technology — its operation, its evolution, where it is going and the inherent weaknesses of its implementation. Topics covered include exchange plant, toll service key pulse dialing, touch tone dialing and more. (80 min.) Order #T-1136, $18.

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.

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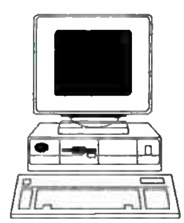

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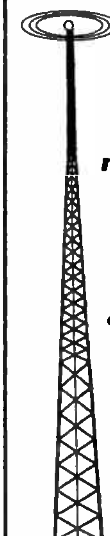

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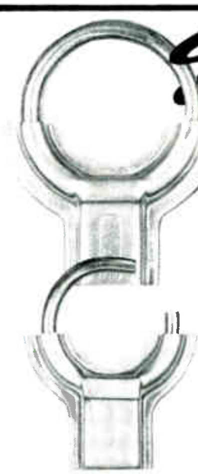

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4: SCTE Great Plains Chapter meeting, BCT/E and Installer exams to be administered, Bellevue, NE. Contact Randy Parker, (402) 292-4049.
8: General Instrument Broadband Network Overview seminar, term definition and component functionality, Hatboro, PA. Contact Lisa Nagel, (215) 830-5678.
8-12: General Instrument Broadband Communications Network Design seminar, operational theory and network design, Hatboro, PA. Contact Lisa Nagel, (215) 830-5678.
8-12: General Instrument Headend Maintenance and Performance Testing seminar, Hatboro, PA. Contact Lisa Nagel, (215) 830-5678.
9: SCTE Desert Chapter seminar, Telephony 101, El Rancho, Beaumont, CA. Contact Bruce Wedeking, (909) 677-2147.
9: Scientific-Atlanta training course, hybrid fiber/coax networks, Atlanta. Contact Bridget Lanham, (800) 722-2009, option "3."
9-11: SCTE Wheat State Chapter meeting, BCT/E exams to be administered, Wichita, KS. Contact Joe Cvetnich, (316) 262-4270.
10: SCTE Bluegrass Chapter seminar, surge protection and grounding, BCT/E exams to be administered, Holiday Inn, Elizabethtown, KY. Contact Max Henry, (502) 753-6521.
10-11: Scientific-Atlanta training course, hybrid fiber/coax design, Atlanta. Contact Bridget Lanham, (800) 722-2009, option "3."
10-12: Philips Broadband Networks Mobile Training Course, broadband technology, Chicago. Contact Cathy Manion, (800) 448-5171.
11: SCTE Satellite Tele-Seminar Programs, *NEC, NESC and OSHA Regulations (Part II)* and *Interdiction and Other Signal Security Techniques (Part I)*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.
11: SCTE Music City Chapter meeting, BCT/E exams to be administered, Nashville, TN. Contact Rodney Lanham, (615) 645-8296.
14-18: NAB '96, Las Vegas, NV. Contact (202) 429-5350.
15-17: Kentucky Cable Telecommunications Association spring convention, Marriott Resort, Lexington, KY. Contact Randa Wright, (502) 864-5352.
15-18: NAB '96, Las Vegas Convention Center, Las Vegas, NV. Contact (202) 775-4970.
15-19: General Instrument Broadband Communications Network Design seminar, operational theory and network design, Hatboro, PA. Contact Lisa Nagel, (215) 830-5678.
15-19: General Instrument Headend Maintenance and Performance Testing seminar, Hatboro, PA. Contact Lisa Nagel, (215) 830-5678.
16-18: Scientific-Atlanta training course, 8600ˣ system operation, Atlanta. Contact Bridget Lanham, (800) 722-2009, option "3."
18: SCTE Michiana Chapter meeting, Installer exams to be administered, LaPorte, IN. Contact Russ Stickney, (219) 259-8015.
18: SCTE Northern New England Chapter seminar, EBS and status monitoring, Ramada Inn, Portland, ME. Contact Bill DesRochers, (207) 646-4576.
19: SCTE North Country Chapter meeting, BCT/E and Installer exams to be administered, Columbia Heights, MN. Contact Bill Davis, (612) 646-8755.
22: Scientific-Atlanta training course, analog headend technology, Atlanta. Contact Bridget Lanham, (800) 722-2009, option "3."
23: SCTE Desert Chapter meeting, BCT/E exams to be administered, Colony Cablevision office, Palm Desert, CA. Contact Bruce Wedeking, (909) 677-2147.
22: Scientific-Atlanta training course, analog headend design, Atlanta. Contact Bridget Lanham, (800) 722-2009, option "3."
24: SCTE Inland Empire Chapter seminar, fiber-optic basics and troubleshooting, Templins Resort, Post Falls, ID. Contact Roger Paul, (509) 484-4931, ext. 230.
24-25: Scientific-Atlanta training course, analog headend systems, Atlanta. Contact Bridget Lanham, (800) 722-2009, option "3."
26: SCTE Desert Chapter meeting, Installer exams to be administered, Colony Cablevision office, Palm Desert, CA. Contact Bruce Wedeking, (909) 677-2147.
26: SCTE Wheat State Chapter meeting, BCT/E exams to be administered, Great Bend, KS. Contact Joe Cvetnich, (316) 262-4270.

