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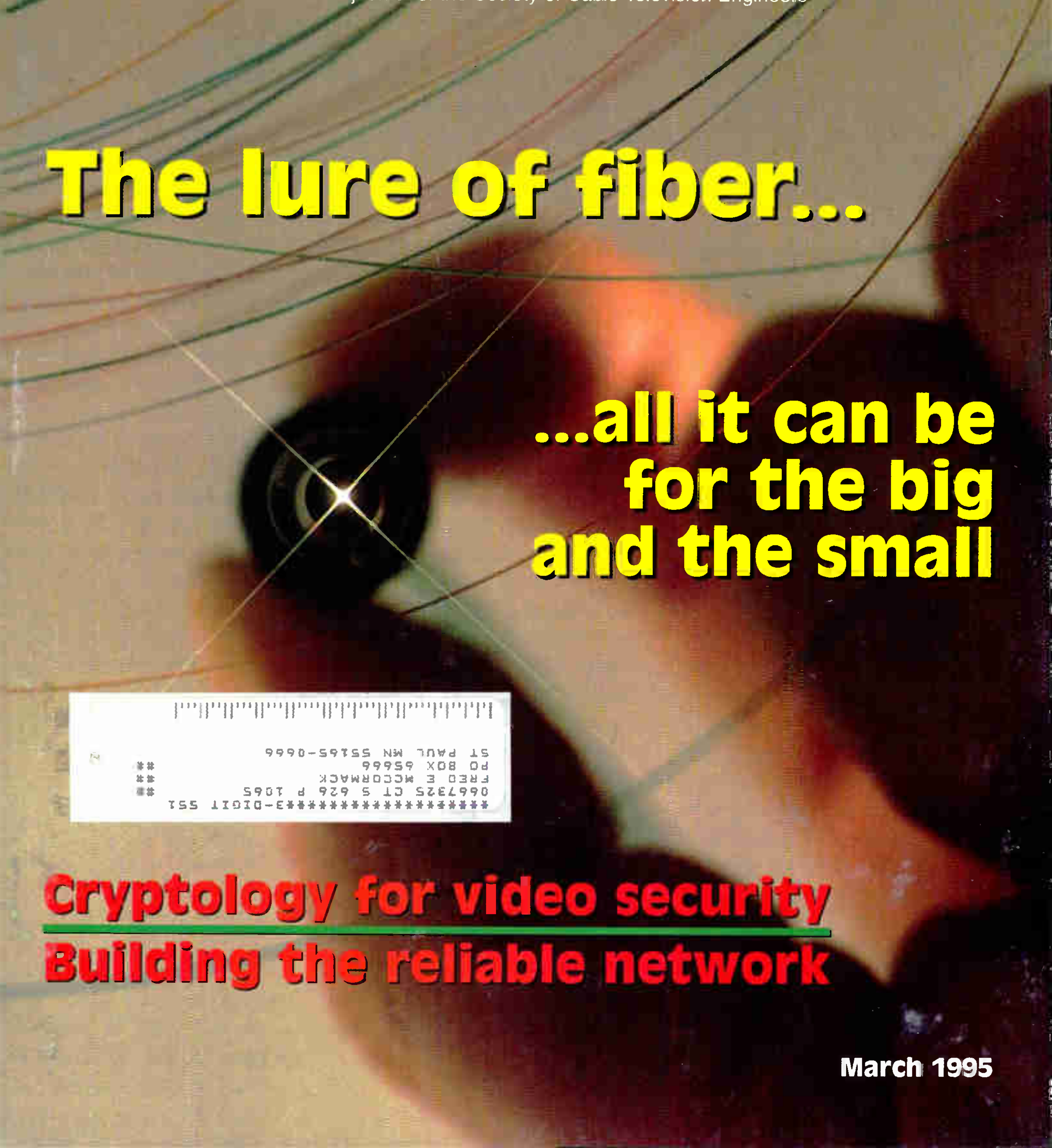

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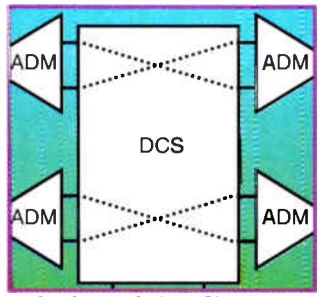

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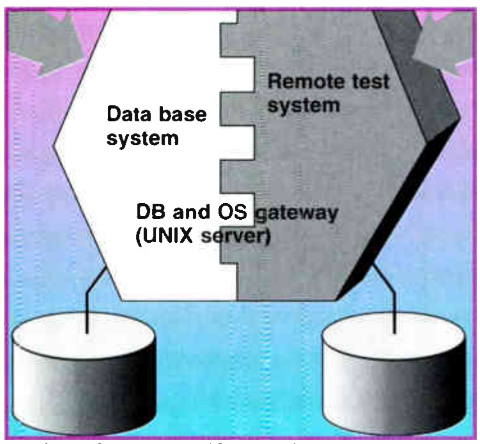

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EDITOR'S LETTER

What is a digital outage?

As we move to a future that will include provision of nonentertainment services to our customers, we need to pay much more attention to reliability. Quite simply, what may be acceptable in an analog entertainment environment won't work in a digital telecommunications environment. For the most part, we have a fairly good grasp of outages and their impact on customer perception of overall service quality in the analog world.

In fact, CableLabs even has a recommended outage definition that has been adopted by many in the industry. It reads as follows: "An outage is defined as any event in which two or more customers experience loss of reception on one or more channels arising from a common cause, regardless of the cause. Loss is defined as an interruption rather than degradation of signal. Loss of a single channel at the headend or hub site is included." This definition is from CableLabs' *Outage Reduction* manual, which was published in the latter part of 1992. The same publication includes a recommended outage threshold, above which customer satisfaction falls off rapidly: "No customer should experience more than two outages within a three-month period." The bottom line of all of this, by the way, is outages as perceived by the customer, not necessarily what cable operators think occurred.

But how do we define a digital outage?

For starters, you might think that some of the commonly accepted digital measures would work in creating such a definition. For example, bit error rate (BER), error-free seconds (EFS) and block error rate test (BLERT) are some that come to mind. But what is a digital outage? A BER of 10^{-6}? Or maybe 10^{-3}? Unfortunately it's going to be a lot more complicated than this. Consider the following scenarios.

- *Scenario 1:* Suppose you're at home watching a movie that is being delivered via a 4.5 Mbps compressed digital video signal. Further suppose that the data stream is interrupted for one second. The effect will be some tiling or blocking in the picture, or a freeze frame until the decoder restores lock. Despite the fact that a substantial amount of data was lost during the one second "service interruption," would you define this as an outage? Highly unlikely.
- *Scenario 2:* You're at home, logged onto an online service such as CompuServe. Again, assume a one second loss of data, this time at a more leisurely rate of 2.4 or 9.6 kbps. Your front end connection manager software flashes a brief message that it has lost sync with the host, then everything is back to normal. Would you define this as an outage? Again, probably not.
- *Scenario 3:* An emergency occurs in your home, and you press the panic button on your multifunction set-top. A one second data loss occurs, but this time at the exact instant you press the panic button. Is this an outage? I think so.
- *Scenario 4:* A large business user experiences a one second loss of data on its multi-Mbps data interconnect. Is this an outage? Ditto.

As you can see, the digital world brings with it some complicating factors. This is especially true in our business, because we will be dealing with both entertainment and nonentertainment services. While I don't have the answer, I do believe that the cable industry's digital outage definition will have to consider the nature of the service, the data rate, the duration of the loss of service and other factors. Any takers?

Ronald J. Hranac
Senior Technical Editor

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LETTERS

Use of traps not declining

The November 1994 issue of *CT* included an article "Addressable set-tops: Signal security for today and the future."

It contained many inaccurate generalizations concerning traps. The reference to dramatically declining use of traps is simply not true. A check of trap suppliers will find employment and production near record levels.

During the recent launch of Encore and Starz, millions of negative, positive and tier traps were shipped. New positive trap systems, such as Eagle's Side Band Interdiction System and Arcom's Gaussian System, were in very high demand. Eagle alone, designed and shipped over 350 new models of eight-pole tier combinations representing 900,000 units.

Canada recently approved 10 new premium channels to launch this year. MSOs and small operators alike will purchase millions of tier traps. Medium and small systems throughout the world will continue to use traps because of economic and friendliness issues. Internationally, because of the low per capita income of subs, traps are being shipped in huge quantities.

In regard to security, the aforementioned article never referred to the theft occurrences of old addressable converter/descramblers and pirate boxes (which costs cable operators millions) and that traps are used to back up questionable locations. Whenever the demise of traps is raised, our production levels increase!

Chester Syp
Sales Manager
Eagle Comtronics

SCTE Emerging Technologies '95: Best technical conference in years

"Communications Technology" Senior Technical Editor Ron Hranac offers up the following report.

Orlando, FL — If you weren't here, you missed what in my opinion was the best technical conference, at least as far as content is concerned, available to the industry in years. First the statistics: SCTE's third annual Conference on Emerging Technologies was held this past January at the Stouffer Orlando Resort. Attendance, at 1,300, was up 37% from last year's conference. The proceedings manual was a whopping 410 pages. Extra copies are available from SCTE headquarters. Call (610) 363-6888 for information. The presentations were generally top notch. And a deserving industry veteran — Cox's Hugh McCarley — received the 1995 Polaris Award.

Ironically, "Emerging Technologies" was almost a misnomer considering some of the underlying themes in several of the panels. Certainly there were presentations about advances in technology, but I observed three very basic but important themes that came up several times throughout the conference. Theme 1: There is no "one-size-fits-all" architecture that is right for every application. Theme 2: Rather than build a system today that will be capable of every imaginable future service, build a system that can be easily upgraded when the marketplace will support those advanced services. Theme 3: The lowly subscriber drop will be our biggest impediment to providing reliable digital services to the home.

Full Service Network

Things kicked off Wednesday afternoon with a trio of well-received preconference tutorials. The first was a Full Service Network (FSN) tutorial by Time Warner Cable's Jim Chiddix, Louis Williamson, Michael Adams and Ralph Brown. The FSN features a number of industry firsts: The first application of high-end return path operation (900 MHz-1 GHz); the first use of compression on an operating cable system; and the first CATV application of asynchronous transfer mode (ATM) and MPEG video via an ATM link. While the technology is impressive, the bottom line, according to Chiddix, is to find out what kind of money the public is willing to spend on new services. Time Warner personnel also had an operating demo of the FSN at the conference, using a stand-alone server.

"Stuff under development"

Intel Corp.'s Thomas Craver described its proposed broadband cable data network architecture in the second tutorial session. Craver emphasized that there are no products commercially available yet to support this concept, because much of it is literally "stuff under development." Partnered with General Instrument and Hybrid Networks, the companies are betting on the home personal computer market for their proposed asymmetric data architecture. It's asymmetric because the effective downstream data rate is 27 Mbps, and the effective upstream data rate is 96 kbps. The 27 Mbps downstream data, which occupies 5 MHz of a 6 MHz channel slot, is actually shared simultaneously among several users, although each user has a dedicated 96 kbps upstream data channel (100 kHz channel spacing). Ultimately this technology will allow cable operators to provide high-speed data communications over the CATV network. As a side note, presentations I've heard at several recent conferences echo the sentiment that data communications will likely be the cable industry's first real money-making opportunity in the interactive arena.

The third tutorial covered the nuts and bolts of building a fast file server. Silicon Graphics' David Perro emphasized the importance of understanding customer requirements and the markets for file servers. The most basic server architecture consists of four components: the clients (users); the request; the server itself; and the server's reply to the request. The convergence of three major industries — media (e.g., film entertainment), information processing and communications (CATV, telephony, etc.) — is driving the new markets for file servers. Perro noted that balanced server architectures will provide the best performance, and future applications will define input/output, network bandwidth and latency requirements. Latency, by the way, refers to the delay from when the user initiates a request to when the response is received by that user. In other words, how long does a customer have to wait after pressing the "order" button?

Conference growth

Society of Cable Television Engineers President Bill Riker kicked off the conference itself on Thursday morning with opening remarks. He said the conference's incredible growth warranted upgrading the audiovisual facilities to handle the increased attendance and, for the first time, required using a professional stage set. While this year's conference was the third annual, Riker explained that the conference series actually got its start back in 1988 as the SCTE's first national fiber-optics conference. He commented on the Society's board of directors elections and the proposed name change to Society of Cable Telecommunications Engineers. After a review of the conference agenda, Riker introduced the conference program subcommittee chairman, Adelphia's Mike Smith.

The first session, moderated by Paul Gemme, covered digital compression and alternative transmission techniques. The most important message from this panel was the vulnerability of in-home wiring. Poor workmanship and substandard materials are among the biggest contributors to in-home wiring problems, and industry experts are becoming worried that this part of the network may not adequately support the data transmission requirements of digital compression and other advanced services.

Among proposals discussed to over-

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come these problems were the use of smaller optical-to-RF nodes closer to the home, then transmitting analog narrowcast services through the coaxial portion of the network; converting digital services to analog directly outside the home; converting high-level digital formats such as QAM or VSB signals to simpler BPSK or QPSK formats at a network demarcation on the outside of the home (in other words, completely isolating the in-home wiring from the external network); "hardening" of the drop with permanent connections, better shielded cable and devices, and use of high quality components; and better education of the public, home builders and our own work force about the importance of high quality materials and proper installation practices. As CableLabs' Claude Baggett put it, "We need to be more active in defining what goes into the home."

Polaris award

Thursday's luncheon was highlighted by the presentation of the 1995 Polaris Award to Cox Cable Director of Corporate Engineering and SCTE Region 9 Director Hugh McCarley. The Polaris Award, sponsored by SCTE, Corning and *CED* magazine, recognizes individuals who have been innovative in their application of fiber-optic technology. In addition, Corning donated $2,000 to SCTE in McCarley's name to fund fiber-optic education. McCarley thanked his family, friends and co-workers, saying, "This award is really yours. I accept it on your behalf."

FCC update

Luncheon keynote speaker Richard Smith, chief of the Federal Communications Commission's Office of Engineering and Technology, commented that the government is looking to restructure communications and services markets to encourage more choice and competition. Upcoming FCC policies and actions will include finalizing rules on compatibility (TV sets, VCRs and systems); digital transmission standards for all video communications media including cable TV and video dial tone; cable's implementation of telco services; and high definition TV (HDTV) and broadcast standards. Smith cautioned those planning to implement digital transmission to "pay attention to the FCC's schedule."

Cable/telco

Thursday afternoon's panel sessions began with comments by moderator Dan Pike. Panelists discussed telephony and the cable industry, clearly showing that cable operators today are far more willing than in the past to talk openly about their telephony plans and projects. CableLabs' David Reed revisited the favorable economics of hybrid fiber/coax architectures such as fiber-to-the-feeder. Fiber-to-the-curb and fiber-to-the-home still cannot provide the same economies of scope.

As for the business of telephony by CATV operators, the United Kingdom's integrated network model has shown customers are interested in alternative providers. Telephone service penetration by CATV operators is running ahead of cable penetration!

Highlighting the importance of in-home wiring to two-way operation, NewChannels' Tom Staniec noted that in his company's telecommunications network trial, it was found that 70% of the time, "reverse junk" comes from the house, and 25% of the problems are bad drops. The return path can be made to work, Staniec added, but operators should clean it up first

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More future challenges

Ted Hartson provided opening remarks to Friday's sessions, emphasizing the value of education as we move into a telecommunications future. Before the panel discussions got underway, SCTE Chairman Tom Elliot presented Bill and Anna Riker with a commendation and plaques from the Society's board of directors, recognizing the Rikers for 10 years of service to SCTE. Moderator Jack Terry of Northern Telecom then kicked off the morning's sessions on broadband multimedia via cable. Some of the things the cable industry will need to come to grips with: bandwidth management, traffic engineering, support systems and return path challenges.

During Friday's luncheon, keynote speaker Gary Arlen of Arlen Communications made some interesting comparisons between Warner Cable's Qube system of the late '70s and early '80s, and today's interactive trials. While it is still too early to determine what interactive services will ultimately be successful, Arlen said that today the world is different. "The Nintendo generation has grown up," he added.

Afternoon session moderator Jim Farmer of Antec pointed out that the information highway is really an information tollway and asked attendees, "How much information is enough?"

Panelists wrapped up the conference with discussions on technology migration into the future. While that future looks good, innovation could be stymied by excessive government regulation of standards, according to Walt Ciciora, Ph.D. He urged the industry to take a bigger role in the standards-setting and regulatory processes.

Next year's Conference on Emerging Technologies will be held at the San Francisco Hilton, Jan. 9-11.

Wireless Cable holds tech conference

Tampa, FL — The first annual Wireless Cable Symposium of the Wireless Cable Association International was held here Feb. 4-6. The major thrust of the conference was digital methodologies for use in multichannel multipoint distribution service (MMDS) wireless. The digital compression plans parallel those of CATV (i.e., up to 10 programs per 6 MHz channel — with up to 33 channels available). →

There were presentations by familiar cable people. Joe Waltrich of General Instrument presented a paper on the company's 64-QAM transmission for use in its MMDS set-top, which he said would be available in the first quarter of 1996. Richard Citta's paper for Zenith, "VSB Digital Transmission Over MMDS Channels for the Wireless Cable Digital Alliance," presented the company's VSB digital transmission for use in its MMDS set-tops. He outlined the system description and presented field test results. John Bowler, vice president of R&D and cable LAN engineering, stated that Zenith MMDS set-tops also would be available in the first quarter of 1996.

There were a number of international attendees amongst the 200 registrants; three of the 20 papers presented were from abroad, reflecting the heavy international activity in wireless cable.

There has been much talk about wireless cable providing interactive services. The first question that occurs is, how can the return from the subscriber be handled? The use of the telephone for return has a number of undesirable effects (e.g., interference with the use of the phone). John Wachsman, director of convergence products for Pacific Monolithics, gave a paper on "Interactive MMDS" in which he proposed the use of the H4 channels. The FCC has allocated a number of these channels for use by wireless cable. Wachsman described them and they are: contiguous with MMDS band; 28 separate 125 kHz channels; 50 kHz of modulation; 70 kHz of frequency accuracy; and 24 dBm maximum output power. — *Lawrence Lockwood*

No more FCC?

CableFAX reports that at a recent dinner with communications industries representatives, House Speaker Newt Gingrich (R-GA) upped the ante of the GOP's deregulatory agenda, initiating talk about abolishing the FCC. In search of fundamental changes in government, Rep. Bob Walker (R-PA) said individual states, as well as marketplace competition, could do the job of the FCC. Rep. Jack Fields (R-TX), chair of the House Commerce Telecom and Finance Subcommittee, recently asked House Budget Committee Chair John Kasich (R-OH) to assign a staff person from his committee to the Commerce Committee to deal with the FCC.

However, answering to 50 different sets of regulations would not be beneficial to any industry, cautioned Pennsylvania Cable TV Association President Bill Cologie, who was part of the National Cable Television Association's two-day telco lobbying effort involving roughly 300 cable operators from 41 states.

On Feb. 2, the FCC distributed a report to Congress, "Creating a Federal Communications Commission for the Information Age," detailing 35 informal legislative recommendations. The proposals follow Vice President Al Gore's mandate to reinvent government. One proposal has the agency auctioning off 1-800 numbers. But don't expect a bill to pass this session, said chief of staff for Tom Foglietta (D-PA), citing Congress' heavy workload this session.

ANSI plans to connect info highway

WASHINGTON, DC — More than 100 leaders from industry and government representing the Information Infrastructure Standards Panel met in January to review progress, coordinate action plans and identify standards requirements needed to implement the information superhighway. The IISP is supported by the American National Standards Institute but funded by panel participants.

Approximately 15 standards requirements needed to attach or interface networks have been identified and are in the final drafting stage. These requirements will be presented to a wide variety of standards developing organizations, including members as well as nonmembers of ANSI, to determine if existing standards can meet identified needs.

☛ The Electronic Industries Association's Consumer Electronics Group submitted a new proposal to resolve the dispute over the interface Congress required by the FCC between TV sets, VCRs and cable. The proposal calls on the FCC to adopt a decoder interface designed to simply accommodate descrambling of cable signals and to promote the competitive supply of set-top boxes.

☛ Times Mirror completed a $2.3 billion merger of its cable operations with Cox Communications. The deal makes Cox the fourth largest MSO, with 82 systems and 3.1 million subscribers.

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Nominations open for 1995 awards

The Society of Cable Television Engineers is currently seeking nominations for its 1995 Member of the Year Award. Presented each year at Cable-Tec Expo, this award is given by the SCTE board of directors to recognize a member for outstanding contributions to the goals and purposes of the Society.

All persons nominated for the award must be active members of the Society.

Nominations must be received in writing by SCTE national headquarters no later than April 1, 1995. All nominations will be presented to the board of directors for consideration, and the selected person will receive a plaque recognizing this honor at the 1995 Cable-Tec Expo, to be held June 14-17 in Las Vegas, NV.

Since its establishment in 1974, the SCTE Member of the Year Award has been presented to 21 individuals. Previous recipients of the award are Wendell Woody (1994); Bill Grant (1993); Ron Wolfe (1992); Steve Allen (1991); Richard Covell (1990); Paul Beeman (1989); Mike Aloisi (1988); Rex Porter (1987); Sally Kinsman (1986); Pete Petrovich (1985); David Franklin (1984); John Kurpinski (1983); Clifford Paul (1982); Yves Fortier (1981); Thomas Polis (1980); Kenneth Gunter and Ralph Haimowitz (1979); James Grabenstein (1978); Frank Bias (1977); Glenn Chambers (1976); James Collins (1975); and Steven Doudourfis (1974).

The Society also is accepting nominations and entries for other awards to be presented at Cable-Tec Expo '95. Among these award programs are:

- *Personal Achievement Award* — Recognizes technical personnel in our industry for outstanding job performance.
- *Field Operations Award* — Promotes technical tools and procedures used in the field to enhance the work performed by installers, technicians and linemen.
- *SCTE Hall of Fame* — Recognizes national SCTE members who, over the course of time, have made extraordinary contributions to the professional development, ideals, goals and enhancements of the Society and the industry.
- *Special Recognition Awards* — Honors industry personnel who have made special contributions to the Society that were deserving of special attention by the industry.