Planning Ahead

April 28-May 1: Cable '96, Los Angeles Convention Center, Los Angeles. Contact NCTA, (202) 775-3629.
June 10-13: SCTE Cable-Tec Expo, Nashville, TN. Contact SCTE national headquarters, (610) 363-6888.
June 26-28: Global DBS Summit, Denver. Contact Global Exposition Holdings, (713) 342-9826.
July 10-12: WCA '96, Colorado Convention Center, Denver. Contact Wireless Cable Association, (202) 452-7823.

MPEG for compression

(Continued from page 54)

in the P frame. The difference between the two macroblocks is the prediction error.

Prediction error can be coded as-is or in the DCT domain. The DCT of the error results in a few high-frequency coefficients — which, after the quantization process, require a small number of bits for representation. The quantization matrices for the prediction error blocks are different from those used in intra blocks, due to the distinct nature of their frequency spectrums.

The displacements in the horizontal and vertical directions of the best match macroblock from the co-sited macroblock are called motion vectors. The motion vectors represent the translation of the picture blocks between frames. These vectors are obviously needed for reconstruction and are differentially coded in the bit stream. Differential coding is used because it reduces the total bit requirement by transmitting the difference between the motion vectors of consecutive frames. The compression efficiency and the quality of the reconstructed video depends on the accuracy of the motion estimation. The methodology for the computation of the motion vectors is not specified by the standard and is left open as a design issue. There is of course a tradeoff between the accuracy of the motion estimation vs. the complexity of the MC technique.

For B pictures, MC prediction and interpolation is performed using reference frames present on either side of it, where reference pictures include both I and P pictures. The prediction is noncausal, since it uses frames from the past and the future. Compared to I and P, B pictures provide the maximum compression. Some other advantages of B pictures include the reduction of noise due to the averaging process, and the use of future pictures for coding.

B pictures are themselves never used for predictions and hence do not propagate errors. MPEG-1 allows for only frame-based MC, while MPEG-2 allows for both frame and field-based MC. Field-based MC is especially useful when the video signal includes fast motion.

The MPEG compression algorithm is a clever combination of a number of diverse tools, each of which exploit a particular data redundancy. The result is that the coded video needs a far lower bandwidth compared to the original, while maintaining extremely good quality. Currently, the technology is gearing up toward an exciting phase with the advent of high definition TV (HDTV), interactive set-tops and the digital video disk. Video compression is a key factor in these new technologies and MPEG has become the *de facto* industry standard. **CT**

Reader Service Number 46

By Bill Riker

SCTE's HQ official grand opening

It's official! February 29 marked the grand opening celebration of the Society's new national headquarters building located in the Pickering Creek Industrial Park in Exton, PA. This exciting occasion capped off the year-long effort of planning, developing and constructing the new facility.

The evening began with guests arriving around 6 p.m. to tour the building during an hour-long open house. In attendance were the national board of directors, standing committee members, subcommittee chairmen, charter members, senior members, chapter presidents and representatives from several sustaining member companies. Special guests included the Society's 1971-1973 President Bill Karnes, 1981-1984 and 1985-1986 President Tom Polis, and *Communications Technology* Editor and SCTE Charter/Senior Member Rex Porter.

Almost 100 guests strolled through the new facility, guided by maps that indicated where staff members are located within their respective departments. Staff was on hand in each department to answer any questions visitors might have about specific job functions, departmental activities and future Society initiatives.

The on-site SCTE museum was open for business and guests had the opportunity to take a look at cable's history. For some, it was a trip down memory lane. Classic pieces of field test equipment were on display to illustrate just how far the cable telecommunications industry has evolved.

A Jerrold Model 220 portable sweep generator is on loan from the National Cable Television Center and Museum's General Instrument Collection. The Model 220 was used to create electronic signals between adjustable limits. These signals were then used to perform frequency response tests at various points within the cable system.

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

A Jerrold 704 field strength meter also appears in the museum for having been the first piece of test equipment to be widely used by the cable TV industry. The particular unit on display is serial #0623 and was donated to the Society's "Loyal Order of the 704" by Darrel Galatas during Cable-Tec Expo '95 in Las Vegas.