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

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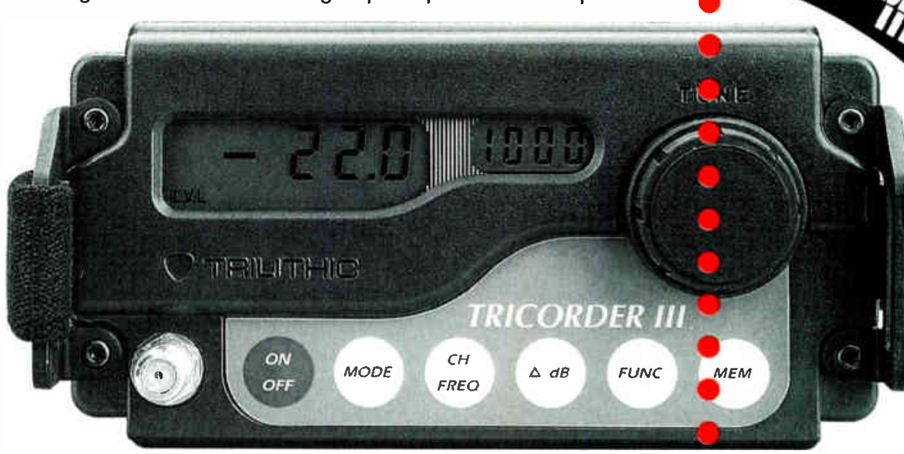

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Résumés, along with salary requirements, should be sent to the attention of Marvin Nelson at SCTE national headquarters, 669 Exton Commons, Exton, PA 19341.

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SCTE-LIST is operated through the facilities of the University of Wisconsin — Madison Division of Information Technology. The opinions expressed on this system are not necessarily those of the University of Wisconsin or the SCTE.

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Reader Service Number 14

Cryptography for video signal security

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

Recent developments in the protection of TV signals from piracy by digital encryption have been announced by Zenith, among others. Historically the protection of analog signals has been done by analog "scrambling" and a description of the various scrambling methods has been written.[1] Now cable is entering the digital world and classic digital encryption techniques can be adapted to TV requirements. Most analog scrambling schemes use various methods of altering the analog TV signal so that TV receivers cannot use it without the process of "descrambling" (i.e., restoring the analog TV signal to the standard format that the receiver can use).

For 100 years the telephone companies have sold the use of their networks to their subscribers for the transmission/reception of voice, data, etc. Cable companies, on the other hand, have sold to their subscribers the programs that are transmitted over their cable networks. The two businesses, although both involve the use of complex networking technologies, are fundamentally different in that the products being paid for are entirely different. The products (programs) being sold by cable systems are not owned by the cable systems. The owners of the programming are quite logically concerned that their programming is protected from "piracy" and this is where digital encryption enters the picture.

Table 1: Decimal and binary equivalents

Decimal	Binary numeral
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010

Table 2: Stream ciphering of DOG using XOR

	D O G
Plaintext	010001001100111101000111
⊕ Keystream	100110101101010100110010
Ciphertext	110111100001101001110101

Table 3: Decrypting DOG with XOR

Ciphertext	110111100001101001110101
⊕ Keystream	100110101101010100110010
Plaintext	010001001100111101000111
	D O G

The EIA/NCTA Joint Engineering Committee was formed in the wake of the Cable Act of 1992. This committee has pretty much agreed that future TV sets may have the video decompression and digital-to-analog conversion circuits built into them. Thus, to protect the digitized TV signals of 1s and 0s, digitized encryption will have to be added. Encryption of digital signals essentially means using a digital "key" to encrypt the signal (i.e., shuffle the 1s and 0s into a sequence that is unintelligible without the use of the key to "unshuffle" the 1s and 0s into their original sequence). There are two generic encryption techniques — the private key and the public key. The public key method is not adaptable to cable requirements so various private key technologies are being proposed — VideoCipher I from General Instrument and the Zenith/Teledyne conditional access and encryption technology are two examples. (More on this technology later.)

Probably the most widely used digital encryption method is the Data Encryption Standard (DES) developed by IBM and issued in 1977 as a federal standard by the National Bureau of Standards. The DES has been heavily used since then for banking transactions and in general commerce. There has never been a recorded case of its being broken — which compares most favorably with the protection offered by analog TV scrambling that has suffered a number of compromises.

Binary addition and modulo 2 addition

Table 1 provides the binary equivalents for the decimal values of 0 to 10.

"No matter how strong a private key system is, the protection of the key is mandatory. If it is compromised the system is then subject to piracy."

The rules for binary addition are:

1 + 1 = 0 and carry 1 to add to next column to the left
1 + 0 = 1
0 + 1 = 1
0 + 0 = 0

Using these rules one can check how the binary equivalents in Table 1 are derived.

The definition of modulo 2 addition of binary signals is binary addition *without* a carry action. This is accomplished by an exclusive-OR (XOR) gate, which is a gate that produces a 1 when either input is a 1 and that produces a 0 when both inputs are a 1 and produces a 0 when both inputs are 0. The symbol used for this type of addition (with no carry) is ⊕.

The rules for modulo 2 addition are:

1 + 1 = 0
1 + 0 = 1
0 + 1 = 1
0 + 0 = 0

Stream ciphering

One method of digital encryption called "stream ciphering" applies a

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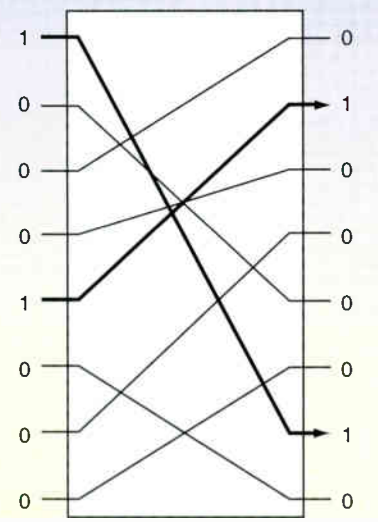
Figure 1: Permutation box



pseudorandomly generated stream of bits ("keystream") to the plaintext stream using the XOR operation. The stream ciphering of the digitized representation of "DOG" in its ASCII values is shown in Table 2 (page 24). The XOR operation has the interesting property that having generated a ciphertext using the XOR operation with a key and the plaintext, the plaintext can be recovered from the ciphertext and the key with another XOR operation as shown in Table 3 (page 24).

The usefulness of modulo 2 addition can be seen if we let:

M = a binary message of n bits
K = a binary key of n bits
C = ciphertext

To encrypt a message, we can use:

$M \oplus K = C$

And to decrypt a ciphertext, we can use:

$C \oplus K = M$

A second method of digital encryption is known as "block ciphering," wherein the plaintext is broken into blocks that are then replaced by blocks of ciphertext. As an example, the plaintext digitization of DOG could be broken into two, 12-bit blocks and each 12-bit block encrypted into a 12-bit ciphertext block. A 12-bit block cipher is mentioned for illustration purposes only since in order to resist cryptanalysis (decryption) effectively, a block cipher device must be much larger (e.g., 64 bits).

Concepts relating to the DES

Permutation is another term for transposition. The number, letter or character in a starting position is transposed or shuffled to another position using a specified scrambling key. An example is shown in Table 4. The transposition has the fourth character in the first position, the third character in the second position, and so on with the second character in the last or sixth position. With a word such as "SYSTEM," the permutation-transposition works as shown in Table 5.

In cryptography the process of shuffling the position of binary digit is illustrated by *permutation box* or *P-box* such as shown in Figure 1.

Substitution tables

A *product-cipher* or *product transformation* involves a combination of both transposition and substitution to produce a ciphertext. Whereas transposition shuffles digits following a fixed sequence (as in a P-box), substitution should provide a nonlinear replacement — nonlinear meaning that it is possible for more 1s to result in the ciphertext than began with the plaintext.

A substitution table works with a key to replace an *input* character with an *output* character. The output characters need not bear any relationship to the input characters. The key controls the selection of characters.

A quite simple example of a substitution table is the Vigenere one shown in Table 6. Each substitution character is found by going down the column of the plaintext letter until the key letter is reached. The substitution letter is found at the intersect of the plaintext letter and the key letter.

Input may be divided between two or more substitution tables.

Let's devise two such tables, each with three digits from the group 3, 4, 5, 6, 7 and 8 scrambled in them as shown in Table 7 (page 28). This process uses a key of 3-2-1. Input to S_1

Table 4: Transposition

Character starting position	Transposition position	Moves to new position
1	4	1
2	3	2
3	5	3
4	6	4
5	1	5
6	2	6

Table 5: Permutation of "SYSTEM"

Starting Position	Permutation position	Word	Result	New position
1	4	S	T	1
2	3	Y	S	2
3	5	S	E	3
4	6	T	M	4
5	1	E	S	5
6	2	M	Y	6

Table 6: Vigenere substitution table

Key letters	ABCDEFGHIJKLMNOPQRSTUVWXYZ (Plaintext letters)
A	ABCDEFGHIJKLMNOPQRSTUVWXYZ
B	BCDEFGHIJKLMNOPQRSTUVWXYZA
C	CDEFGHIJKLMNOPQRSTUVWXYZAB
D	DEFGHIJKLMNOPQRSTUVWXYZABC
E	EFGHIJKLMNOPQRSTUVWXYZABCD
F	FGHIJKLMNOPQRSTUVWXYZABCDE
G	GHIJKLMNOPQRSTUVWXYZABCDEF
H	HIJKLMNOPQRSTUVWXYZABCDEFG
I	IJKLMNOPQRSTUVWXYZABCDEFGH
J	JKLMNOPQRSTUVWXYZABCDEFGHI
K	KLMNOPQRSTUVWXYZABCDEFGHIJ
L	LMNOPQRSTUVWXYZABCDEFGHIJK
M	MNOPQRSTUVWXYZABCDEFGHIJKL
N	NOPQRSTUVWXYZABCDEFGHIJKLM
O	OPQRSTUVWXYZABCDEFGHIJKLMN
P	PQRSTUVWXYZABCDEFGHIJKLMNO
Q	QRSTUVWXYZABCDEFGHIJKLMNOP
R	RSTUVWXYZABCDEFGHIJKLMNOPQ
S	STUVWXYZABCDEFGHIJKLMNOPQR
T	TUVWXYZABCDEFGHIJKLMNOPQRS
U	UVWXYZABCDEFGHIJKLMNOPQRST
V	VWXYZABCDEFGHIJKLMNOPQRSTU
W	WXYZABCDEFGHIJKLMNOPQRSTUV
X	XYZABCDEFGHIJKLMNOPQRSTUVW
Y	YZABCDEFGHIJKLMNOPQRSTUVWX
Z	ZABCDEFGHIJKLMNOPQRSTUVWXY

① Plaintext letter
② Key letter → ③ Substitution letter

As an example:
BC = Plaintext
UN = Key
VP = Ciphertext

Figure 2: Product-cipher system

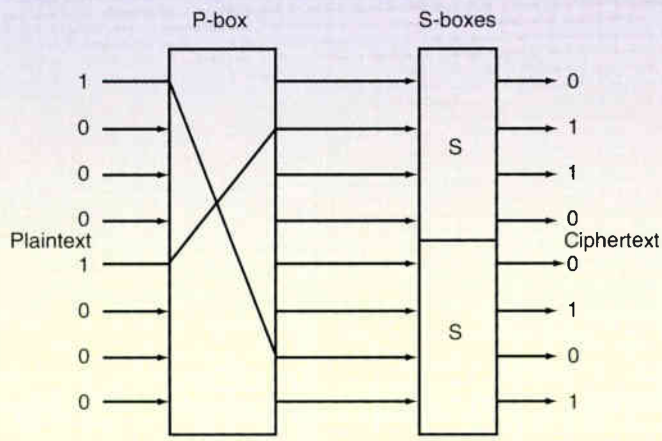
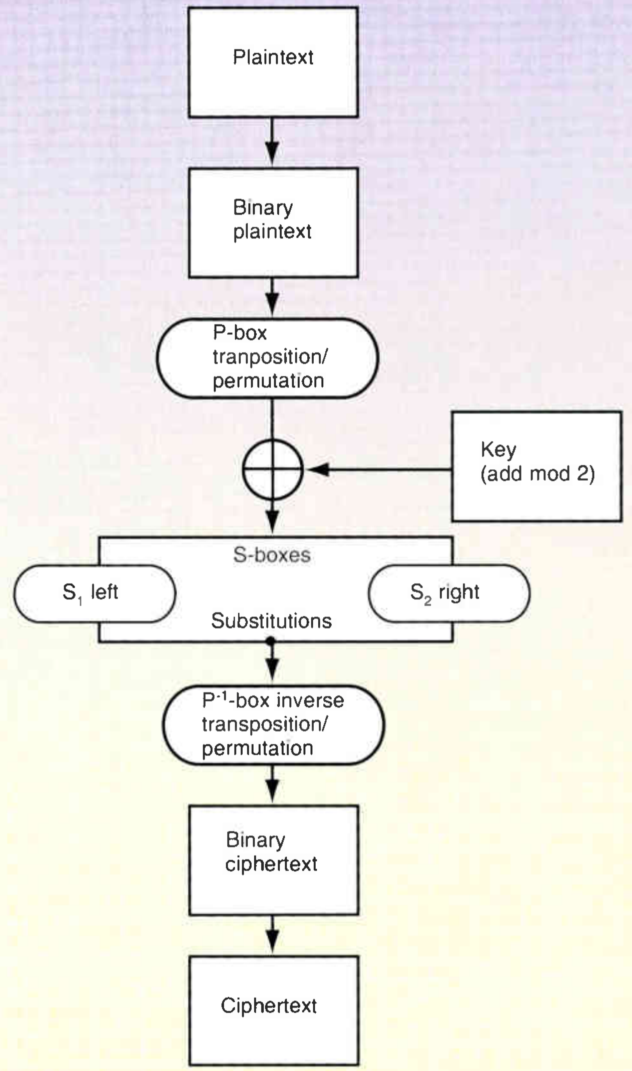


Figure 3: Product-cipher system



and S_2 is as follows: the first three characters from a P-box are replaced by characters in S_1 following the key sequence; the next three characters from the P-box are replaced by the characters in S_2 back and forth, S_1, S_2, S_1, ...

Using the word SYSTEM and the preceding permutation results, we have the cipher as shown in Table 8. In this discussion, we started with the plaintext word SYSTEM, transposed it to become TSEMSY, and replaced each character to develop the ciphertext 847653.

A product-cipher system is diagrammed in Figure 2. Shown is binary plaintext going through a P-box and then through a group of substitution boxes or S-boxes. The P-box will shuffle the position of the 0, 1 digits using a fixed sequence. The S-boxes will provide the substitution characters based on a key in a nonlinear way.

Simplified DES

Figure 3 represents a more involved product-cipher having the basic characteristics of the DES. The system in Figure 3 shows a plaintext converted to binary digits. These digits are scrambled in a P-box; the results have a key added to them using modulo 2 addition as signified by the symbol ⊕. The resulting set of binary digits is divided into left and right halves to become the input into a left and right S-box. Here substitutions occur. The output from the S-boxes is then scrambled by a permutation box labeled P^{-1}. This box is an *inverse permutation box*; that is, it scrambles in a reverse sequence of the starting P-box. Finally the bits of P^{-1} are converted into standard characters to produce a ciphertext. This system is presented solely for illustrative purpose to indicate the basic characteristics of the DES.

The full enciphering diagram of the DES as published in the standard is shown in Figure 4 (page 32). The DES algorithm converts 64 bits of plaintext into 64 bits of ciphertext under the action of a 56-bit keying parameter. Deciphering is essentially the operation in reverse.

Table 7: Substitution tables

S_1			S_2		
1	2	3	1	2	3
7	4	8	3	5	6

Zenith/Teledyne conditional access and encryption

Zenith and Teledyne have developed a conditional access and encryption system for use in CATV. Teledyne of Northridge, CA, has largely served the military and is well known for its development of Identification, Friend or Foe (IFF) system.

John Bowler, Zenith vice president, corporate R&D and network systems engineering, said: "Our system should be as secure as those Teledyne has designed for military applications. As set-top decoders continue to play a significant role in the wide range of programming choices being developed, a high-level, tamper-proof security system is essential. Our Media Access system will be the most secure on the market."

Conditional access is simply identifying a customer and authorizing him to receive a program. It is now often done with an addressable set-top. Encryption adds another level of security.

Teledyne designs block cipher systems with what it calls dynamic substitu-

Table 8: Cipher resulting from use of substitution table

Word	Result	Key	S_1/S_2 replacement character
S	T	3	8
Y	S	2	4
S	E	1	7
T	M	3	6
E	S	2	5
M	Y	1	3

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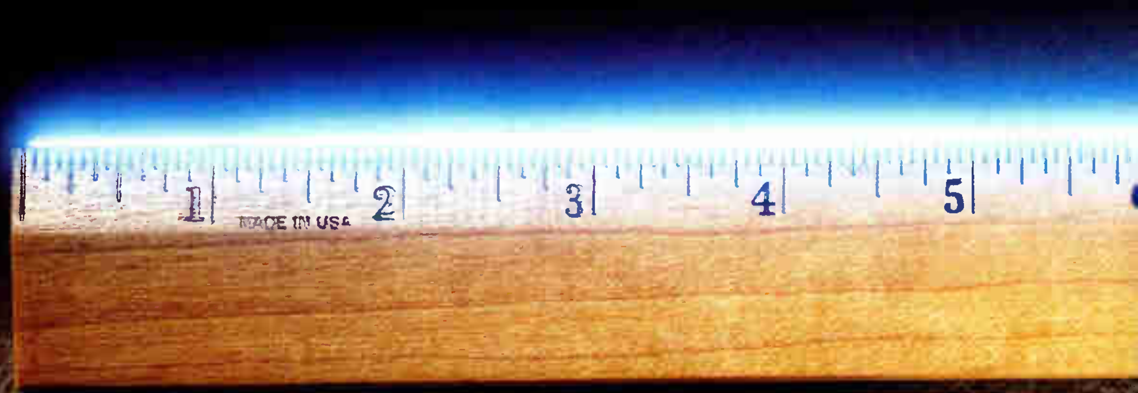

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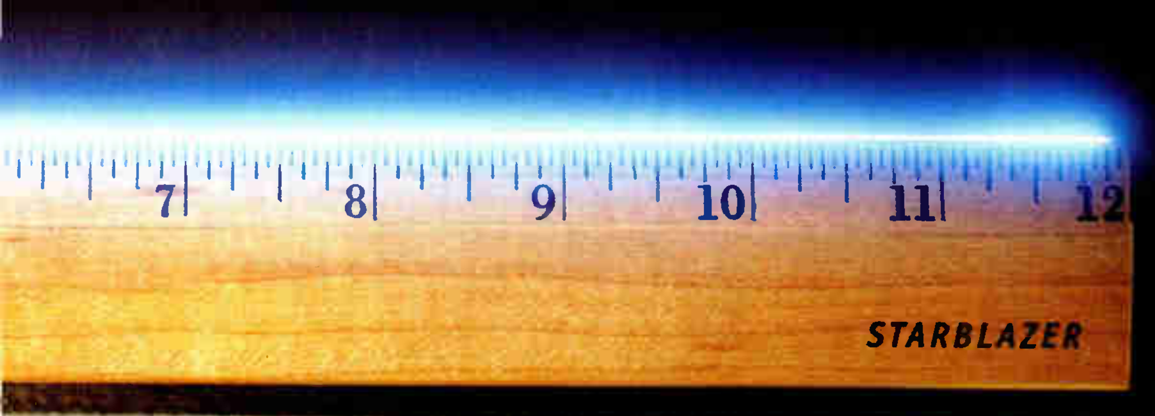

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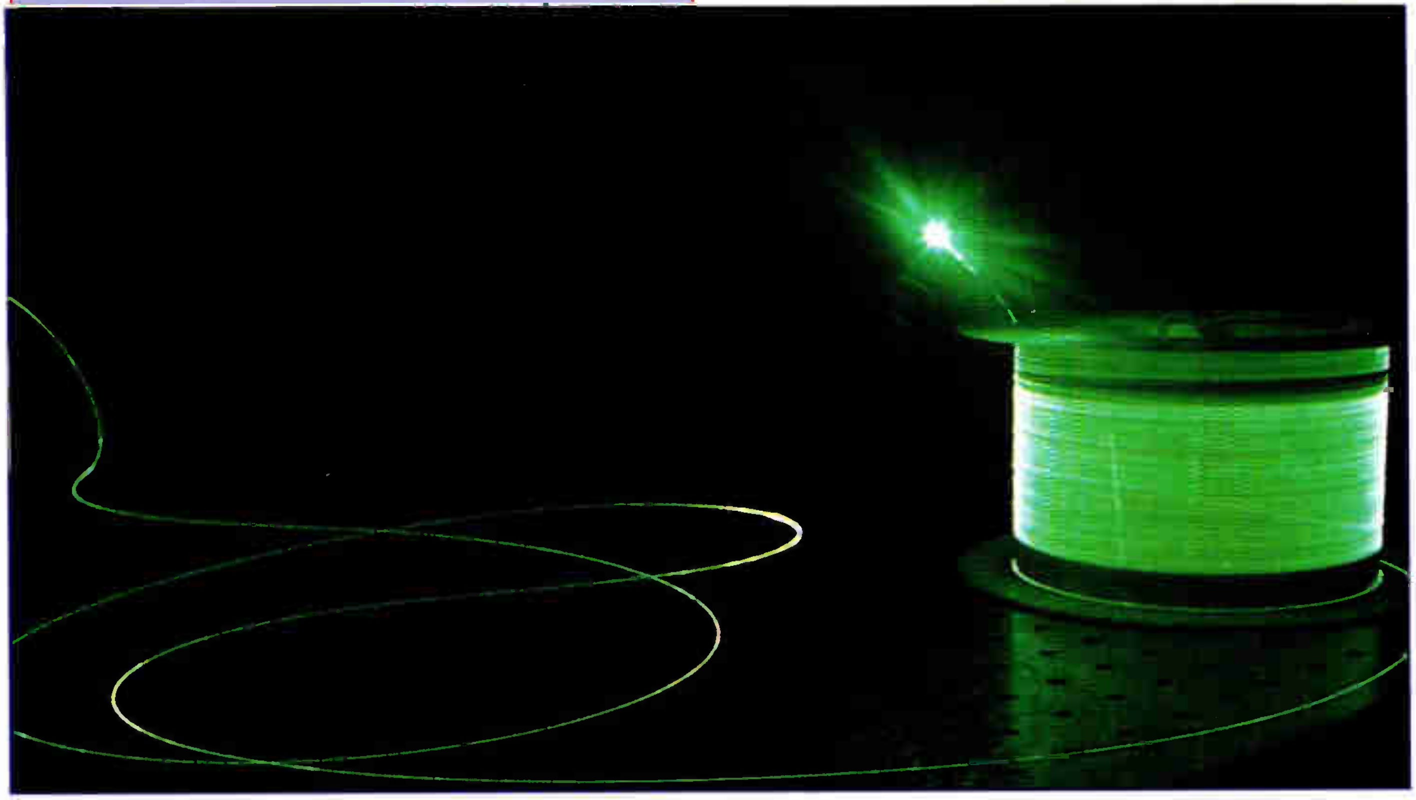


Courtesy AT&T

Going fiber in a small way

By Karl Poirier
Vice President, Corporate Development
Triple Crown Electronics

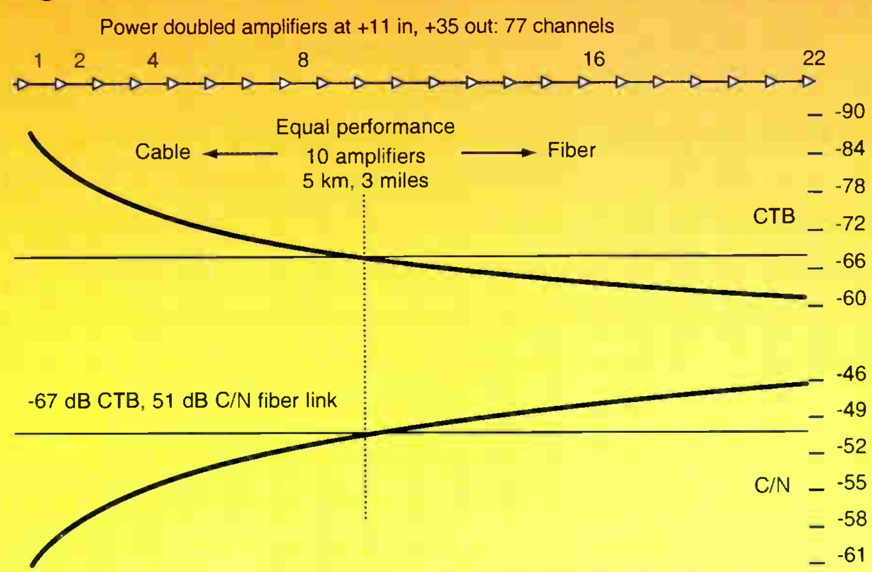
While AM optical fiber has become the norm for new-builds, most system designs and related technical publications see fiber in the "information superhighway" context. These large system designs are meant to incorporate future interactive services and new forms of telecommunications and tend toward ring, star and other more complex architectures. There is little written on the deployment of fiber in smaller systems for the more prosaic objectives of system performance and reliability. This article looks at fiber deployment from the viewpoint of the smaller cable system with emphasis on hands-on aspects.

To begin: Why fiber?

Many small to medium CATV operations still look at fiber as a big system product. The technology is still a little frightening and the costs and benefits are not clearly understood. The very concept, let alone the tools, equipment and procedures seem too much for them to accept with any level of comfort. However, the technology of fiber has been refined and simplified over the last two or three years and is accessible to anyone (with a little guidance). If we look at fiber deployment in small systems, we can break down the process into a few basic categories:

- The basic AM fiber link
- Link performance
- Fiber architectures
- Designing and operating a fiber-based system

Figure 1: Power doubling vs. DFB laser



Fiber link

The fiber link consists of three parts: transmitter, receiver and light path. There are three basic transmitter types currently available, each with its own characteristics and application.

1) F-P (Fabry-Perot) laser transmitters are low-cost, low-channel capacity devices used for data or low-channel capacity video such as sub-low return paths or dedicated low capacity point-to-point links.

2) DFB (distributed feedback) laser transmitters are the most common cable TV forward band lasers. They are usually built to operate in the 1,310 nm wavelength for CATV appli-

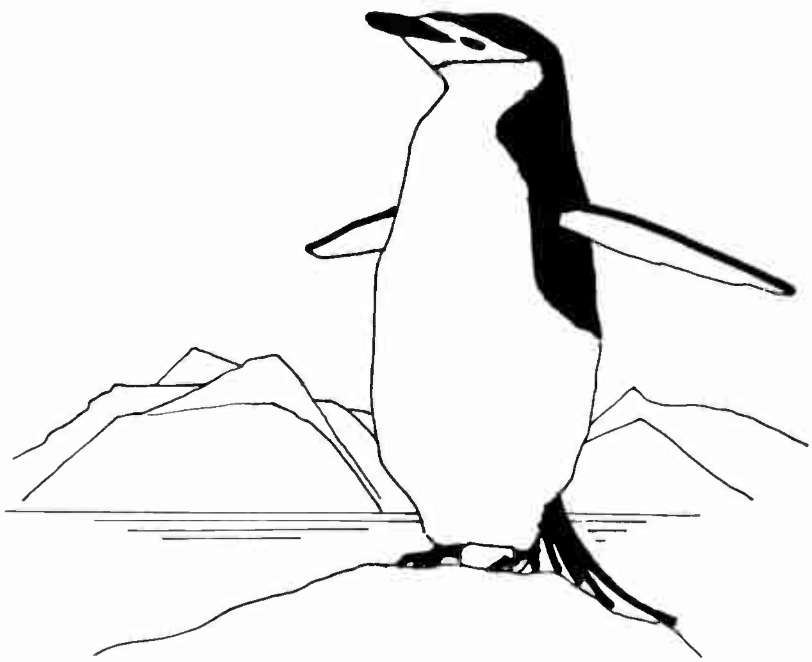


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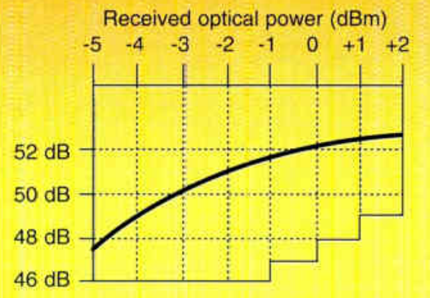
Figure 2: Typical DFB fiber link noise performance (77-channel loading, 550 MHz)



cations with output power in the 8-12 milliwatt range.

3) Externally modulated YAG laser transmitters are fairly expensive high-power devices that are normally employed in primary or backbone applications for larger networks. YAG lasers operate in the 1,310 to 1,550 nm wavelength and offer output powers in the 15-20 milliwatt region.

It is important to note that these laser transmitters are available from many sources in a wide variety of styles and options. However, when delivered to the user, they have been essentially reduced by the manufacturer to an "RF in/light out" black box, and require only elementary cautions to operate. It also is notable that much like CATV amplifiers, there is no magic in the performance area. Good quality transmitters and receivers will generate similar RF performance, even when intermixing different brands in a link.

Receivers

Receivers come in a wide variety of styles, but these are mostly feature and operating mode related. The heart of a receiver is a device that performs the electronic opposite of the transmitter: modulated light coming in is transformed to cable TV RF out. The decisions when selecting a receiver are more in the area of:

- Single fiber, dual fiber or fiber/RF backup receiver
- Stand-alone receiver or receiver/trunk amplifier
- General flexibility, features and reliability

Light path

The light path consists of the fiber, connections, splitters, couplers and other passive devices. The fiber consists of color-coded fiber strands incorporated into a functional cable, and may comprise anywhere from one to several hundred fibers per cable depending on the application. The fiber itself will be a "single-mode" type, meaning that it has a very small transmission core, in the region of 8-10 microns in diameter. Only single-mode fiber is used for cable TV distribution. The fiber will have been "corrected" for transmission of either 1,310 nanometer, 1,550 nm or in some cases both wavelengths. The transmission loss will be in the region of 0.35 dB/km at 1,310 nm, or 0.25 dB/km at 1,550 nm.

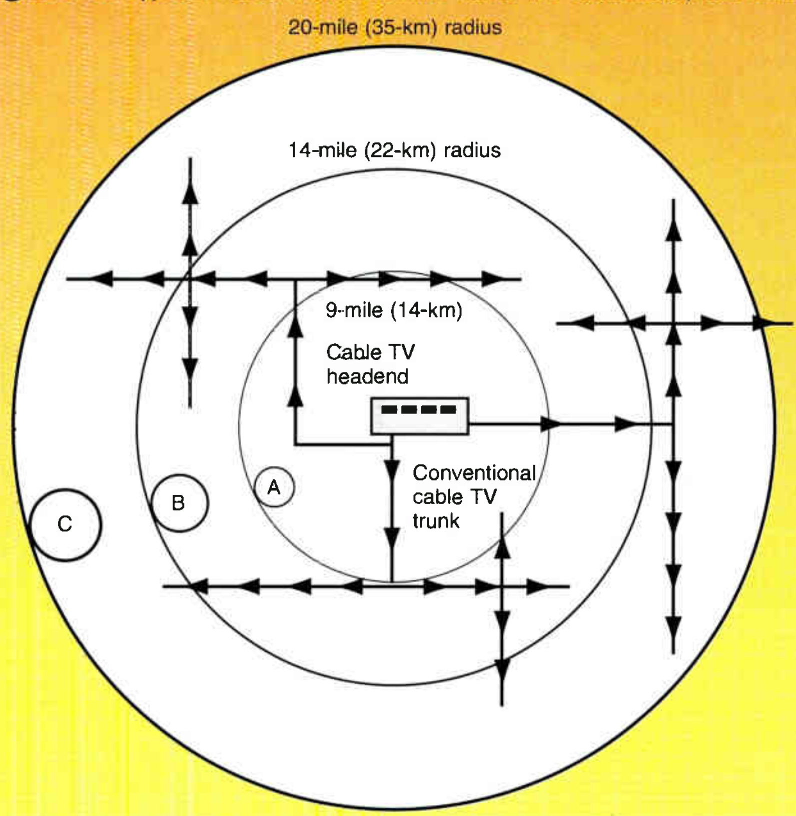
Three types of connection are required for a fiber link: permanent, interim and disconnectable. The various connection methods range in insertion loss from 0.01 to as high as 0.5 dB, and with such low fiber cable losses, the splice performance can be a significant system reach factor.

Permanent connections are employed where a fiber is to be connected to another with no apparent need to disconnect in future. The most common form of permanent connection is the fusion splice where the fibers are in fact welded together. This process involves the use of equipment that most small systems cannot afford to own but such splicing services are available from major construction contractors.

Interim connections are used where a fusion splice is not immediately available or for emergency fiber restoration. They consist of a wide variety of mechanical connectors that align and hold the fiber ends together. Some of these devices are one-time only, where the connector is discarded if the splice does not perform as expected. In other types, the splice can be tuned and optimized and even redone if desired.

Connectors are used where we expect that there may be a need to disconnect an item such as a coupler or a piece of electronics. There are many types, but they are generally classified as "PC" or physical contact, and "APC" or angled physical contact. The connector type prefix, such as "FC," "ST" or "SC" describes the body and fastening style. APC connectors are more expensive but have better return loss, and are most often used at the laser end of the link. To ensure interconnectability, all equipment should be purchased with

Figure 3: Typical reach for a 10 mW laser (77 channels, 550 MHz)



Radius	Number of -48 dB C/N nodes	Number of -52 dB C/N nodes
A	4	2
B	2	1
C	1	

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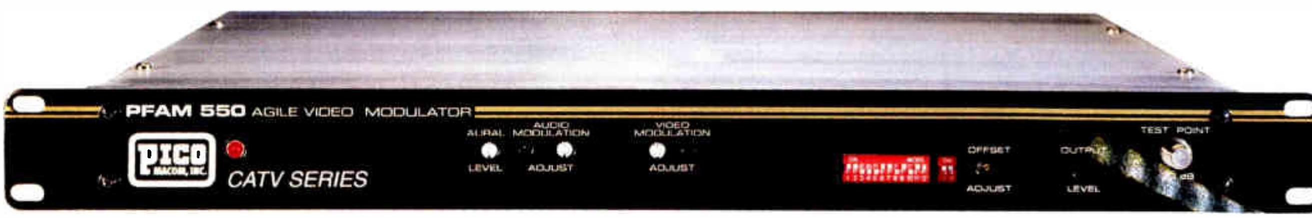

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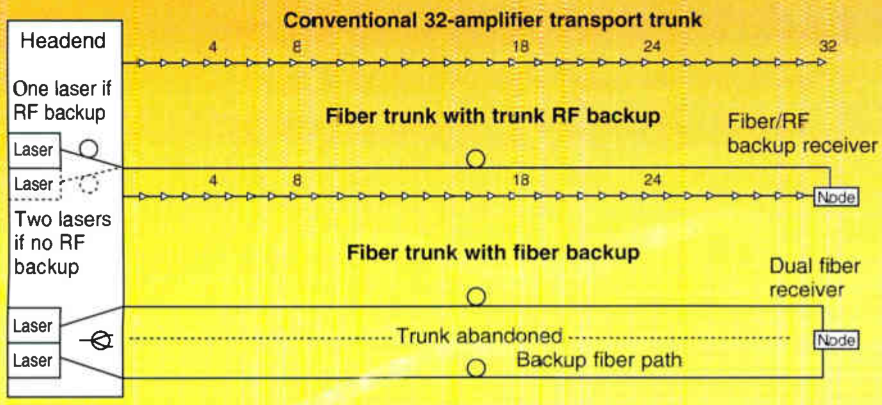
Figure 4: Trunk fiber replacement



the appropriate mating pigtails included.

Fiber is split or divided with couplers having split ratio losses similar to the CATV devices with which we are familiar.

Link performance

A fiber link is characterized by carrier-to-noise (C/N) and distortion performance. While delivering both parameters at an acceptable headend level, fiber is not ideal for all applications. It is possible to operate conventional amplifier cascades delivering better performance over short distances. In Figure 1 on page 36, the comparison of a power doubled amplifier cascade with a DFB fiber link shows that for transport distances up to about 5 km (3 miles), conventional technology performs better. It is in the longer transport application that the fiber link offers a performance advantage because the link, when operated within the allowable budget, delivers the same performance regardless of distance. Fiber may be implemented for short links when reliability or access (rather than RF performance) are the primary driving factors.

In a fiber link, the composite triple beat (CTB) and cross-modulation are totally a function of the laser transmitter. With a 77-channel load, a DFB laser will deliver a CTB performance of -65 to -67 dB regardless of distance to the receiver. Some manufacturers offer lasers with predistortion that can improve this CTB to the -75 dB region. Conventional trunk amplifiers will exceed this over short transport distances.

In a fiber link, the C/N performance is a function of the sum of the laser noise limit and the optical power at the receiver, with some less significant noise being generated in the fiber under certain conditions. As we would rarely plan to build a transport system with less than 48 dB C/N, we arrive at a fairly narrow limit of allowable receiver power. The receiver requires an input of -4 dBm to deliver 48 dB C/N, while above +1 dBm, the laser noise prevents any further significant C/N improvement beyond 52 dB. (See Figure 2 on page 40.)

If we push the link to the 48 dB C/N limit, or -4 dBm receiver input, we then establish the overall performance of

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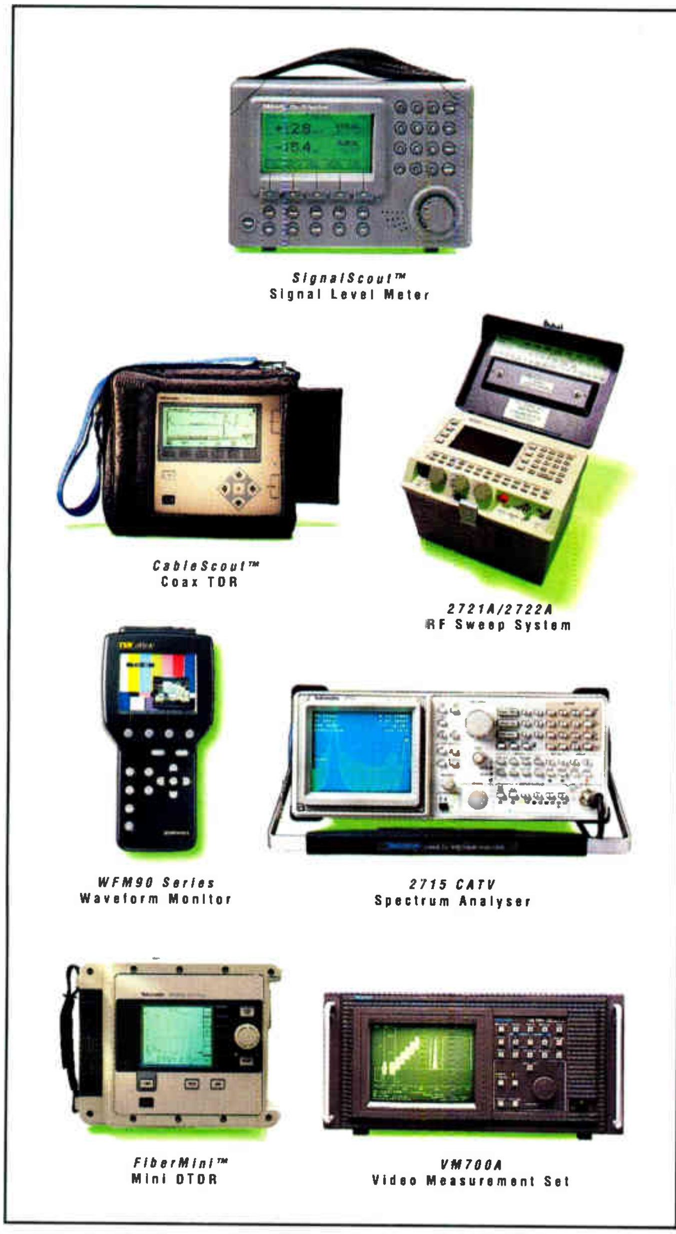

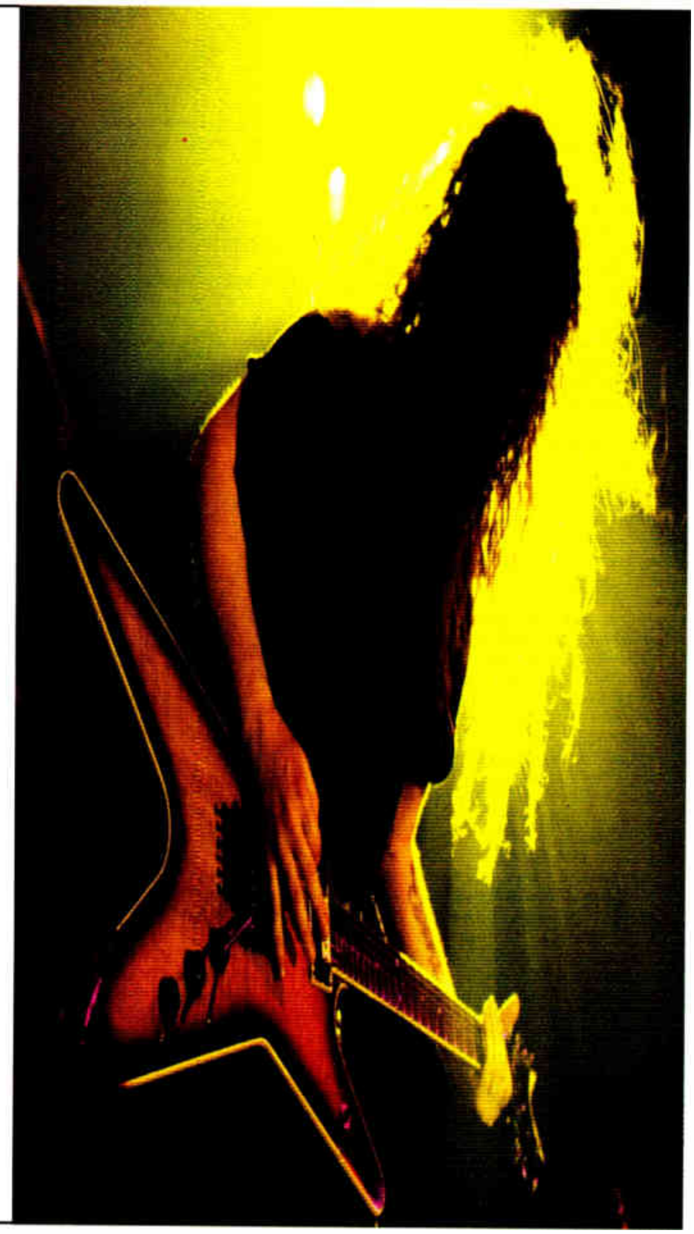

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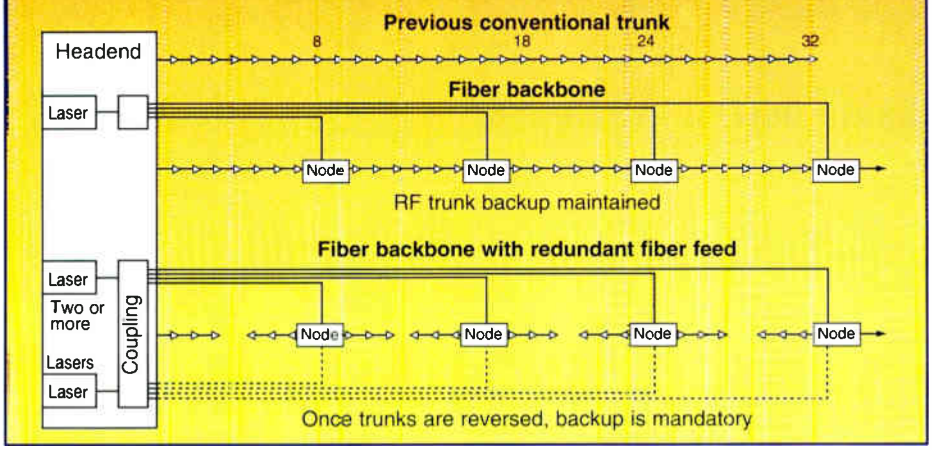


Figure 5: Necessity of redundant fiber paths

the link as in the example: 550 MHz, 77-channel loading. 1,310 nm. In this example:

- A DFB laser (nonpredistorted) can deliver -67 dB CTB regardless of distance to the receiver.
- A receiver operating at -4 dBm input power can deliver 48 dB C/N.
- A 10 mW laser has an output power of +10 dBm.
- The difference between +10 dBm and -4 dBm is 14 dB. This is the loss budget.

This link is a fixed item that will deliver 48 to 52 dB C/N and -67 dB CTB over a distance or loss budget of 9 to 14 dB (how ever we choose to allocate it.)

At 0.35 dB/km (rounded to 0.4 to allow for splices), this budget could be used to deliver signals to:

- One receiver at a distance of 35 km/48 dB C/N (22 km, 52 dB),
- Two receivers at a distance of 25 km/48 dB C/N (13 km, 52 dB),
- Four receivers at a distance of 15 km/48 dB C/N (3 km, 52 dB), or
- A variety of unequal divisions and fiber loss totaling 9 to 14 dB, depending on the C/N required from the laser to any individual receive node.

Thus, for most applications we can think of a fiber link as a fixed performance item, varying only in reach/node count. When we take this approach, we can then visualize fiber feeding a system along the lines of configurations described in Figure 3 (page 38).

More importantly, this fixed performance item requires no access, powering or maintenance, and this can be the most significant factor in selecting fiber as the system transport medium.

Fiber architectures

While the architectures proposed in large system rebuilds may be elaborate to the point of appearing foreboding, the designs that will be applied to medium to small systems are relatively straightforward. Two basic design architectures will be employed when implementing fiber in these systems: fiber trunking and fiber backbone (or fiber-to-the-service-area — FSA).

Fiber trunking is the simplest and probably first step that most systems will take into fiber. As the name implies, this is fiber applied as a trunk replacement. It is possible to replace a 16- to 32-amplifier transport trunk with a fiber cable and only two pieces of electronics (laser transmitter and optical receiver). Figure 4 (page 40) shows a trunk fiber replacement with either RF or second fiber serving as backup.