The SCTE museum also contains a great deal of material from the Society's own archives. There are enlarged photos commemorating such SCTE milestones as the grand opening of SCTE's national headquarters building at Exton Commons in January 1987, and the first fully certified Broadband Communications Technician/Engineer (BCT/E) candidate, Ron Hranac, with members of the curriculum committee in November of 1987. Other photos show SCTE charter members at a meeting in Nashville, TN, in 1978, and the board of directors at Cable-Tec Expo '84 also in Nashville.

The museum walls are graced by the names of Member of the Year Award recipients dating back to the first award, given in 1974. Also proudly displayed are the Society's past presidents since SCTE's inception in 1969 and the Society's charter members.

A glass case in the museum displaying SCTE memorabilia contains promotional items the Society has offered to its members over the years, such as a Cable-Tec Expo '85 mug from Washington D.C., Cable-Tec Games medals, SCTE buttons and pins, paperweights, tie clips, playing cards, pens, patches, luggage tags and exhibitor tiles from previous Expos.

From SCTE's more recent history is the shovel that I used along with SCTE Chairman John Vartanian and Region 11 Director Dennis Quinter at the groundbreaking ceremony for the new building held on July 18, 1995. An original artist's rendering of the new national headquarters facility hangs on the wall next to the original site plan for the building and the surrounding property.

For visitors interested in the Society's scope, there is a map of the United States in the museum with each of SCTE's 12 regions noted along with pins indicating the location of each of the Society's chapters and meeting groups.

I took some time out from the open house to be interviewed by Harron Cable's local origination channel, and shortly thereafter directed the guests to the training room for SCTE's official grand opening ceremony. This gave me an opportunity to thank all of the people who put so much time and effort into the planning and construction of the building. In particular, I wanted to thank Peter Schultz, the industrial park's developer, for guiding this project so successfully to completion. He received a plaque in recognition of his efforts and briefly addressed the audience. Bill Karnes, John Vartanian and Rex Porter also addressed the guests and commented on the Society's recent growth and its new facility.

As I write this, the staff is in the midst of presenting "Introduction to Telephony," the first regional seminar to be held in the new facility. A full house of attendees enjoyed seeing the new building and making use of the many features it has to offer. Next month, we will host an open house for the Society's over 500 chapter and meeting group board members, and I look forward to meeting even more of the membership at national headquarters. **CT**

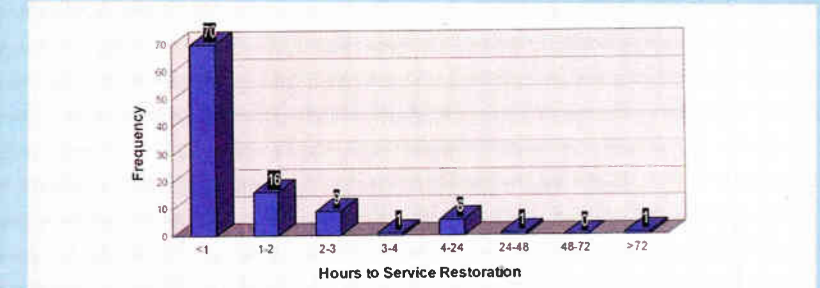
network to full operation in less than four hours, with 70 of these being resolved in less than one hour. The collected data indicates only one instance during which full network restoration required over three days to complete.

This high degree of success in meeting Rogers' initial average MTTR objective of less than four hours stems from the effective use of network monitoring tools that not only enable early fault detection, but also fast fault isolation resulting in the rapid dispatching of a technician.

Improving availability

For network operations, the WTAC looks after both the HFC physical network and the WAVE data service network. However, as service penetration increases, and additional services are being prepared for introduction to the Rogers systems, the need for more efficient problem resolution has become increasingly obvious, as has maintaining high service and HFC network availability .

Figure 6: Actual times to repair



A new model for network management is now being implemented. It involves the establishment of regional Network Operations Centers (NOCs) to look after all aspects of the Rogers HFC network. The NOCs' primary goal is to ensure compliance with HFC reliability and availability objectives. This involves enforcement of change control procedures for all network maintenance activities, ensuring network and service restoration within established time frames, and continuous tracking and reporting of HFC network performance.

The WTAC will continue to perform similar monitoring and management functions for the WAVE data service network.

The establishment of the NOCs ensures that availability targets are met through the performance of continuous network monitoring and making more efficient use of available resources. This means that HFC network maintenance activities become more focused on taking preventive action to avoid failures and achieve the objective of 99.94% for HFC network availability. **CT**

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