Fiber backbone is employed where the trunk has local subscriber distribution along its length and cannot be abandoned in favor of a fiber transport link. In this architecture, the fiber intercepts and replaces the existing trunk at strategic points providing a fresh input point. If the trunk is maintained as a single direction feed, then each fiber receiver can have an RF backup available from the previous section. To further reduce amplifier cascades, the trunk can be reversed to feed forward and backward from the receiver point. This should be backed up by redundant fiber paths as in Figure 5.

FSA is similar to fiber backbone. The difference is that rather than simply feeding subscribers along an abandoned RF trunk, we deliberately break the system into smaller mini-systems. We begin by identifying "logical nodes" in our system. A logical node is an area that could operate as a stand-alone cable system if a local headend were available. Logical nodes should be areas of about 3,000 subscribers or less and might be entire communities along a transport trunk or a subdivision of a larger urban area. A good guideline for a service area is one wherein all subscribers could be reached with cascades of six to eight amplifiers. The center, or node, should be within reach of receiving -4 dBm to +1 dBm of optical power. At this location, a fiber receiver brings a virtual headend delivering 48 to 52 dB C/N and -67 dB CTB to the service area. In Figure 5, each node is a service area, and could be considered a mini-system.

Design and operation

The first step in designing and operating a fiber-based system is to understand some fundamental points. These include:

1) When the overall cost of materials, makeready and construction are considered, the actual cost per fiber is fairly small. Adding fibers later would be a major cost penalty. In light of this, we

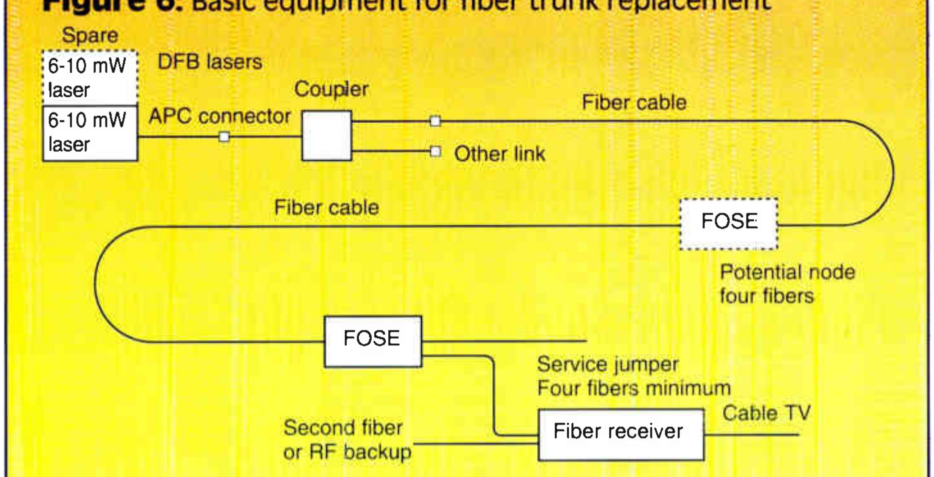
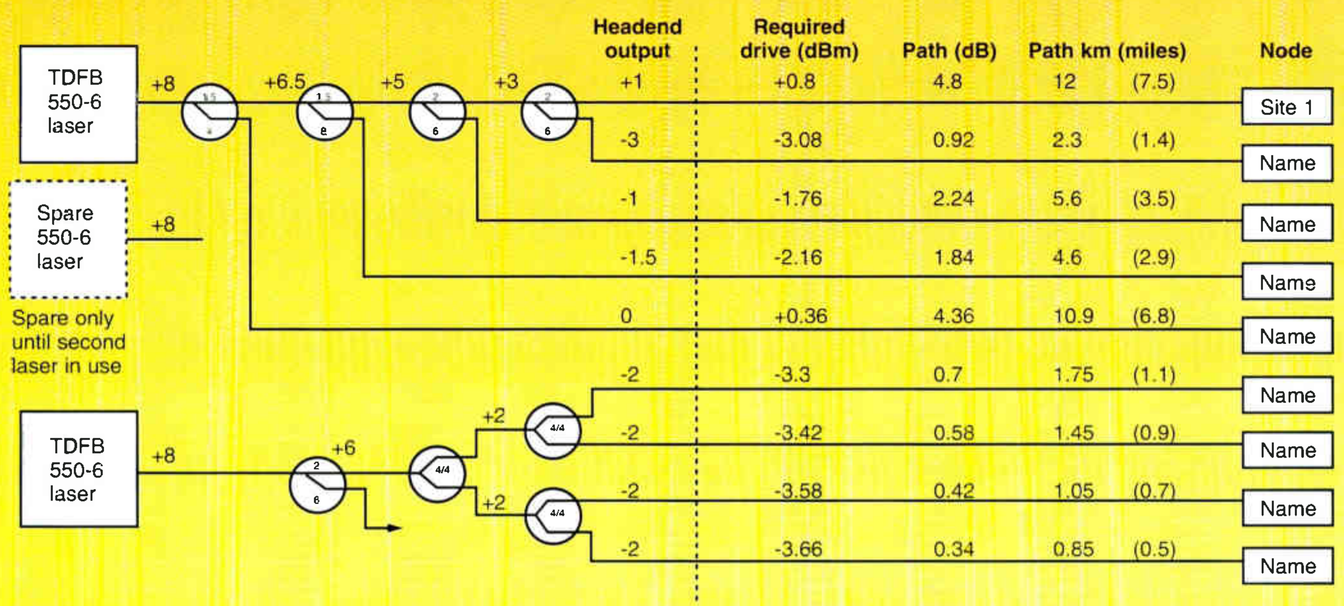


Figure 6: Basic equipment for fiber trunk replacement

Figure 7: Typical multiple node fiber design



Drive based on -4 dBm input power for 48 dB C/N.
Fiber taken at 0.4 dB/km (0.65 dB/mile) allowing splices and loopbacks

should plan at the outset to lay four to six fibers to each receive location. We can see how even four fibers could be quickly exhausted if we use one for cable, one for return signals, one for digital, and one for the future (a spare).

2) When we plan to feed more than one receiver on a common path, the first impulse is to split the fiber at a field splice point. This should always be avoided! Split at the headend and run parallel fibers if necessary. It may cost more in fiber but removes future bottlenecks and limitations.

3) The first fiber link, unless an RF backup is provided as in Figure 4 (page 40), will consist of two laser transmitters. This is necessary even if one transmitter will suffice for normal operation because an immediate spare for this critical item is mandatory. The good side is that once two transmitters are in use, there is no need to carry a spare in the future. Any existing transmitter can have its output split to temporarily serve for a failed unit.

4) Receivers are available in a wide variety, from a simple "receive-only" housing connected to the input of a standard trunk amplifier to the very complex "hub" devices that incorporate receivers, return transmitters and multiple high-level RF outputs. The choice is more one of application and system design than in actual hardware design, but a few basic points should be considered:

- Will the link be backed up by a second fiber or an RF trunk? If so, then this provision (or better, provision for both features) should be incorporated.
- Is the current RF trunk bidirectional, or will it ever have to be? The best answer to this question is always "yes," and provision for an immediate or future return laser in the receiver should be provided.
- If only a few receive nodes are to be installed, then the system itself should be altered as little as possible and as few specialized pieces of equipment employed. In lightly fibered systems, distinct stand-alone optical packages coupled to the input of conventional amplifiers would be the best initial implementation.

Bearing the previous ideas in mind, we can now proceed to a basic fiber implementation. As an example, we will look at three implementations of fiber as described before, with a materials requirement review, operational guide and system before/after performance summary.

Implementing a fiber trunk

In this example, we will assume that we have an existing conventional trunk of 450 MHz capacity, employing 32 push-pull amplifiers spaced at 21 dB, and using 18 km (11 miles) of 0.750 PIII-type cable. This trunk, properly aligned and maintained could deliver an end performance of 48 dB C/N and 57 dB CTB. It would not be possible to upgrade this trunk to 77-channel 550 MHz operation with any useable performance.

The distance covered is 18 km (11 miles) and would result in a fiber-only loss of 8 dB, which includes a 10% allowance for splice loss and loops. A single 10 mW laser would easily feed two runs of this length, delivering 77 channels (550 MHz) at -67 dB CTB. This is a unique case, in that we would be able to operate a fiber link and keep the existing trunk as a backup. (Again, see Figure 4 on page 40.) The minimum equipment and hardware requirement to replace this trunk would be a DFB laser transmitter, fiber and receiver.

If this is the only link to be installed, a transmitter of 6 mW power would suffice. At 6 mW (+7.8 dBm), the link would deliver -51 dB C/N. If the trunk is not to be maintained as a backup, then two such lasers would be required if redundancy is desired. Transmitters of 10-12 mW would allow splitting to feed two similar links in different directions for a relatively small price increment.

The fiber-optic cable should be selected to provide at least four fibers to the receive location, and while we are at it, four extra fibers passing any lo-

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Transmit power, coupler ratios

Optical coupler ratios (typical)		Transmit power
Divide %	dB loss	2 mW = 3 dBm
50%/50%	4 dB/4 dB	4 mW = 6 dBm
60%/40%	3 dB/5 dB	6 mW = 7.8 dBm
70%/30%	2 dB/6 dB	8 mW = 9 dBm
80%/20%	1.5 dB/8 dB	10 mW = 10 dBm
90%/10%	1 dB/10.5 dB	12 mW = 10 dBm

cation along the route that can be foreseen as a future receive node. (As long as we are constructing, a few more fibers will not add much to the total.)

When routing the fiber, we should remember that no routine access will be required and the fiber should deliberately be placed out of high traffic areas. Most importantly, if the fiber is to operate with a second fiber or an RF trunk as a backup, then the fiber must take a distinctly different route to reach the end. We cannot expect a trunk or fiber to back up a second fiber if both are lashed to the same strand. Figure 4 (page 40) shows how this link could be implemented.

Implementing a fiber backbone

In this example, we will again assume that we have an existing conventional trunk of 450 MHz capacity, employing 32 push-pull amplifiers spaced at 21 dB, and using 18 km (11 miles) of 0.750 PIII-type cable. In this case, however, bridger amplifiers are feeding subscribers along the length of the trunk. When upgrading to 550 MHz, the existing feeder will have to remain in place and be upgraded.

The first method would be to drop a fiber node at strategic points along the trunk and feed in the forward direction only to reduce the trunk cascades. In this case, we could maintain the trunk as an RF backup at each node, and backup lasers would not be required. When the new shorter trunks are rebuilt to 550 MHz, they would be 9-10 amplifiers in cascade and would require amplifier respacing. When operating in backup mode (such as when a laser has failed) the performance at the line end would be poor because the cascade would be longer than acceptable, but useable.

A more intense implementation of fiber that includes backup fiber would allow the existing trunk to be rebuilt without respacing, and feed only about four amplifiers in all directions. (See Figure 5 on page 42.)

Equipment requirements

Both cases described before would be the first implementation of fiber in the system, and as such, care should be taken to not overcomplicate the process while still keeping future options open.

The receiver in these cases should be a simple stand-alone package with provision for a return laser transmitter and either/both RF or second fiber backup. This type of receiver allows the optical portion of the system to be separated from the conventional CATV amplifiers. At least one spare receiver package is mandatory. The receiver should be purchased with mating connectorized pigtails to assure compatibility.

Fiber cable will be one of two distinct types: metallized or dielectric. Metallized cable provides protection from some forms of damage (including small animals) but this cable is conductive and requires grounding and bonding as would any aluminum coax. Dielectric cable is nonconductive and can safely be installed along rural transmission lines where metal would be impossible.

The fiber cable should be spliced and terminated in special enclosures and not inside the electronic equipment. Therefore, several "FOSE" (fiber-optic splice enclosures) will be required — one at every splice point and one at each electronics point.

Other hardware will include couplers and splitters. Depending on the number of fibers, couplers and lasers to be employed, a headend fiber management system should be considered. This is a racking system that provides space to store and mount slack fiber, couplers and connectors. It is not mandatory if a simple trunk replacement system is all that is being installed, but in any case, the fiber equipment should occupy a separate distinct area in the headend.

Couplers and splitters should be connectorized, preferably with the same connector type as on the laser transmitter.

The provision for sparing should impact on the initial laser purchasing decision. It is important to be able to split one of the lasers to spare a failed unit. As part of the initial equipment purchase, a spare connectorized two-port splitter should be stocked for this purpose.

All of these requirements are summarized in Figure 6 on page 42.

Designing a laser coupling network

The only major design calculation involved is the laser coupling ratios. In order to best employ the fairly expensive laser, we must develop an efficient method of distributing the optical power to both deliver the minimum level to each node and to not overdrive any receiver. Most AM optical receivers do not accept input power above +2 dBm because this can saturate the receive diode. Rather than send unwanted power into a fiber, which may then require an expensive optical attenuator, we will consider both the minimum and maximum power into each fiber as part of the laser coupling. Lasers are specified in milliwatts of output power and couplers are (for some unknown reason) specified in percentages. The accompanying table converts both these items into decibels for easier use. The couplers outlined are typical of what is available, although the actual coupling ratios and losses from various manufacturers may vary.

When designing the coupling network, we begin with a block diagram as in Figure 7 on page 44. Starting with the site name, we then calculate back to determine what drive would be required into the fiber for the desired performance. In the example of Site 1, we see that the path distance is 12 km (7.5 miles). At 0.4 dB/km or 0.65 dB/mile, the path is 4.8 dB long. If our design calls for -4 dBm at the receiver for 48 dB C/N, then this fiber requires a drive of +0.8 dBm minimum.

Bearing in mind the cost of laser power and the possibility of overload, we would not want to put much more than +2 dBm into this fiber. Once we have determined the drive level for each fiber, it is a matter of choosing the most appropriate coupler values that will serve as many fibers as possible from one transmitter. Each of these cases will be different, and Figure 7 (page 44) shows two possible configurations.

Even if the initial design does not require the full power of the laser, coupling should be installed to deliver only what is required, saving the extra laser power for future use. Extra unneeded power into a fiber is simply wasted.

The major point of this exercise is to be aware that fiber, while being the technology of all major system builds, is equally viable in small systems, and is no longer the fearsome unknown that it once was. **CT**

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Reader Service Number 127

Fiber's role in "niche" and narrowcasted services

By Mike Shafer
Director of Product Management
Broadband Transmission Products, Antec
And Joe Parola
Product Manager
Digital Video (a division of Antec)

More than 80% of the fiber-optic cable presently being installed in the cable network is to position it for future services. Many operators are establishing the architecture to size service areas to 500 homes, but the optoelectronic portion of the plant is rarely installed to take advantage of this node sizing. Lasers are being optically split an average of 2.8 times at the headend to serve multiple nodes. This type of optoelectronic installation is adequate for today's analog services, but what does this mean to the cable operator seeking to provide node-targeted services, such as near-video-on-demand (NVOD) or localized advertising insertion? What happens when the industry begins offering digital services requiring more bandwidth?

A look at narrowcasting

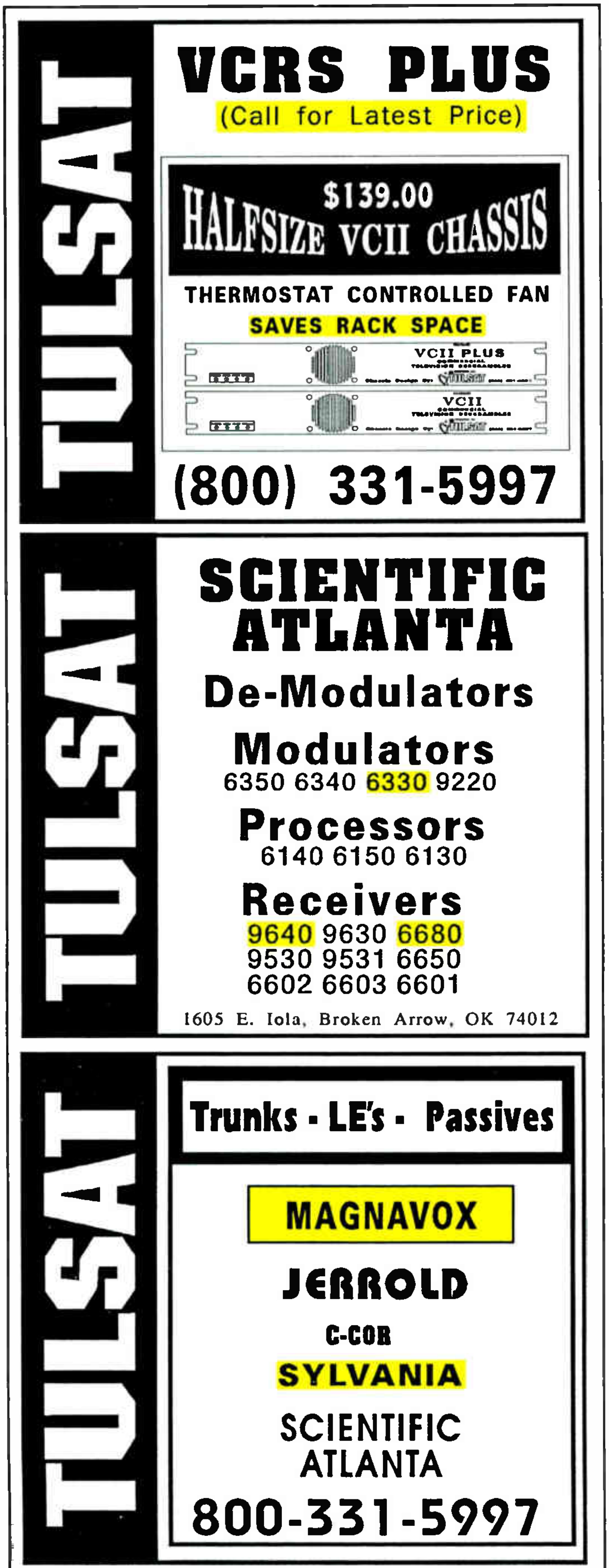
Targeting a service to a particular demographic group requires the ability to narrowcast that service to a given node. While many may consider such capabilities as far-flung and futuristic, installing advanced technologies can help cable operators use their hybrid fiber/coaxial (HFC) cable architecture to build new unregulated revenues. With lasers available in bandwidths to 750 MHz today, operators can elect to use this spectrum to their advantage.

Take NVOD as the first example. Today's pay-per-view (PPV) provides the cable industry with $175 million in annual business, but it still commands less than 4% of the video rental marketplace. Part of the problem with PPV is that it offers few choices and is not always convenient. For these reasons and others, only 20% of the current 22 million PPV-equipped subscribers have even tried it and just 6% of those users access PPV on a regular basis.

"To meet and beat potential competition, low-powered optical lasers that serve a single receiver clearly represent a critical advantage in future positioning."

NVOD

NVOD takes PPV a step further, providing greater selection and convenience to the consumer since it relies on the narrowcasting capabilities of the broadband network to deliver services. Using today's NVOD file server technologies and a single laser/single receiver configuration, movies are no longer subject to specific times or specific channels as with today's PPV. NVOD file server technologies allows users served from each specific node to individually request a given movie title — while viewers in another node watch the same movie just one minute (or even a few seconds) later. Since demand in each individual node can differ, cable systems



have the means to respond quickly to changing demand patterns based on buy rates of each individual node.

To illustrate, a cable system may elect to offer 10 channels of NVOD service throughout its system. On the node level, this means only the number of consumers in each given node would be contending for those same 10 NVOD channels. This gives the consumer the chance to watch the same movie that might already be playing on another channel in his/her own node. This capability gives consumers greater choice and time convenience over today's existing PPV and could drive up unregulated revenues for the cable system.

In the future, this same scenario applies to more robust and digitally based video-on-demand (VOD) applications. In this case, the 10 channels of analog NVOD movies would be segmented. One (or more, depending on digital converter penetration based on node size) could be dedicated to MPEG-2-compatible converter users — providing six or eight movies within a single channel given the final MPEG-2 compression ratio. The other nine channels would remain in analog form for those using existing analog set-tops.

Segmentation between analog and digital users could occur naturally based on the needs of an individual node. In some nodes, analog may remain prevalent. In others, digital may be supreme. This capability allows for graceful migration to a digitally based network, whether on node-by-node or systemwide basis.

The single laser/single receiver scenario means just 500 homes are contending for the allocated VOD bandwidth. Since more consumers will have the opportunity to watch what they want, when they want it, more viewers will be willing to spend money to select programs of their choice.

Targeted advertising insertion

Targeted advertising insertion represents another near-term application that takes advantage of a network with an ability to narrowcast. Using the same type of digital technologies and distributed file server architecture of the NVOD scenario, cable operators can begin specifically targeting a given TV commercial to an individual demographic group — using the HFC infrastructure that's positioned to provide node-targeted services.

For instance, upper income areas are generally clustered together and could be targeted with commercials for luxury automobiles. Middle-income families — again generally clustered — could be targeted for minivan spots. Digital technologies available today mean that even if both groups are watching the same cable program, they can receive different commercials.

Digital addressable commercial insertion (ACI) systems can store, retrieve and insert one of thousands of individual commercials on a particular cable channel at a particular time. Certain nodes, for example, could receive customized advertisements. Again, the ability to narrowcast to a given node is required to make true targeted advertising a potential income generator for the cable operator.

Other digital services

With the advent of cable modems and new market opportunities in digital services, upstream bandwidth will become a critical concern for the future infrastructure.

A single digital service is expected to use 3 megabits of bandwidth (0.6 MHz). If a network operator plans to deploy 750 MHz lasers with 550 MHz for today's analog video and

200 MHz reserved for digital services, a current laser split an average of 2.8 times means approximately 1,400 homes will contend for the same 200 MHz of digital bandwidth. If we assume a 60% penetration rate among those 1,400 homes, 840 households are current cable TV customers. Among that group, this means more than 500 homes will run into a "busy" signal when trying to access one of the 333 digital "channels" (assuming everyone wants to access services simultaneously).

To help reduce these potential contention problems and to position the network to provide the narrowcasted services mentioned before, a low-powered (3 to 4 milliwatt) laser transmitter designed to deliver dedicated services to a single 400- to 600-home node was recently introduced.

For NVOD, only those subscribers in a given node would contend for one of the available NVOD channels. Advertisers could target an advertisement to an area as small as 500 homes. For digital services, every one of the 300 subscriber households (60% penetration rate in the 500-home node) could access a 3 Mb/s digital "channel" at the same time — without the contention problems associated with today's "split" laser environment.

Deploying low-powered lasers does present a premium today. However, in the long-term, today's deployment could save cable operators more than 20% over the long-term capital cost of network deployment to narrowcast services.

Consider this scenario.

In a 100-node system with current lasers split an average of 2.8 times, 36 lasers are required to deliver today's entertainment video services. At an estimated cost of $9,500 per laser, capital costs are $342,000.

To implement the low-powered laser, 100 lasers would be needed to serve each node. At a cost of $7,000 each, capital costs are $700,000 — a premium of $358,000 over today's laser deployment.

Yet, when demand for new digital services builds — or when operators are looking toward NVOD and targeted advertising as new services offerings, operators that are ready to implement a one laser/one receiver platform for each 500-home node means the currently installed 36 lasers will need to be retrofitted with attenuators to bring their launch power down. The additional 64 low-powered lasers needed to serve remaining nodes would entail an additional $448,000 in capital costs, for a total of $790,000 — $90,000 over deploying the low-powered lasers today.

Broadband operators have a number of near-term applications that make establishing the 500-home node, served by a single laser and single receiver, attractive. NVOD gives operators the chance to radically improve current PPV revenues, and targeted advertising means cable operators can begin building completely new — and unregulated — revenue streams. As cable modems enter the market and network operators begin offering digital services, the need for improved upstream bandwidth will become more critical.

Those seeking to position their networks for these types of services must consider taking a much closer look at their components. While bandwidth contention isn't a serious problem today, the network that provides the best mix of services will clearly be tomorrow's provider of choice. To meet and beat potential competition, low-powered optical lasers that serve a single receiver clearly represent a critical advantage in future positioning. In the end, broadband operators positioned in this way will be able to take advantage of any number of narrowcasted and other niche services. **CT**

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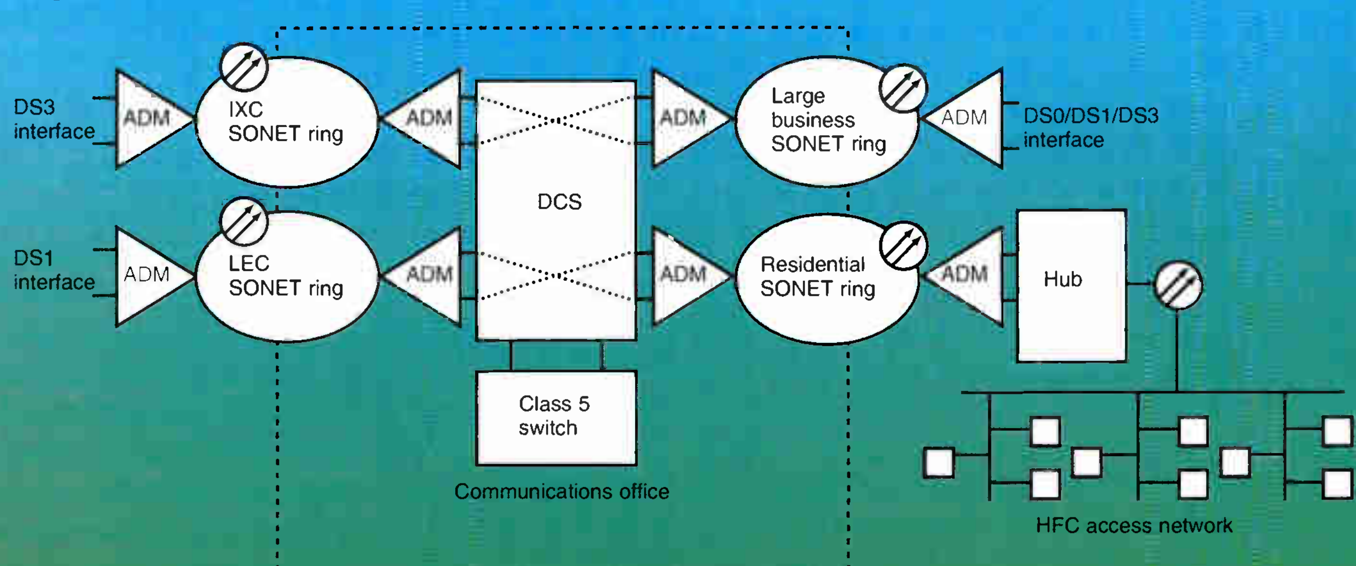
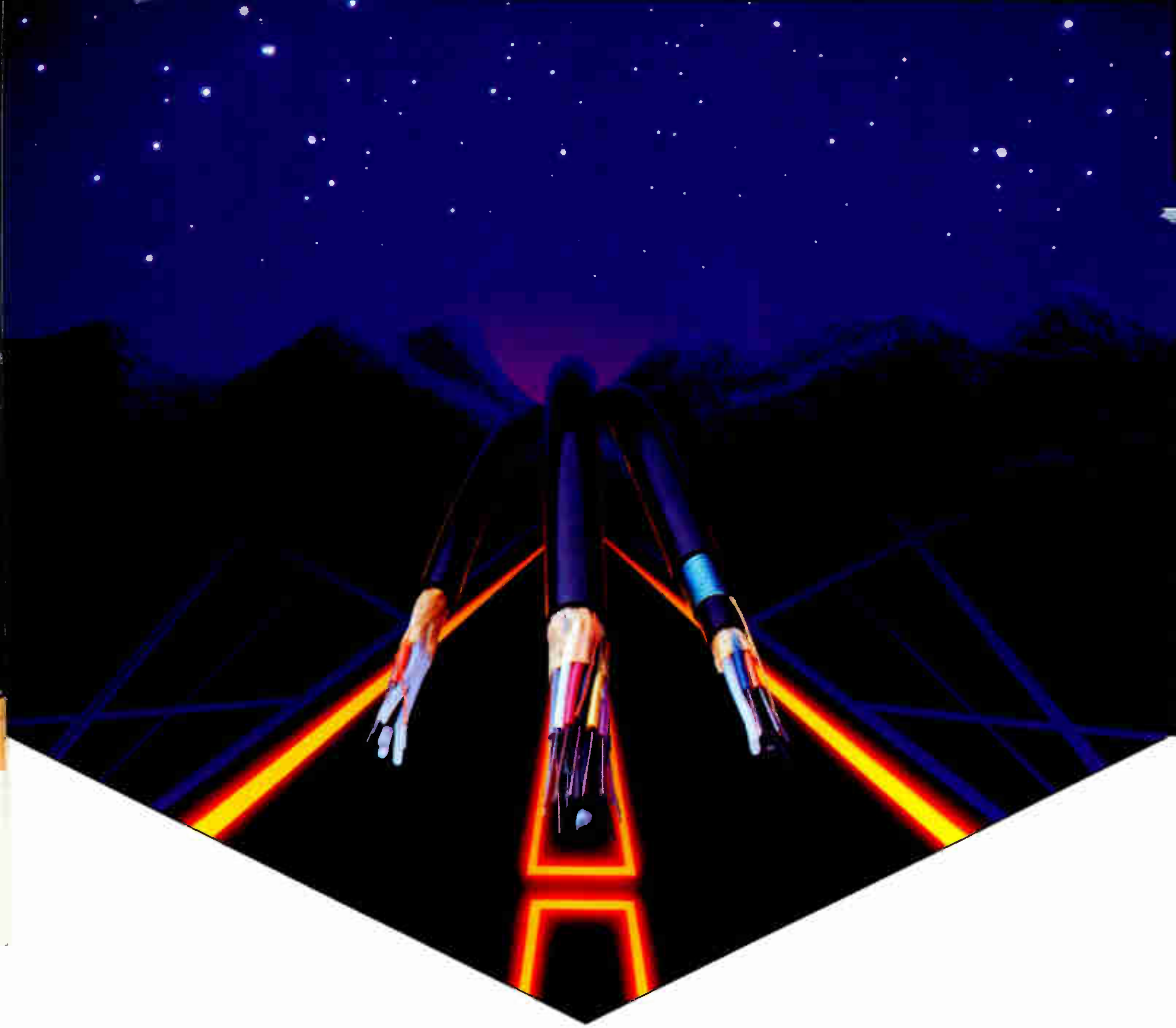
Telephony service integrity in the convergence industry

By Steve Pearse
Senior Vice President, Engineering/Operations/MIS
And Chris Barnhouse
Vice President, Technology
Time Warner Cable

As the cable TV industry prepares to roll out competitive local telephone services based on state-of-the-art broadband networks, assurances that the new services will be of the highest quality are essential. In traditional local exchange carrier (LEC) copper wireline networks, service in-

Figure 1: Telephony network architecture





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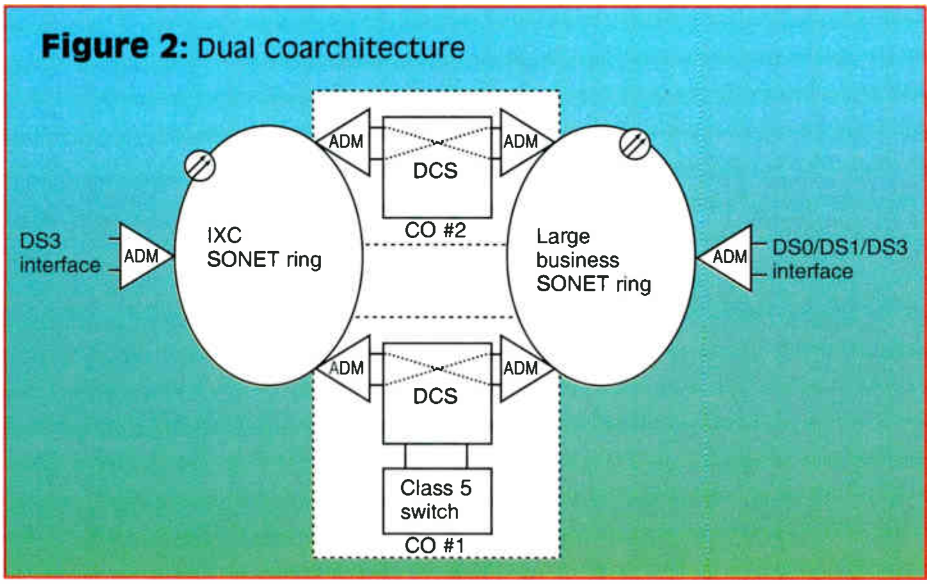


tegrity issues and mechanisms to ensure reliability are well-defined. The implementation of voice telephony services on two-way broadband cable networks, however, requires a fresh look at network performance and reliability. While the end goal of "lifeline" service remains the same, a whole new set of modeling, measuring and operations tools will be required.

The general network

Figure 1 (page 54) depicts a typical integrated entertainment/telephony network. The hub of the network is the communications office (CO), which combines the functions of the LEC central office with the cable TV headend. Connectivity to interexchange carriers (IXCs), LECs and large business customers is provided by synchronous optical network (SONET) rings that utilize dedicated fiber routed directly from the CO to the IXC, LEC or end customer. Connectivity to residential customers uses a similar SONET ring from the CO to a distribution hub, where telephony signals are integrated into the same hybrid fiber/coax (HFC) network that delivers entertainment services to residential customers. In the following discussion, we'll look at each major network component in more detail and review associated reliability and integrity issues.

The CO provides the central connection point in the network. For special access services (high-capacity point-to-point digital circuits that connect IXCs directly to their business customers), traffic is collected on SONET rings that provide direct access to end customer locations, which is then delivered to the CO for cross-connection to the SONET rings that serve the IXC points of presence (POPs). For switched voice services, traffic is similarly collected and delivered to the communications office from the business customer and residential SONET rings. The CO also terminates SONET rings that deliver traffic to the LEC offices, to allow hand-off of local switched traffic between the LEC and the competitive carrier.

Service protection for the traffic from CO to the end customer, IXC and LEC locations is straightforward, due to the use of self-healing SONET capabilities. In the case of fiber cuts, or even the loss of an entire end location on the SONET ring, the SONET ring self-heals within 50 milliseconds, providing virtually error-free service protection.

CO failures

Protection against failures in the CO itself presents a more complex problem. For special access services, incoming traffic from end customers is terminated and cross-connected by the digital cross-connect system (DCS), which becomes a potential single point of failure in the network. One option to protect against loss of the DCS, or the entire CO, is to route all traffic through a second CO, which is equipped with redundant SONET add/drop multiplexers (ADMs), as well as a redundant DCS. Figure 2 depicts this approach.

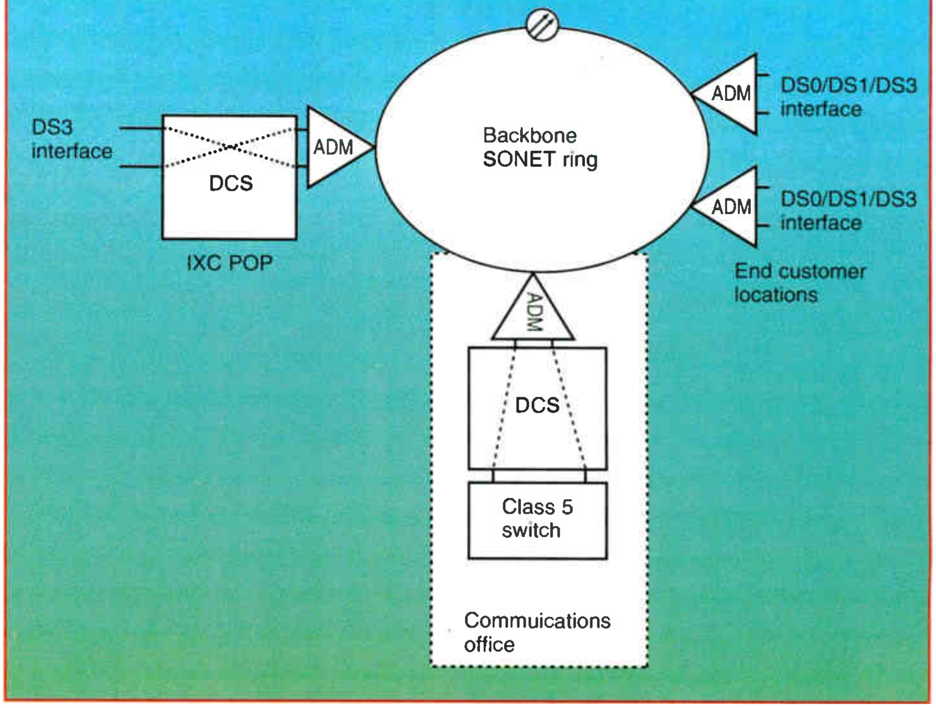
In the case of a DCS failure or loss of the CO, traffic is restored using an alternate path through the second CO. Another alternative is to move the DCS from the CO to the IXC location, as depicted in Figure 3. In this scenario, the SONET self-healing rings provide traffic continuity between the end customer and the IXC even if the CO suffers a catastrophic failure. A second DCS installed in the CO is used only when test and diagnostic access is required.

Class 5 switch failures

Protection against loss of the Class 5 switch requires a different strategy. Equipping the network with redundant Class 5 switching offices is neither economical nor practical. Switch disaster recovery is instead based on a strategy of rapid replacement. Major switch vendors offer the capability to maintain a containerized replacement switch that can be delivered and activated within a matter of hours to replace a failed or destroyed office. Customers with critical traffic requirements also have the option of obtaining redundant connections to the diverse switching offices operated by the LEC and the competitive carrier.

The issues and methods discussed in the prior paragraphs are well-understood within the telecommunications industry. SONET ring technology has been deployed in working applications for several years and has been the subject of a great deal of analysis and testing. Disaster recovery methods to protect against CO failures have evolved over time, and have proved effective in recent disasters including the World Trade Center bombing, the 1993 Midwest floods and Hurricane Andrew.

Figure 3: Distributed DCS architecture



HFC access network

Reliability and integrity considerations for telephony applications on broadband HFC plant are not as well-defined. The lations regarding power transmission in the coaxial plant also will require analysis and possible revision as plant powering architectures are implemented.

Several aspects of HFC plant component reliability require careful consideration. The reduction of amplifier cascades in HFC plant upgrades is critical. In conventional tree-and-branch coax networks, cascades of 30 or more amplifiers are not uncommon, resulting in maintenance difficulties and high failure rates that are not acceptable for the support of telephony services. In Time Warner's upgraded HFC plant, a count of five or less amplifiers in cascade is typical. New amplifier and tap designs that reduce the component counts and simplify maintenance requirements for these devices also result in far fewer failures and less downtime than devices in the current networks.

Protection against radio frequency ingress also is required in two-way plant. Return signals from TV sets, VCRs, two-way radios, appliances and other devices have the potential to interfere with telephony return signals. Plant improvements, including installation of high-pass filters at problem residences and general leakage improvement measures help prevent stray signals from entering the plant. Frequency-agile modems and robust modulation techniques help the telephony NIU and HDT overcome ingress when it does occur.

The optical transmitters and receivers at the hub and fiber node locations are particularly critical, since service to all 500 homes on each node depend on these devices. Data collected from Time Warner Cable systems that have been upgraded suggests that catastrophic laser failures have been extremely rare. One factor in the apparent high reliability of these devices is the sorting process that manufacturers go through to obtain devices that provide linear broadband operation. Use of redundant lasers has been the subject of some discussion in the industry, but field performance statistics to justify the need for this investment are not yet available. One prudent approach is to utilize nonredundant optics during initial service deployment, when telephony penetration rates are low, and then carefully collect and monitor statistics on field performance of the optical components.

Performance monitoring techniques that utilize intelligence embedded in the network elements, computerized operations support systems (OSSs) and a set of streamlined operations processes provide an additional array of tools to contribute to robust and reliable services. Real-time continuous monitoring of lasers and power supplies can be used together with OSS-based expert system techniques to detect degradation and rapidly isolate failures. NIUs will include embedded bit error rate (BER) monitoring. This ability to continuously monitor performance directly at the customer demarcation exceeds capabilities of the current wireline network. Conventional telephony service models have been based on a paradigm that assumes an unanticipated failure of a nonintelligent device followed by a lengthy sectionalization, dispatch and repair process. A new paradigm is developing that assumes detection of potential degradation conditions before they create service affecting faults, followed by a rapid sectionalization and repair process supported by the OSS, reducing or eliminating customer service impact.

"In traditional LEC copper wireline networks, service integrity issues and mechanisms to ensure reliability are well-defined. The implementation of voice telephony services on two-way broadband cable networks, however, requires a fresh look."

Conclusion

As the cable TV and telecommunications industries go through a fundamental restructuring that drive together what were once separate and discrete businesses, it is essential that we maintain a focus on service quality standards, and use the full array of tools at our disposal to ensure the integrity of our networks. The opening of competitive markets for telephony and other two-way interactive services creates significant opportunities for operators in this "convergence" industry, and it also brings with it an obligation to ensure that these new services are of the highest possible quality. The adoption of this quality focus as a basic business strategy ensures that customers and service providers alike stand to benefit from the continuing evolution of the Full Service Network. **CT**

pect that savvy marketers might leverage this issue in their promotional efforts.

For the reasons mentioned, the MSOs announcing their cable telephony plans have all indicated that they intend to employ network powering of the CIUs. The question then is whether to utilize existing coaxial drops or to replace them with composite drop cables.

"By incorporating flexibility in their networks ... operators can place themselves in the best position to take advantage of new developments."

Existing drop powering considerations

One might assume that the preferred approach would be to utilize the existing drops. These cables represent a significant investment that operators do not wish to replace. In addition, this is the most customer-friendly approach because it does not require retrenching of yards to replace underground service or lengthy service disruptions related to drop replacement. However, this approach carries with it a number of concerns as well.

A primary concern is related to the increased effects of corrosion on the cable and connectors resulting from carrying low-level currents. In a manner similar to a common battery, corrosion occurs when two dissimilar metals are electrically in contact in the presence of a liquid solution, such as water. In the past, corrosion was of less concern because the only currents flowing in the drops were of extremely high frequency RF or random, low-level "sheath currents" related to unbalances in the electric utility power system. However, with the addition of load currents on the drop cable for powering CIUs, the effects of corrosion are increased. While a thorough study has been conducted regarding this issue (see the reference listed at the end of this article), additional testing and empirical data is required to more clearly assess the performance and maintenance impacts of this potential problem.

In addition to the corrosion-related risks, there also may be regulation concerns associated with passing power over the coaxial drop cable. While these services appear to be compliant with "National Electric Code — Class 3 Circuits," operators should research local codes to ensure that they do not violate access and burial depth regulations.

There also is concern that usage of the existing drops may not be sufficient for advanced services applications. Specifically, digital services such as telephony are more affected by signal ingress and attenuation. Semirigid cable, such as RG-7, may be the preferred medium because of its inherent high isolation and low-loss attributes. Little cable of this type is currently installed.

Further complicating this approach is the tap requirement. Because of the expected penetration rates of 25% to 30%, it is conceivable that a portion of the customers sharing a tap will have CIUs and a portion will not. Taps that can selectively provide power to individual drops are required. Another alternative would be to provide individual taps — a very costly option.

In short, while powering over the existing coax drop would at first glance seem to be the most cost-effective and customer-friendly approach, the considerations associated with it are numerous and are not yet fully understood.

Composite drop powering considerations

With these concerns in mind, many MSOs are planning to power CIUs over separate twisted-pair wires encased with the coax in a composite cable. However, there is a cost premium associated with this approach resulting from several issues. First, existing drops must be replaced or, at a minimum, twisted pairs must be installed parallel to the coax. Installation of the cable drop averages $25 (and may be more for terminating the additional twisted-pair). Given the previous discussion regarding the need for drop change-out to deliver the advanced digital services, this cost may not be confined to this alternative. Second, the cost of the composite cable itself entails an additional expense. It currently carries a 80% to 90% price premium over a standard drop. As volumes increase, it is expected that this price differential will be measurably reduced.

Because of the expense associated with this alternative, most MSOs intend to install these drops on an "as-needed" basis. Only those existing customers requesting telephony services will be provided with the composites drops cables. Additionally, most operators are considering installing the composite cable to their new connects.

While this approach is not immune to corrosion, its effects are minimized. Corrosion of the twisted-pair or any of its connectors obviously does not degrade the RF performance because it is carried on the coax only. In addition, the solid conductors of the twisted-pair cables are inherently less likely to corrode than the braided coaxial cable.

The taps required to deliver this service are inherently less complex than the "over-the-drop" powering type. While sharing many of the features previously described, these taps are able to selectively power without difficulty. Twisted-pair connections are provided for each drop and are used as customer demand warrants. RF service is not impacted. In summary, this is most likely a more expensive approach, but one that has less associated risk.

Conclusion

As MSOs develop their telephony strategies and tactics, cost is just one of many important factors. Equally, or even more important, is the need to provide a product that is perceived as similar to or better than the existing service with reliability that is second to none.

As operators weigh the various options surrounding issues such as powering of CIUs, they move into areas for which there is little current experience. Working with equipment suppliers, many of these questions are being addressed, but it will take some time before all can be resolved. By incorporating flexibility in their networks, such as using taps that are upgradeable to the various network powering approaches, operators can place themselves in the best position to take advantage of new developments.

The good news is that while there is much to consider, the rewards associated with cable telephony are great. **CT**

Reference

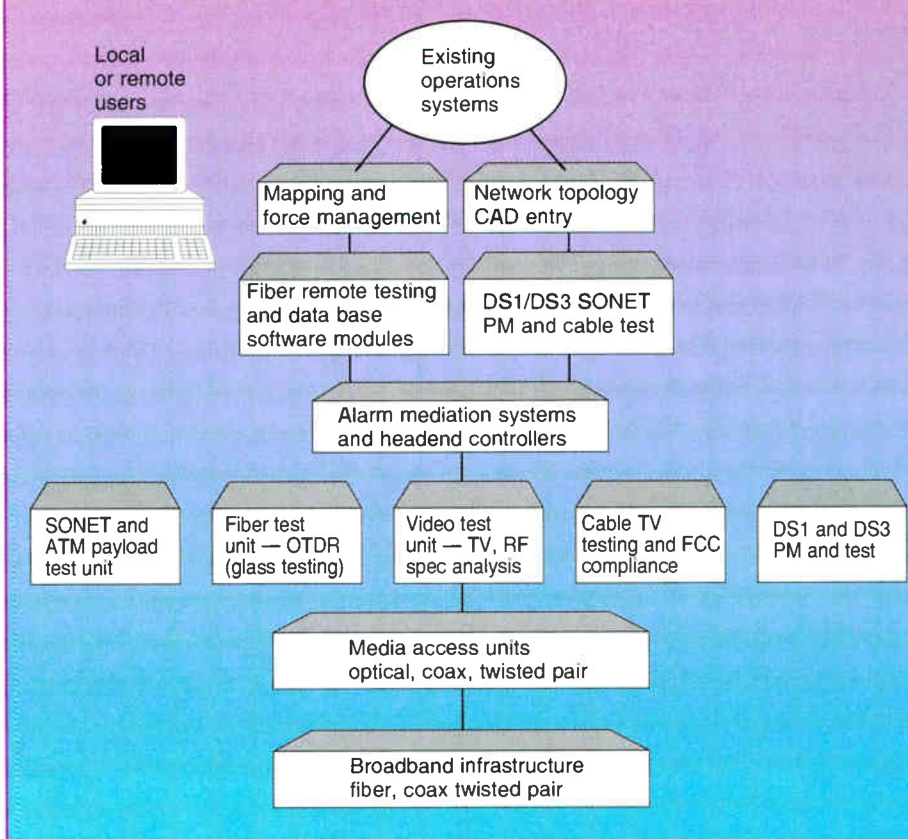
"Hidden Influences on Drop Reliability: Effects of Low-Level Currents on F-Interface Corrosion and Performance," Brian Bauer, Raychem Corp., *1992 NCTA Technical Papers.*

The author would like to thank Bart Spriester, senior electrical engineer, Scientific-Atlanta, for his technical input and assistance.

Prepare for broadband network service assurance

By Jeffrey L. Korkowski
Senior Market Manager
ADC Telecommunications Inc.

Figure 1: Broadband maintenance architecture



Good news! Over the next several years, you will be building an enormous, multifunctional network supporting thousands of customers who will be depending on you to transport millions of dollars in voice, data and video communications. The bad news is that over the next several years, you will be building an enormous, multifunctional network supporting thousands of customers who will be depending on you to transport millions of dollars in voice, data and video communication. Are you ready to support that network?

If not, you aren't alone. In fact, you'd be alone if you were prepared. Not only are the support requirements for tomorrow's networks not fully defined (as yet) but the same can be said — to some extent — of the network itself. We know it will be inclusive, carrying anything from a phone call or a fax to a first-run movie, a data file or an order for next fall's wardrobe. We know that signal density — up to 224 DS0s per 6 MHz channel and 400, 3 megabit digital broadcast channels — will greatly exceed that of today's networks. We know that it will function in a far more competitive environment than any of us has ever experienced.

In short, the network will be bigger, faster and more complex. Customers will shop aggressively for price and service, which means that the successful network provider will be one whose investment is returning every available dollar. Keeping a network fully productive will require a higher level of testing, surveillance and system management than ever before.

Emerging support systems

Fortunately, as network capabilities develop, so do plans for comprehensive management systems. There are already some very powerful service assurance tools available and more are on the way. The speed of fundamental network change is allowing system providers to develop support products that will be fully integrated into the new networks. These will offer users unprecedented insight (in the literal sense of the word) and control.

Your search for support systems should start as soon as you begin your network planning. Look for many of the same attributes in management tools as in the network itself. For starters, expect your future support systems to be comprehensive, integrated and intelligent.

Comprehensive support

We all accept the fact that convergence of services will force networks to unify, ultimately carrying a range of signals, from multimegabit data transmission to a call to grandma. If you don't separate your signals, why separate your support facilities?

"Comprehensive" can be interpreted in several ways. First, it means end-to-end. Ideally, just as a signal can travel unhindered along the length of your network, there will be no discernible break in support for the cable, fiber or SONET components of your network. You will be able to manage every aspect of the system from a central location.

Second, support will include both physical plant and the signals themselves. This is important when you are building an infrastructure that will have to support a variety of signal formats and protocols. It is even more important when you can't be sure what some of those protocols will be, even a few years from now.

Finally, the distinction between troubleshooting and prevention will blur or disappear entirely. Comprehensive man-

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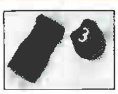

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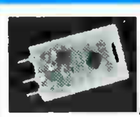

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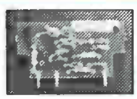

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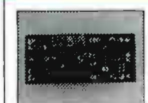

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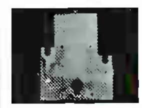

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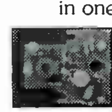

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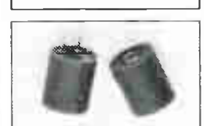

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"The distinction between troubleshooting and prevention will blur or disappear entirely."

agement will include anything from disaster recovery to service enhancement. And, with the proper tools you should quickly be able to shift your emphasis from reactive to proactive operations.

Integrated support

Figure 1 on page 66 shows a broadband maintenance architecture. Management systems for broadband network service assurance will be comprehensive, integrated and intelligent, as well as more cost-effective than traditional test methods. The result for network providers will be improved service to customers. Traditionally, support systems have been separate from the network. Testing devices are carried from place to place and physically connected when and where they are needed. Data that concerns network operation is typically transferred off the network onto management systems. As support systems become more sophisticated and their operations become more critical, these "externalizations" will no longer be either necessary or desirable.

The amount of performance data being transferred to network management systems has skyrocketed, and will only continue to grow as more traffic (of every kind) crowds expanding networks. Data flow from the network will be continuous and the consequences of its loss or delay will be severe. To be effective, the performance management data system will have to literally become part of the network.

The same is true of test equipment. It is no longer necessary for many types of equipment to be carried to a trouble spot and attached to the system to perform diagnoses. Today's high-end, stand-alone optical time domain reflectometers (OTDRs) are being replaced by fiber test units (FTUs), a more cost-effective OTDR that can be built into the network, usually at the fiber distribution frame. Cascading 1:N optical switches allow a single FTU to be connected to any one of thousands of fibers. A remotely located technician accessing an FTU and switch can quickly and easily test any of the attached fibers. By accessing a number of switched FTUs, the technician can test the entire network.

Fast, affordable access not only speeds testing, but can change the entire approach to system maintenance. Instead of fault location and identification, technicians can focus on fault anticipation. Scheduled, systemwide testing can be implemented to look for the signal degradation that often precedes breakdowns. Problems can be spotted and headed off before they impact service. Customers are spared the interruption and the company avoids the loss of revenue. By investing in cost-effective equipment, rather than expensive, nonproductive technician travel, the cost of providing the improved service can be less than that incurred using traditional test methods.

Growing intelligence

At one time, networks were purely passive, simply responding to human input. Today, we take for granted the intelligence of system software, both centralized and in many remote network elements. In the near future, however, we'll start seeing a hierarchy of intelligence throughout the system. Onboard processor chips will allow traditionally passive components to make decisions, or to refer unusual events to "higher authorities" for action.

Intelligent splitters, combiners or connectors may monitor signal strengths, adjusting levels in response to attenuation. They may check for errors and send alarms or even act autonomously to reroute traffic on the spot. Suspect transmissions may be rerouted to shared testing resources for in-depth analysis. Of course, any intelligent component will be addressable through the network, allowing it to carry out orders from higher-level systems within the network, or those of technicians. As the cost of processing power drops and the value of lost time increases, the benefits of local intelligence within the network are obvious.

Start with a data base

If you've never done it, you might think it's difficult to misplace a fiber or cable run. It isn't. In fact, they can be as evasive as your car keys or that other blue sock. But before you go looking behind the dryer, think seriously about a relational data base.

A system data base will catalog every foot of fiber, every splice and component, every access point and the landmarks you need to find them after you park the truck. (The truck keys are still your problem.) A data base also should

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> **"A good, general rule of thumb is 'features that are not easy to use won't be used.' "**

some users may not be engineers.

A good, general rule of thumb is "features that are not easy to use won't be used." That's a painful realization if it comes only after you've paid for a system. You can avoid it by looking for modern conveniences like a graphical user interface (GUI). For software features that aren't used regularly (or that may be used differently every day) step-by-step prompts can make any procedure go faster. While a smart technician could certainly figure out an unfamiliar procedure, why waste the tech's valuable time, particularly when he or she is trying to troubleshoot your multimillion dollar network. After all, every saved minute of a technician's time also may be saving time for a repair crew and a few hundred (or thousand) of your customers.

Another way in which systems can free up technician time is by assuming some of the simpler, more repetitive tasks. For example, if you create a schedule of pre-emptive testing, much of it can be done automatically by intelligent systems. These can be programmed to run a series of remote tests and notify a technician of questionable, or out-of-range readings. A remote fiber test and surveillance system as shown in Figure 2 (page 71) combines fiber-optic switching, test equipment and software to produce an open, flexible system that provides all of the necessary interfaces for alarm, surveillance and test operations.

Depending on the systems you have implemented, this can get very sophisticated. For example, you can have intelligent components in the field referring questionable occurrences to the central systems, which in turn can automatically perform more rigorous testing. This multitiered approach may catch intermittent problems that would escape the most expert technician until a hard failure occurred.

Broadband service assurance

There are plenty of open questions regarding the future of broadband networks, but a few things are certain:

1) Networks will keep growing and becoming more complex and crowded. A lost hour will cost you more revenue than in the past.

2) Network markets are becoming more competitive. Unreliable networks will find it increasingly difficult to keep customers, while reliable ones will capture those lost customers.

3) Unnecessary costs of operation reduce a network provider's expansion, marketing and pricing options. Consider operating cost along with construction cost.

4) Equipment is becoming less expensive; human resources aren't. Look carefully at ways in which a system investment can multiply personnel impact.

5) Compatibility problems seldom get better, but often get worse. Make compatibility a top priority.

6) Murphy's Law predicts that a falling body will find the hole in the safety net. Look for comprehensive solutions.

7) Busy people use the tools that are easiest to use and ignore the rest. Look for ease of use.

As you consider your network requirements, start planning your support systems. Not only will you be safeguarding critical revenue, but you may reduce operating costs at the same time. That's called "good news/good news." **CT**

Network management: Why it's important, how to implement it

By Guy Sucharczuk
Product Manager, Network Management Systems
Harmonic Lightwaves Inc.

"The perfect time to implement a new NMS is during a system upgrade."

Cable TV networks are emerging as the communications networks of tomorrow. Some CATV networks are now providing various forms of data, telephony and other information-related services. Many also are providing transactional-based programming such as pay-per-view (PPV) and near-video-on-demand (NVOD). In order for these services to be economically viable they require a reliable network. A bank that uses the CATV network to link automatic teller machines will not tolerate a network that is unavailable. Customers that do not receive their PPV events are lost sources of revenue and they may discontinue service.

CATV operators who wish to compete in the increasingly competitive communications marketplace by selling alternate access, telephone services, etc., must be able to demonstrate network reliability that is equal to or better than what is currently available. Also, as digital broadcast systems and telephone companies provide alternative programming, even CATV operators content to provide only video service will have to become more reliable to maintain their current market share. The key to ensuring network reliability is the implementation of an integrated network management system (NMS) for the transport layer.

One of the key strengths of telcos has been their ability to foster a sense of reliability in their network. Pacific Bell, Sprint, Nynex and AT&T have all promoted their NMSs in their advertising to demonstrate reliability. Their ability to pinpoint failures before they affect customers has gone a long way in providing telephone network operators with an excellent customer satisfaction rating.

In addition to network reliability, another compelling reason to implement a NMS is to reduce overall system costs. By knowing the location and type of outage that has occurred, the system operator can dispatch the proper personnel to the right location to deal with the problem immediately. This pinpointed action saves money and reduces outage time. In a network that has redundancy, the system operator has the option of scheduling the repair when it is most cost-effective.

Timing and technology are attractive reasons to implement a NMS today. The technologies of CATV networks have reached the point where NMSs are technologically and economically viable. Today's hybrid fiber/coax (HFC) networks are a much more NMS-friendly medium than the traditional coax CATV network. Fiber networks are immune to many of the problems that hampered status monitoring systems in the past. In addition, the implementation of two-way communication systems to provide interactive customer services provides the infrastructure that makes upgrading to a NMS very simple and economically attractive.

Along with the advances in fiber optics, computer systems have made great leaps in technology making them very cost-effective to implement while providing sophisticated, yet user-friendly, graphically based systems. In light of the many added demands on today's communications networks, by taking advantage of the advances made in CATV networks and optical equipment, as well as computer hardware and software, it is easy to justify the implementation of a NMS.

Implementing a system

While implementing a NMS is not necessarily difficult, it does require some preparation. The system operator must determine the NMS capabilities of his equipment, the level of integration he wants to achieve, and the requirements he wishes his NMS to fulfill. The perfect time to implement a new NMS is during a system upgrade.

The first step in the implementation process is for the system operator to determine the NMS capabilities of the equipment in his network. In order for a NMS to be truly effective, every signal affecting network parameters should be displayed to the user in an easy-to-interpret manner, allowing for immediate action when necessary. Unmonitored equipment and cryptic messages leave room for undetected network failures and unhappy customers. The more information displayed, the more effective the system becomes and the more satisfied customers will be.

In addition, adjustments to the equipment should be accessible from the NMS computer. This capability is the difference between status and performance monitoring and network management. The more integrated the NMS is in the equipment, the easier and more successful the implementation will be.

Another factor that must be looked at is how the NMS will support the network architecture. For example, can the system support remote monitoring if the network topology includes hubs where much of the equipment is not in the headend? With the adaptation of optical rings and hubs, the equipment chosen must provide compatibility with these and other unforeseen configurations. This is probably the hardest part of implementing an effective NMS.

The second step in the implementation process is to determine the desired level of integration into the network. What equipment does the operator want to monitor and at what level? The system operator must determine if he wants

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Reader Service Number 10

to monitor the headend equipment, the optical plant, the coaxial plant, systemwide or selectively. The operator should look at the parts of the system that affect the largest number of subscribers and tailor his NMS around that part of the network.

Usually the optical plant is where network management is the most critical and easiest to implement because it affects the largest number of customers, the amount of equipment to manage is reasonable and the technology exists to manage it effectively. The next most important segment is the coax plant, followed by the headend. In certain cases, the coax plant is becoming so passive it might be looked at selectively through end-of-line monitors or other means.

The third step is to determine the requirements the operator wishes his NMS to fulfill. Network management systems vary widely in capabilities and can range in cost from a few thousand dollars to a million or more, so the system operator must examine his requirements and pick the system that comes closest to meeting his needs. Regardless of the system chosen, it is the underlying network hardware that will ultimately determine the success of the implementation. If the required parameters and controls are not provided by the network equipment, the NMS cannot be effective. It is crucial that the operator consider the compatibility of the network equipment and the NMS before going ahead with an implementation.

There are certain key requirements that must be investigated in determining the appropriate system. The operator should look for a system that is graphically based. This allows for nontechnical personnel, such as a customer service representative, to monitor the system and only call in a technician if something goes wrong. The system should be extremely easy to set up and use and should support multiple users. The system should allow for remote connection through standard dialup telephone lines and should be flexible enough to grow with the system in a variety of architectures. If in the future the system operator decides to upgrade to an umbrella NMS to manage all aspects of the network — telephony, data, customer billing, addressable converters, etc. — the system should provide the necessary interface hooks.

Alarm and status logging are very important factors to consider in determining network failure trends and maintenance schedules. Is the company that is providing the NMS going to support it, as well as develop new features as network requirements change? While every system operator must determine his own needs, the previous requirements should be included in every NMS implementation decision.

Conclusions

CATV networks are evolving to provide reliable communication networks for the future. Reliability and resource management are the cornerstones of these networks. The best way to achieve these cornerstones is by implementing an integrated NMS. These systems provide system operators with a 24-hour, nonintrusive view of the network, and the ability to effectively manage network resources. The technologies and equipment exist today to provide operators with economically viable and effective network management. Once a system operator has determined his requirements, a NMS can be implemented that will leave the system operator wondering how he got along without it. **CT**

THE SCTE VIDEO STORE PRESENTS

T-1169: *The Terminology Explosion*—What Does It Mean to You and Your Business?

It seems that everywhere we turn, we hear of a new technology that is going to change the way we do business forever.

Recognizing this growing level of confusion, SCTE enlisted the assistance of Alan Hahn to help develop a videotape that would explain much of the new terminology we are hearing.

Hahn, a widely recognized communications engineering consultant with over 30 years of experience in communication system design and management, is an SCTE Senior member and presently advises both CATV and telephone companies.

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By providing a straightforward understanding of standard and digital TV transmission techniques, Hahn provides a foundation upon which to analyze new technologies and recognize just how they are evolving.

Since this program focuses on these technologies from a business perspective, it will be a useful tool for managers, as well as all technical personnel.

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- Video servers
- VOD penetration
- Pulse code modulation
- Standard TV
- Digital TV
- Analog vs. digital bandwidth requirements
- Digital transmission bit rates
- Quantization
- Digital compression (both vector quantization and descrete cosine transform)
- MPEG
- ADSL (strengths and weaknesses)
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WESTERN CABLE SHOW EDITION

CT DAILY IC

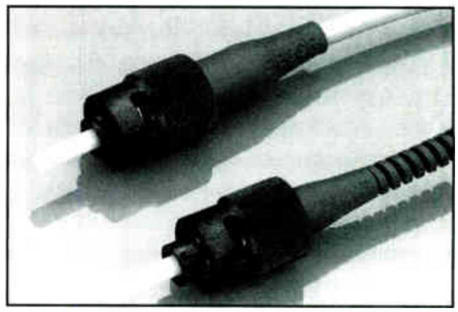
PBI From *Communications Technology* and *International Cable* magazines March 1995

The following is the second of three installments highlighting products introduced recently at The Western Show. Part 1 ran last month.

Ultra Assemblies Rolled Out by Siecor

Siecor announced a comprehensive family of optical fiber cable assemblies with Ultra PC reflection performance, including SC-, FC-, D4- and ST-compatible connectors. Providing a guaranteed reflectance of ≤ -55 dB, the assemblies offer superior performance for data, telecommunications and video applications where low reflectance is required. Typical reflectance is ≤ 58 dB. Color-coded connector boots identify reflectance performance of single-mode connectors for system management. All connectors use standard adapters for the respective connector type. Typical insertion loss is less than 0.20 dB for a mated pair.

Also, the company distributed information on its hands-on training course specifically designed for cable TV applications. The course, "Fiber-Optic Installation and Splicing, Maintenance and Restoration for CATV Applications." This is the fifth year the company has offered the applications-specific class for the cable TV industry. The schedule has



been expanded to provide classes 19 times this year. **Reader service #175 connectors), #174 training course)**

S-A Intros Receiver, Headend

Scientific-Atlanta Inc. introduced the Nexus IRD-2000 Pro receiver and SmartHub headend. Both products help operators link traditional analog distribution architectures with digital-based cable metropolitan areas networks.

The SmartHub enables operators to consolidate earth stations at a single source headend and deliver clearer signals to their customers. Using this approach, operators can retain their initial capital investment, reduce operating costs and upgrade service quality.

The unit reduces the need to staff technicians at remote sites through its ability to identify a problem, notify a technician and, if desired, automatically fix the problem. The tech often can remotely access the headend to gain information about the source or hub headend status and take corrective actions, thereby significantly reducing outage times and improving service levels.

The SmartHub features up to 1 GHz capacity and provides IF and RF automatic gain controls for signal stability. Available options include IF substitution and phase locking. **Reader service #209 receiver), #208 SmartHub)**

Analog And Digital Set-Tops At Zenith

Zenith showcased addressable MultiMedia analog and Media Access digital set-top systems featuring real-time interactive two-way communications, on-screen program guides and displays, and revenue-generating concepts to assist in the deployment of these systems.

The company also demonstrated ScreenPlay, an operator tool for creating and modifying the interactive TV screens to support unique requirements and new services. **Reader service #207 set-tops), #206 ScreenPlay)**

Ipitek News: Wider Bandwidth, -48 VDC Powering

Ipitek extended the bandwidth of its FiberHub AM fiber-optic CATV distribution platform to 750 MHz and 900 MHz. The wider bandwidth allows transportation of up to 110 NTSC video channels or use of RF digital techniques to transport up to 500 channels for video-on-demand applications. The FiberHub uses an integrated splitter/amplifier to support up to eight laser transmitters in a 19-inch rack-mount chassis.

The splitter/amplifier module provides all signal division and amplification for input to eight laser transmitters. No splitting or amplification need be supplied by the user. Only a single +20 dBmV per channel RF input is required to support approximately 40 FiberNodes.

In addition to wider bandwidth drive circuitry, the laser transmitter modules incorporate input automatic level control to ensure an optimum optical modulation index even when the channel count is changes. Automatic power control and temperature compensation circuitry stabilize the laser against temperature and aging effects. Advanced predistortion circuitry is used to provide excellent laser linearity. **Reader service #200**

Standard Intros International Receiver

The Satellite & Broadband Products Division of Standard Communications introduced its Continental MT620 satellite receiver to the international market, satisfying the demand for a receiver that works on multistandard TV formats and almost any satellite.

Spawned from the company's Intercontinental satellite receiver, the unit is a cost-effective alternative to its predecessor. This versatile receiver is designed to accommodate both CATV and SMATV continuous operation. It also provides space efficient, easy integration into new and existing commercial systems with its industry standard one-rack-high design.

The unit is compatible with all recognized 950-1,450 and 950-1,750 MHz LNBs, as well as wideband 950-2,050 MHz LNB operation. The high performance AFC tracking circuit continuously corrects LNB drift and is directly linked to the 100 kHz accurate PLL. **Reader service #197**

Philips Polishes New Diamond Net For Fiber/Coax

Philips Broadband Networks debuted its new combined fiber-optic receiver and RF amplifier for use in hybrid fiber/ coaxial systems. The Diamond Net optical/RF mainstation is an ideal choice for digital, telephony, data and CATV applications.

The unit is designed to complement existing fiber/coaxial equipment to provide a deeper fiber penetration into network infrastructures including fiber-to-the-node, near passive or all passive network configurations. It allows for the introduction of advanced fiber-optic performance to established systems by offering interactive, two-way transmission of video, audio and data without obsoleting existing equipment or fixed network architectures. It accommodates the reception of RF signals between 46 and 86O MHz to facilitate both domestic and international applications.

The amplifier is available with a range of options that can be configured to meet current and future network requirements, and is fully upgradeable to accommodate both forward/return modules and forward/return routing. Its patented housing design provides superior heat dissipation, according to the company, and an extra-large heat sink accommodates amplifier modules up to 1 GHz. High output levels ensure excellent performance in handling a full menu of network services including broadcast video, pay-per-view, video-on-demand, HDTV, multiplayer games, shop-at-home, cable radio, long-distance bypass and POTS.

The unit's optical lid assembly allows for the management of up to eight fibers and includes two fiber cable entry ports. Connections do not require any fusion splicing. The unit is upgradeable to provide two receivers, two return transmitters and an A/B switch, while and optional upconverter expands the Diamond Net's return path by 300%. **Reader service #202**

CableData Demos Intelecable

CableData showed its Intelecable transactions management system designed specifically to support converged telephony and cable operations. The system, recently made available to the U.S. market, encompasses more than 100 integrated programs that support virtually every aspect of operations, including order processing, collections, charging and billing, field communications, marketing and financial reporting. It enables new orders, service orders and billing inquiries to be seamlessly addressed from a single screen, according to the company. Cable TV, residential telephony and business telephony customers can be serviced simultaneously with immediate access to complete information.

Intelecable's software employs a service group concept that allows key customer information to be maintained independently from the services each customer receives. Service groups enhance the data base integration by linking related information, while allowing separate data input screens, specific report output, fault processing, and separate billing and collections management for each service provided.

The system runs on the IBM RISC System 6000 family of computers. Its environment is Posix (a standardized Unix operating system) and Oracle-embedded SQL. Strict adherence to X/Open standards are maintained throughout the system. Intelecable software includes applications, programs and modules designed expressly for global markets providing multiple telecommunications services. **Reader service #196**

Agile Transmitters, Audio AGC Introduced by Leaming

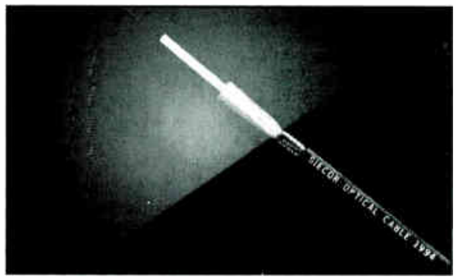
The FMT111 and the FMT115 are new frequency agile transmitters from Leaming. The FMT111 accepts a composite (baseband multiplex) stereo or monaural audio program. The FMT115 accepts separate left and right audio inputs and multiplexes them into the U.S. standard FM stereo broadcast format before modulating the RF carrier. Both units contain an internal power supply.

The AGC-1 audio automatic gain control stops drastic channel-to-channel level changes and saves technician time. The unit can process either one stereo (L & R) input or two monaural inputs. Each unit contains and internal power supply. **Reader service #178 FMT111), #177 FMT115), #176 AGC-1)**

Siecor Unveils Optical Cable, Micro Splicer

Among the new products on display at Siecor was the OptiSpan optical fiber cable, a low fiber count, low-cost solution for cable TV feeder applications. This armored cable is the newest addition to Siecor's single tube cable family, incorporating up to eight single-mode Corning optical fibers color-coded for easy identification and administration. Fibers are protected in a dual-layer buffer tube. The all-dielectric Aramid strength members surrounding the buffer tube require no bonding or grounding. The core is jacketed with a polyethylene outer jacket for a cable with a small outside diameter. Available in continuous lengths up to 12 kilometers, OptiSpan cable meets industry mechanical and environmental requirements. This cable is craft-friendly, optical fiber can be accessed using existing craft tools.

The company's new X76 fusion splicer bridges the gap between micro and full-featured splicers, incorporating three-dimensional profile alignment and on-site loss calculation. Compact and weighing under 7 pounds, the splicer is fully automatic, providing microprocessor-controlled precision splicing. Two cameras allow simultaneous viewing of the X and Y axes, as well as accurate fiber end-angle determinations. At the touch of one button, the splicer will clean, align and fuse fibers. Splice loss is then automatically calculated and displayed on the high-resolution LCD.



The completed splice can be tested for tensile strength and the splice loss stored in the unit's memory. An RS-232 printer port permits print-outs of loss measurements. The micro splicer incorporates 10 splicing programs and an external video output. **Reader service #163 cable), #162 splicer)**

Demos At LSI Logic: MPEG-2 Decoder, Microprocessor Core

LSI Logic introduced what it says is the industry's first single-chip MPEG-2 audio video decoder. The L64002 will be used for cable, satellite and wireless interactive digital video to transmit up to 500 TV channels. The unit's one-chip graphics controller provides a user-friendly interface for on-screen display of TV guide listings and other requirements such as score boxes and product information for home shopping.

The chip, which packs over a million transistors into an area smaller than that of a postage stamp, receives simultaneous audio and video signals in compressed digital format and decompresses them back into analog signals for TV viewing and listening.

Also at LSI was the MiniRISC CW4010 microprocessor core aimed at the interactive set-top box market. It is the world's first superscalar microprocessor core and can execute at speeds of up to two instructions per clock cycle. The core features a 64-bit memory interface that enhances the speed of memory transactions. Because of these features, the core is said to be ideally suited for high performance embedded system designs in interactive set-top boxes, multimedia systems and virtual reality video games. **Reader service #199 decoder), #198 MiniRISC)**

S-A Announces PowerTV Open-Platform Interactivity

Scientific-Atlanta Inc. introduced PowerTV, a common operating system environment for set-top boxes. The software is intended to make it easier for network providers, authors and programmers to deliver interactive multimedia programming to consumers.

The software is being developed by PowerTV, a majority-owned subsidiary of Scientific-Atlanta that will license the software to other set-top manufacturers. PowerTV will be used in cable TV, telephone and satellite environments.

It will be a real-time multitasking system specifically designed to support the delivery of time-critical media — the essence of the data that will arrive on the information superhighway. In addition, it will be optimized to handle the rich colors, video, audio and data that will be essential elements of future multimedia applications.

The architecture will be scalable across platforms of differing capabilities so that additional features can be added as more complex applications evolve. **Reader service #195**

GTE Offers Telco Management to Cable Ops

GTE NMO, an unregulated subsidiary of GTE, announced plans to begin offering a new family of network management tools to cable operators in mid-1995. The ISM 2000 line of products will enable cable operators to manage the physical plant and the accounting of services with a single integrated package. It will contain tools for configuration management, fault management, security, accounting and administration.

ISM 2000 will compete not only with products that manage the physical plant, it also will support many of the billing services offered by companies like CableData. GTE said that it has hired experts from the cable transaction industry to help it design its own transaction system.

Cable operators can use just about any type of network monitoring equipment on the market today to send information to the management system. That data can be send via X.25 packet network, asynchronous lines, or a hybrid fiber coax network. **Reader service #203**

Wavetek Adds Reverse Sweep to Stealth

Wavetek introduced an enhanced option for its Stealth system sweep. The hand-held Stealth now solves reverse alignment and test problems in addition to its comprehensive forward sweep and signal level meter applications. One technician can now make remote "reverse sweep" measurements with one hand-held instrument in the field, eliminating the traditional cumbersome collection of additional equipment.

Weighing 4.9 pounds, the Stealth reverse option's built-in transmitter communicates with the rack-mounted 3ST transmitter in the headend. When the reverse sweep is activated from a field test point, the headend transmitter receives the telemetry signal identifying the 3SR unit, the frequencies being swept and the timing information. The headend transmitter measures the sweep and sends the results with other pertinent data via its telemetry signal to the receiver in the field. The headend sweep response is easily viewed in the field on the Stealth 3SR's high-resolution LCD. **Reader service #172**

Ipitek Offers New Fiber Products

Ipitek displayed a new line of AM CATV DFB laser transmitters, a new return path receiver and a fiber feed for broadcast, among other products.

The transmitters are for use in the company's FiberTrunk system. They are offered in a wide range of optical powers from 4 mW up to 16 mW (12 dBm) in 2 mW increments. This permits users to purchase only the power required for their application. The transmitter modules incorporate input automatic level control to ensure an optimum optical modulation index even when the channel count is changed. Automatic power control and temperature compensation circuitry stabilize the laser against temperature and aging effects. Advanced predistortion circuitry is used to provide excellent laser linearity. The FiberTrunk chassis can support up to four laser transmitter modules, two upstream receiver modules and status monitor module.

The new fiber-optic return path receiver is for the transport of CATV return path information from the node site to the headend. It is used with the company's FiberNode return laser transmitter to transport subscriber data, telephony, status monitor information and video. The status LEDs, RF and optical photocurrent test points facilitate troubleshooting. Also, each receiver's RF output can be shut off remotely using the company's FiberSentry network management system. This allows the user to extinguish any disruptive ingress from the coaxial return path.

The 19-inch 1U high chassis accepts four optical receiver modules and is fully connectorized with FC/PC, APC or SC/PC, APC bulkhead connectors for ease of implementation. The chassis can be powered with 220 VAC, 110 VAC or standard telephone closet voltage of -48 VDC. A redundant power supply that supports up to 16 receivers is optional.

The company also has developed its Professional Series modules for the IMTRAN line of fiber digital video delivery systems. The weak link in the broadcast chain can now be replaced with the crystal clarity and reliability that fiber technology offers. Crucial satellite/studio, studio/studio, studio/transmitter, must-carry handoffs and event links can all be improved by using the company's high-speed digital fiber-optic technology. The IMTRAN 10-bit professional line offers better than RS-250C short-haul video and audio performance. Four or eight discrete NTSC composite video feeds may occupy a single fiber. Each video channel may optionally have up to four CD-quality balanced audio lines and one simplex RS-232 data line. **Reader service #171 transmitters), #170 receiver), #169 IMTRAN)**

GI Previews End-To-End Solutions, More

General Instrument demonstrated the base user interface for its DigiCable digital decompression terminal. The DCT 1000 digital set-tops process MPEG-2 and DC-II signals, and support downloadable applications that enable operators to deploy an assortment of advanced user interfaces customized to the service markets. The company also displayed models that support the international PAL and SECAM formats. **Reader service #205**

New Modulators, Processors At Holland

Holland Electronics Corp. introduced the HMA-500 and 500H agile modulators with 500 MHz (68 channel) range. The units feature a microprocessor-controlled front panel LED channel display, a low out-of-band noise dual conversion output converter, and overmodulation indicators for easy operation. The HMA-500 provides 40 dB output while the 500H provides 60 dB output using a low distortion CATV hybrid. Both come with a two-year warranty.

Also, the company introduced two low-cost agile processors, the HP-40 and HP-60. The new units feature microprocessor-based controls and a front panel LED channel display for easy operation. The company says the units use SAW filtering to maintain exceptionally clean conversions as well as a switching power supply for efficient low heat operation with AC inputs between 80-230 VAC. The units are available in 40 and 60 dB outputs, respectively, and are available from stock with a two-year warranty. **Reader service #150 modulators), #149 processors)**

Harmonic Lightwaves Unveils Optical Switch, Preamp Modules

Harmonic Lightwaves rolled out an optical switch and preamp plug-in modules for the HL 4000 broadband platform. The HOS 4000 optical switch module provides automatic network backup and redundancy capabilities, eliminating the need for additional backup transmitters. The cost-saving module increases optical distribution plant reliability and provides for a self-healing network. The HPA 4807-4 preamplifier module has four outputs that drive the PWRLink DFB transmitter family, eliminating the need for splitters.

These new modules enhance the flexibility of the HL 4000 system by providing increased capabilities in the same high-density packaging that houses the transmitters. The modular design allows operators to add new features without replacing existing equipment. The platform accommodates up to six modules, including the optical switch, preamplifier, controller power supply and PWRLink transmitters. **Reader service #191 HOS 4000), #179 HPA 4807-4)**

Two-Channel Intercom At Anchor

Anchor Communications showed its PortaCom basic two-channel intercom that sets up and tears down quickly, and offers the choice of AC or battery operation (battery pack available in early 1995). The unit easily powers a network of up to 2,000 feet of standard XLR mic cable. The small, lightweight belt packs have their own volume and channel controls. The company says the basic two-channel unit costs about the same as most one-channel systems without sacrificing power or sound quality. **Reader service #204**

1,550 nm System New From Photon Systems

Photon Systems showed its new LT-4000 fiber-optic transmitter and LT-4000-A fiber-optic amplifier. This 1,550 nm transmission system is designed for long-haul delivery of analog video and digital signals at bandwidths to 750 MHz. The company employs 980 nm pump laser technology in an erbium-doped fiber amplifier to achieve high power. Eighty video channels can be carried up to 200 km with C/N of 50 dB while distortions remain better than -65 dBc. The system is available with optical output powers over 40 mW to cost-effectively address such applications as headend consolidation, new service area feeds and side area broadcasting.

The amplifier incorporates an optical receiver. RF signal is available to feed coaxial plant at any point in the optical transmission path where an amplifier is placed.

Future product options will include a diagnostic return path capability that allows monitoring of actual video performance on any channel right from the headend. The return video feed will allow technicians to assess system performance without having to roll a truck — an important consideration given the long distances involved. **Reader service #194**

Cable AML Offers Improvements For Transmitters

Two performance improvement kits for STX-141 channelized transmitters were shown by Cable AML. The FKA-001 is designed to eliminate what has been described as video "flutter" through STX-141 transmitters that have been retrofitted with solid-state amplifiers. The kit includes a power amplifier thermal shut-down circuit that is activated by a temperature sensor. This device prevents power amp burnout in the event of an over-temperature (thermal runaway) condition.

The model FKS-001 kit for solid-state sources in STX-141 transmitters reduces the source case temperature by 20°C, which results in a significantly increased lifetime (an increase of a factor of nine times in mean time to failure). **Reader service #193 FKA-001), #192 FKS-001)**

Cable Innovations Features Surge Suppression

Among the products highlighted by Cable Innovations was the DLPS-15D drop line power suppressor. The 1 GHz, 4 amp product protects drop line electronics from damaging faults due to surges, transients, spikes and lightning. Using duel direction Sidactor technology, it protects in both directions (from the house and into the house). With a trigger sensing time of 1 nanosecond, the DLPS-15D will virtually eliminate damage to drop line electronics caused by overvoltages. **Reader service #168**

Power Guard Gets Robust On Surge Protection

Power Guard has re-engineered the Power Clamp to include two SCRs (silicone controlled rectifiers). These units can be placed in discreet locations in the cable/telephony plant and fit most manufacturer's power inserters, couplers, two- and three-way splitters from 450 MHz to 1 GHz. **Reader service #167**

Implementing digital compression at the system level

The introduction of digital signals into existing analog cable systems will begin in less than a year. It is important to know how to prepare for this introduction. This article will attempt to provide some guidelines for cable system technical personnel to facilitate the implementation of digital transmission into their systems.

By Joseph B. Waltrich
DigiCable Project Manager
General Instrument Communications Division

In order to better understand the way in which digital transmission will be integrated into cable systems, let us first review the manner in which end-to-end transmission of compressed digital video will be conducted. Figure 1 shows an example of the DigiCipher transmission system, starting with the satellite uplink and ending at the subscriber's home.

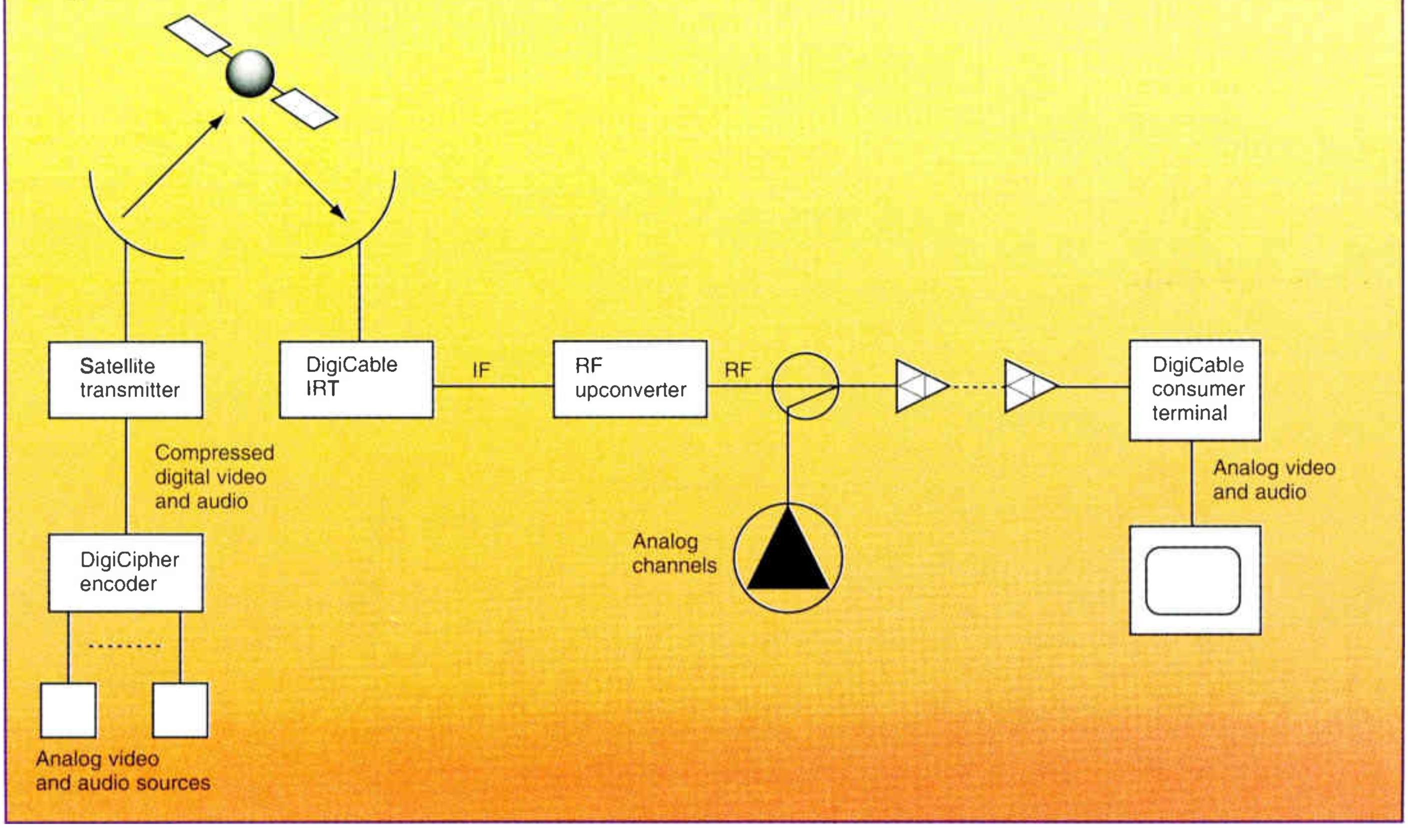
At the uplink, the digital signal is produced by digitizing and compressing anywhere from two to 10 analog video sources, with associated audio, and multiplexing these compressed signals into a single serial data stream. Additional data bits are added for forward error correction (FEC) and the data stream is then modulated in QPSK format for transmission over the satellite.

The cable system receives the digital signal using an integrated receiver/transcoder (IRT). The IRT performs the following functions:

- Demodulation of the L-band signal from the satellite and recovery of the digital data stream.
- Error correction of the data transmitted over the satellite.
- Removal of the satellite FEC overhead data and addition of FEC appropriate for cable.
- Modulation of the data in 64-QAM format for transmission over cable.

The transcoder output is an IF signal, centered at 43.75 MHz. The signal is upconverted to RF and combined with analog channels for cable transmission. RF upconversion may be accomplished

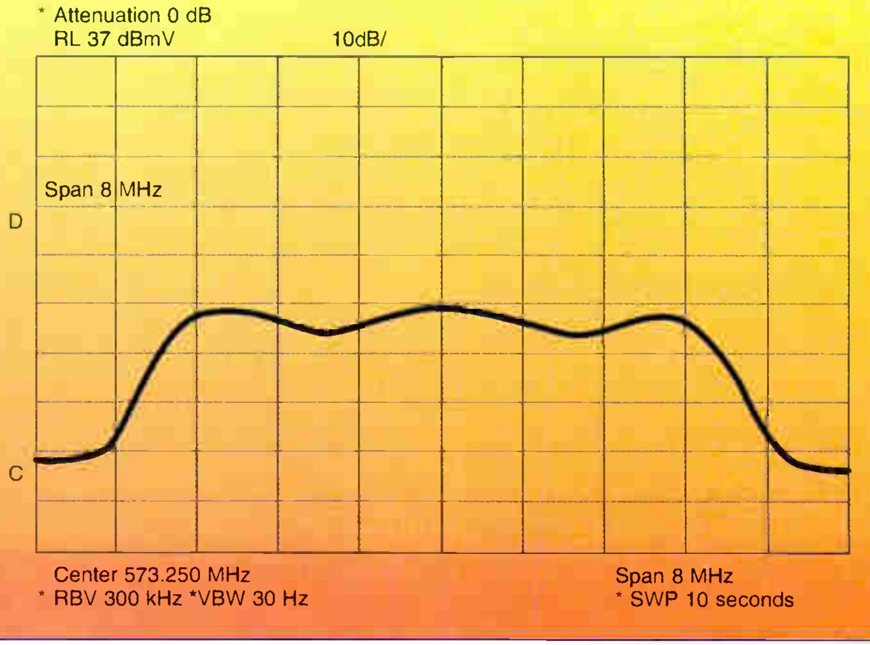
Figure 1: DigiCable transmission system



either by feeding the IF signal into the AUX IF input of a Commander VI modulator or by using a CVIU dual RF upconverter that is capable of accepting two IF inputs and providing two frequency-agile RF outputs.

At the subscriber's home, the digital signal is received by a DigiCable consumer terminal (DCT), which performs demodulation, error correction, decryption and decompression of the digital signal and converts the recovered video and audio to analog format for display on the consumer's TV receiver. The signal remains in digital form from the time it is encoded until it reaches the consumer. Therefore, cable headend technicians and field service personnel will need to know how to deal with the digital signal as it passes through the system so as to assure error-free reception at the subscriber's location.

Figure 2: Digital signal spectrum with 400 ns echo at -10 dB



Tips on good reception

Preparation for good digital reception starts with the satellite downlink. Techniques for ensuring good satellite reception of digital signals are no different than those used for analog signals. It is necessary to make sure that the digital signal level and carrier-to-noise ratios (C/Ns) are within specified limits for correct operation of the IRT, and that adequate fade margin is provided. Current specs for the DigiCable IRT call for a digital signal level between -25 and -65 dBm and a minimum C/N of about 8 dB. (Obviously, operation near the minimum C/N level is not recommended.) Also, bear in mind that if a spectrum analyzer is used to measure digital signal power, the measurement must be corrected for analyzer resolution bandwidth. C/N levels, however, can be made without a bandwidth correction. (Information on using a spectrum analyzer for digital signal measurements can be found in Reference 1 listed at the end of this article. Further information on downlink setup may be found in Reference 2.)

At the headend

Once the signal has been received and transcoded to 64-QAM, the next step is to make sure that no degradation occurs at the headend. Improper terminations and poor grounding in the headend wiring can cause small reflections that may not be noticeable in an analog picture but that can cause intersymbol interference in digital signals. Although the adaptive equalizer in the set-top terminal can correct for these effects, some of the equalization budget will be used unnecessarily, leaving less equalization capability available for correction of system echoes. Checking for correct terminations and grounding before putting the digital signal on the system will assure good signal quality throughout the entire spectrum as well as in the digital transmission channel.

"Using a noninterfering sweep with digital transmission is a must. The older high level sweep generators will cause errors in the digital picture."

Significant echoes will appear as ripples or notches in the spectrum as shown in Figure 2 on page 85.

Using a noninterfering sweep with digital transmission is a must. The older high level sweep generators will cause errors in the digital picture. Errors in a digital picture appear as small multicolored blocks. If the errors are severe, a freeze frame or loss of picture will occur. Even when using a noninterfering sweep, it is a good idea to check the empty digital channel prior to inserting the digital signal. Look at the empty channel spectrum and make sure that there are no stray RF components in the channel such as might occur from an improperly set up sweep generator.

As far as RF output level is concerned, it is possible to set the digital signal level as low as -10 dB relative to adjacent analog carriers. The DigiCable system was designed for operation at lower power levels in order to minimize the effect of digital third-order distortion on adjacent analog channels. Third-order distortion produced by digital signals appears as an increase in the analog channel noise floor.[3] If only a single digital channel is used, there probably won't be enough distortion generated to be noticeable and operation at higher power may be possible. If several digital channels are present, distortion can be minimized by spreading the digital channels throughout the cable spectrum rather than grouping them together. Digital third-order distortion can be checked rather easily by making C/N measurements in the analog channels with and without the digital signal on the system.

When choosing channels for digital signals, stay away from channel locations that are adjacent to trapped channels. Although it won't be noticeable at the headend, the trap's frequency response and group delay can produce distortion in the adjacent digital signal at the receive site. The effect of the trap will probably show up as severe tilt in the received signal spectrum. Even if the adaptive equalizer can compensate for this, it is an unnecessary use of the equalization budget.

Quality signals throughout system

Once the signal leaves the headend, it is important to assure good signal quality throughout the system. One of the best ways to do this is to make sure your system meets Federal Communications Commission requirements for analog transmission. In general, if a system is capable of meeting FCC technical requirements for C/N, distortions and cumulative leakage index (CLI), it should be able to accommodate digital signals without difficulty. Digital transmission is not a cure-all, nor is it a substitute for adequate maintenance. Don't get the idea that digital transmission will work where analog transmission won't. Although this may be true in some cases, it is the exception rather than the rule.

A well-maintained trunk will not add much in the way of noise or reflections to the digital signal. Fiber-optic links are even more benign, provided that the digital signal does not overmodulate the laser. This applies to digital peak power — not just average power. For 64-QAM transmission, the peak power is about 6 dB greater than the average power.

If the signal is to sent through an AML link, it is important to check the link for phase noise. This can be done by sending an unmodulated carrier through the link and using a spectrum analyzer to measure phase noise.

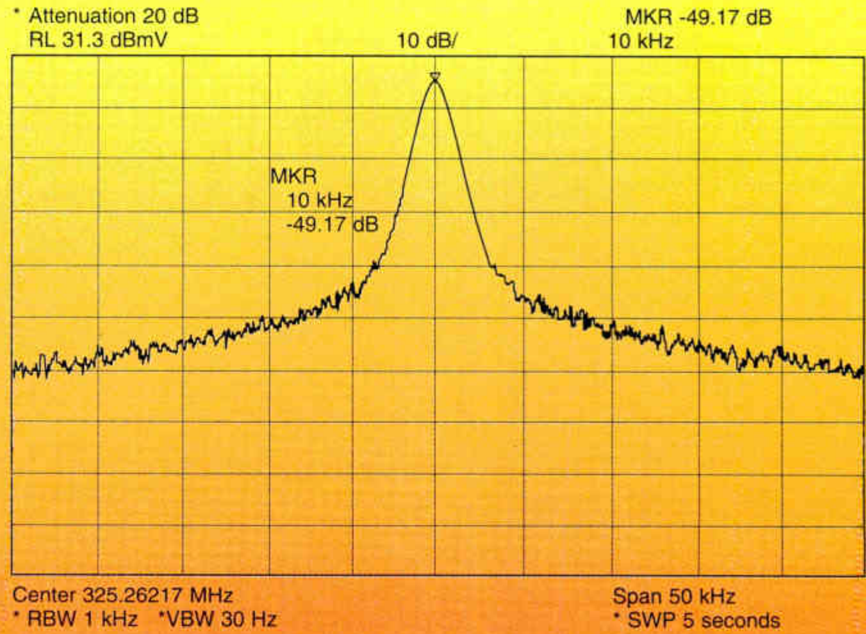
To measure phase noise, proceed as follows:

Set the analyzer resolution bandwidth to 1 kHz and the video bandwidth to 30 Hz.

- Set the analyzer center frequency to the carrier frequency and the span to 50 kHz. Adjust the analyzer center frequency as required to put the carrier in the center of the analyzer display.
- Measure the difference between the peak value of the carrier and the value at a point 10 kHz either side of the peak. Subtract 30 dB from this value to obtain the phase noise in dBc/Hz.

For example, if the measured value is -40 dB, the phase noise would be -70 dBc/Hz. Figure 3 shows a typical phase noise plot.

Figure 3: Spectrum of unmodulated carrier with -79 dBc/Hz phase noise



If the analyzer has a MAX HOLD function, it would be helpful to set the analyzer on MAX HOLD and leave it on the system for a 24-hour period, since this will provide information on how the phase noise varies with time. If the phase noise does not exceed -80 dBc/Hz, the AML link should not be a problem. Phase noise in excess of this value can be corrected by replacing the local oscillators in the AML equipment with dielectric resonant oscillators (DROs).

The same maintenance considerations as required for the trunk apply to the distribution system. Distribution system echoes will be small (and therefore easily handled by the converter's adaptive equalizer) if all unused tap ports are properly terminated and the integrity of cables and connectors is checked before putting the digital signal on line.[4]

The most likely place for problems to occur is at the subscriber's home. The first thing to do when installing a digital service is to check the signal level at the end of the drop. This can be done with a signal level meter (SLM) provided that the resolution bandwidth of the SLM is known and appropriate bandwidth correction is made.

Use the same technique for bandwidth correction as described in Reference 1 at the end of this article. Once the correction factor is calculated, add the appropriate number of dB to the SLM reading to obtain the correct signal level. The SLM also can be used to measure noise power in an empty channel using the same correction. C/N ratio is calculated by subtracting the noise power from the signal power. A digital C/N of 30 dB or better will assure good reception, provided that no other significant impairments are present.

One thing to watch for at the subscriber's home is the presence of reflections. Echoes in the home environment are usually caused by a combination of improperly terminated devices and the use of poor quality splitters that have low return loss and poor port-to-port isolation. If the signal level and C/N are OK, this would be the next thing to check. Although nothing much can be done about return loss of cable-compatible receivers, VCRs, etc., the integrity of splitters and A/B switches can be checked. In addition to a visual check for loose or corroded connections, a very simple test of splitter integrity can be conducted as follows:

> ***"Don't get the idea that digital transmission will work where analog transmission won't. Although this may be true in some cases, it is the exception rather than the rule."***

- Connect the digital signal to the customer's TV receiver and tune the receiver to one of the digital services.
- Turn on one of the other devices that are being fed by the splitter (e.g., a cable-compatible TV receiver and surf through the channels on this device while watching the digital picture. Obviously, if the other device is in a different room, it will be necessary to ask the customer to do the channel surfing.)

If no errors are observed in the digital picture during the on/off switching or surfing process, the customer installation is probably OK. If errors are present, it may be necessary to replace the splitter or to run a separate drop for the digital service. If this is necessary, the customer should be cautioned not to change the setup without first checking with the cable operator.

Tests by General Instrument, Cable Television Laboratories and others have shown that digital signals can be transmitted successfully over existing cable systems. In most cases, if the system meets requirements for analog transmission, it should be possible to introduce digital services without difficulty. It is, however, important to recognize the differences in the effect of the transmission channel on analog and digital signals as described in the preceding paragraphs. If these differences are taken into consideration, there should be very few problems associated with the introduction of digital video services into existing cable systems. **BTB**

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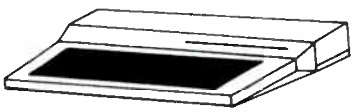

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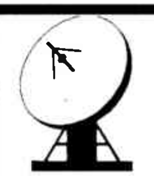

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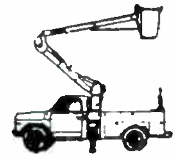

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24	50	76	102	128	154	160	206	232	258	284	310
25	51	77	103	129	155	181	207	233	259	285	311
26	52	78	104	130	156	182	208	234	260	286	312

A. Are you a member of the SCTE (Society of Cable Television Engineers)?

01. ___ yes
02. ___ no

B. Please check the category that best describes your firm's primary business (check only 1):

Cable TV Systems Operations

03.___ Independent Cable TV Syst.
04.___ MSO (two or more Cable TV Systems)
05. ___ Cable TV Contractor
06. ___ Cable TV Program Network
07. ___ SMATV or DBS Operator
08. ___ MDS, STV or LPTV Operator
09. ___ Microwave or Telephone Comp.
10. ___ Commercial TV Broadcaster
11. ___ Cable TV Component Manufacturer
12. ___ Cable TV Investor
13. ___ Financial Institution, Broker, Consultant
14. ___ Law Firm or Govt. Agency
15. ___ Program Producer or Distributor
16. ___ Advertising Agency
17. ___ Educational TV Station, School, or Library
18. ___ Other (please specify)____

C. Please check the category that best describes your job title:

19. ___Corporate Management
20. ___ Management
21. ___ Programming

Technical/Engineering

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

D. In the next 12 months, what cable equipment do you plan to buy?

30. ___ Amplifiers
31. ___ Antennas
32. ___ CATV Passive Equipment including Coaxial Cable
33. ___ Cable Tools
34. ___ CAD Software, Mapping
35. ___ Commercial Insertion/ Character Generator
36. ___ Compression/Digital Equip.
37. ___ Computer Equipment
38. ___ Connectors/Splitters
39. ___ Fleet Management
40. ___ Headend Equipment
41. ___ Interactive Software
42. ___ Lightning Protection
43. ___ Vaults/Pedestals
44. ___ MMDS Transmission Equipment
45. ___ Microwave Equipment
46. ___ Receivers and Modulators
47. ___ Safety Equipment
48. ___ Satellite Equipment
49. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
50. ___ Telephone/PCS Equipment
51. ___ Power Suppls. (Batteries, etc.)
52. ___ Video Servers

E. What is your annual cable equipment expenditure?

53. ___ up to $50,000
54. ___ $50,001 to $100,000
55. ___ $100,001 to $250,000
56. ___ over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?

57. ___ Fiber-Optic Amplifiers
58. ___ Fiber-Optic Connectors
59. ___ Fiber-Optic Couplers/Splitters
60. ___ Fiber-Optic Splicers
61. ___ Fiber-Optic Transmitter/Receiver
62. ___ Fiber-Optic Patchcords/ Pigtails
63. ___ Fiber-Optic Components
64. ___ Fiber-Optic Cable
65. ___ Fiber-Optic Closures & Cabinets

G. What is your annual fiber-optic equipment expenditure?

66. ___ up to $50,000
67. ___ $50,001 to $100,000
68. ___ $100,001 to $250,000
69. ___ over $250,000

H. In the next 12 months, what cable test & measurement equipment do you plan to buy?

70. ___ Audio Test Equipment
71. ___ Cable Fault Locators
72. ___ Fiber Optics Test Equipment
73. ___ Leakage Detection
74. ___ OTDRs
75. ___ Power Meters
76. ___ Signal Level Meters
77. ___ Spectrum Analyzers
78. ___ Status Monitoring
79. ___ System Bench Sweep
80. ___ TDRs
81. ___ Video Test Equipment

I. What is your annual cable test & measurement equipment expenditure?

82. ___ up to $50,000
83. ___ $50,001 to $100,000
84. ___ $100,001 to $250,000
85. ___ over $250,000

J. In the next 12 months, what cable services do you plan to buy?

86. ___ Consulting/Brokerage Services
87. ___ Contracting Services (Construction/Installation)
88. ___ Repair Services
89. ___ Technical Services/ Eng. Design
90. ___ Training Services

K. What is your annual cable services expenditure?

91. ___ up to $50,000
92. ___ $50,001 to $100,000
93. ___ $100,001 to $250,000
94. ___ over $250,000

L. Do you plan to rebuild/ upgrade your system in:

95. ___ 1 year
96. ___ more than 2 years

M. How many miles of plant are you upgrading/ rebuilding?

97. ___ up to10 miles
98. ___ 11-30 miles
99. ___ 31 miles or more

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16	42	68	94	120	146	172	198	224	250	276	302
17	43	69	95	121	147	173	199	225	251	277	303
18	44	70	96	122	148	174	200	226	252	278	304
19	45	71	97	123	149	175	201	227	253	279	305
20	46	72	98	124	150	176	202	228	254	280	306
21	47	73	99	125	151	177	203	229	255	281	307
22	48	74	100	126	152	178	204	230	256	282	308
23	49	75	101	127	153	179	205	231	257	283	309
24	50	76	102	128	154	180	206	232	258	284	310
25	51	77	103	129	155	181	207	233	259	285	311
26	52	78	104	130	156	182	208	234	260	286	312

A. Are you a member of the SCTE (Society of Cable Television Engineers)?

01. ___ yes
02. ___ no

B. Please check the category that best describes your firm's primary business (check only 1):

Cable TV Systems Operations

03.___ Independent Cable TV Syst.
04.___ MSO (two or more Cable TV Systems)
05. ___ Cable TV Contractor
06. ___ Cable TV Program Network
07. ___ SMATV or DBS Operator
08. ___ MDS, STV or LPTV Operator
09. ___ Microwave or Telephone Comp.
10. ___ Commercial TV Broadcaster
11. ___ Cable TV Component Manufacturer
12. ___ Cable TV Investor
13. ___ Financial Institution, Broker, Consultant
14. ___ Law Firm or Govt. Agency
15. ___ Program Producer or Distributor
16. ___ Advertising Agency
17. ___ Educational TV Station, School, or Library
18. ___ Other (please specify)____

C. Please check the category that best describes your job title:

19. ___Corporate Management
20. ___ Management
21. ___ Programming

Technical/Engineering

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

D. In the next 12 months, what cable equipment do you plan to buy?

30. ___ Amplifiers
31. ___ Antennas
32. ___ CATV Passive Equipment including Coaxial Cable
33. ___ Cable Tools
34. ___ CAD Software, Mapping
35. ___ Commercial Insertion/ Character Generator
36. ___ Compression/Digital Equip.
37. ___ Computer Equipment
38. ___ Connectors/Splitters
39. ___ Fleet Management
40. ___ Headend Equipment
41. ___ Interactive Software
42. ___ Lightning Protection
43. ___ Vaults/Pedestals
44. ___ MMDS Transmission Equipment
45. ___ Microwave Equipment
46. ___ Receivers and Modulators
47. ___ Safety Equipment
48. ___ Satellite Equipment
49. ___ Subscriber/Addressable Security Equipment/ Converters/Remotes
50. ___ Telephone/PCS Equipment
51. ___ Power Suppls. (Batteries, etc.)
52. ___ Video Servers

E. What is your annual cable equipment expenditure?

53. ___ up to $50,000
54. ___ $50,001 to $100,000
55. ___ $100,001 to $250,000
56. ___ over $250,000

F. In the next 12 months, what fiber-optic equipment do you plan to buy?

57. ___ Fiber-Optic Amplifiers
58. ___ Fiber-Optic Connectors
59. ___ Fiber-Optic Couplers/Splitters
60. ___ Fiber-Optic Splicers
61. ___ Fiber-Optic Transmitter/Receiver
62. ___ Fiber-Optic Patchcords/ Pigtails
63. ___ Fiber-Optic Components
64. ___ Fiber-Optic Cable
65. ___ Fiber-Optic Closures & Cabinets

G. What is your annual fiber-optic equipment expenditures?

66. ___ up to $50,000
67. ___ $50,001 to $100,000
68. ___ $100,001 to $250,000
69. ___ over $250,000

H. In the next 12 months, what cable test & measurement equipment do you plan to buy?

70. ___ Audio Test Equipment
71. ___ Cable Fault Locators
72. ___ Fiber Optics Test Equipment
73. ___ Leakage Detection
74. ___ OTDRs
75. ___ Power Meter
76. ___ Signal Level Meters
77. ___ Spectrum Analyzers
78. ___ Status Monitoring
79. ___ System Bench Sweep
80. ___ TDRs
81. ___ Video Test Equipment

I. What is your annual cable test & measurement equipment expenditure?

82. ___ up to $50,000
83. ___ $50,001 to $100,000
84. ___ $100,001 to $250,000
85. ___ over $250,000

J. In the next 12 months, what cable services do you plan to buy?

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99. ___ 31 miles or more

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Science & Technology - Director of Engineering

The **NCTA Science and Technology Department** is seeking a Director of Engineering. The successful candidate for this position will become part of a hard working team that is charged with keeping up with rapid changes in the areas of technology policy and standards as they relate to advances in telecommunications technology.

The successful candidate will be required to:

- ❑ Represent the Cable Television Industry before the FCC and congressional staff, attend committee meetings and be active in standards activities involving Cable, Telephony, Satellite and Data Issues.
- ❑ Perform engineering calculations of the kind normally associated with cable TV, radio, video etc.
- ❑ Analyze complex engineering matters and communicate the results in a clear and concise written form suitable for both a technical and a non-technical audience.
- ❑ Maintain contact with the top engineering people in the cable TV and related industries.

We require:

- BSEE or equivalent training.
- Direct experience in one or more facets of the Cable Television Industry.
- Hands on skill with electronics test equipment a plus.
- Solid writing skills.
- Experience in the public policy and regulatory environment desirable.

Mail a letter of interest with resume and salary requirements to:
Wendell Bailey, VP Sci. & Tech., NCTA, 1724 Mass. Ave., NW, Washington, DC 20036.

— NCTA is an equal opportunity employer —

BOOKSHELF

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

☛ *Extension Ladders* — A course designed to provide thorough and comprehensive instruction on the safe use of extension ladders. Includes segments on ladder positioning, transporting and carrying, securing, climbing and safety. Produced by the Atlee Cullison Training School. (35 min.) Order #T-1043, $145. **(Reference for Installer Certification)**

☛ *Digital TDRs, An Investment You Can Find Fault With* — Riser-Bond presents a discussion and instruction on the proper use of its line of digital time domain reflectometers. From SCTE's Product-Specific Tele-Seminar Program. (Approx. 20 min.) Order #T-1044 , $30.

☛ *Balance and Alignment Techniques for Scientific-Atlanta Series 6500 and 6800 Distribution Equipment* — Scientific-Atlanta engineers discuss components and proper alignment techniques for this particular series of distribution equipment in this video produced exclusively for SCTE's Product-Specific Tele-Seminar Program. (30 min.) Order #T-1045, $30.

☛ *Implementing Stereo Headend Equipment* — Audio engineers Tom Williams and Steve Fox discuss BTSC stereo technology and its proper testing through specific headend equipment in this workshop from Expo '87. (1 hr.) Order #T-1046, $35.

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, 669 Exton Commons, Exton, PA 19341 or fax with credit card information to (610) 363-5898.

Listings of other publications and videotapes available from the SCTE are included in the March 1994 issue of the Society newsletter, "Interval."

March

6-9: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Hickory, NC. Contact (800) 743-2671, ext. 5539 or 5560.

6-9: Western Communications Forum '95, Broadmoor, Colorado Springs, CO. Contact (312) 938-3500.

7: SCTE New England Chapter seminar, BCT/E and Installer exams to be administered, Best Western, Marlboro, MA. Contact Tom Garcia, (508) 562-1675.

7-9: C-COR training seminar, broadband communications technology, Fremont, CA. Contact (800) 233-2267, ext. 4422.

7-9: Scientific-Atlanta training course, hybrid fiber/coax operation and maintenance, San Francisco. Contact Bill Brobst, (404) 903-6306.

7-9: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

9: Society of Cable Television Engineers Tele-Seminar Program, *Digital Transmission Techniques (Part II)* from Cable-Tec Expo '94 in St. Louis, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.

12: SCTE Old Dominion Chapter seminar and testing session, BCT/E Category III tutorial — transportation systems, BCT/E and Installer exams to be administered, Holiday Inn, Richmond, VA. Contact Margaret Fitzgerald, (703) 248-3400.

13: SCTE Old Dominion Chapter seminar, vendor show, Holiday Inn, Richmond, VA. Contact Margaret Fitzgerald, (703) 248-3400.

14: Scientific-Atlanta training course, fundamentals of the hybrid fiber/coax network, Denver. Contact Bill Brobst, (404) 903-6306.

14-16: C-COR training seminar, digital video and fiber-optic networking, Fremont, CA. Contact (800) 233-2267, ext. 4422.

14-16: Philips mobile training course, Denver. Contact (800) 448-5171.

15: SCTE Big Sky Chapter seminar and testing session, BCT/E and Installer exams to be administered, Billings/Laurel Mt., MT. Contact Marla DeShaw, (406) 6324300.

15: SCTE Michiana Chapter seminar, BCT/E Tutorials: Categories II and V, Comfort Inn, New Buffalo, MI. Contact Russ Stickney (219) 259-8015.

15: SCTE San Diego Chapter seminar, San Diego. Contact Kathleen Horst, (310) 715-6518.

15-16: Scientific-Atlanta training course, understanding hybrid fiber/coax design, Denver. Contact Bill Brobst, (404) 903-6306.

16: SCTE Big Sky Chapter seminar and testing session, BCT/E and Installer exams to be administered, drawing for winner of 1995 Cable-Tec Expo trip, Elks Lodge, Helena, MT. Contact Marla DeShaw, (406) 6324300.

16: SCTE Penn-Ohio Chapter seminar, the demanding role of the installer/technician, afternoon hands-on vendor show, Sheraton Inn North, Pittsburgh. Contact Marianne McClain, (412) 531-5710.

20-21: Ohio Cable Television Association convention, Hyatt of Capital Square, Columbus, OH. Contact (614) 461-4014. →

Planning ahead

May 7-10: The National Show, Dallas. Contact (202) 775-3669.

June 14-17: Society of Cable Television Engineers Cable-Tec Expo, Las Vegas, NV. Contact (610) 363-6888.

Aug. 13-15: Great Lakes Cable Expo, Indianapolis. Contact (317) 845-8100.

20-23: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Keller, TX. Contact (800) 743-2671, ext. 5539 or 5560.
20-23: SuperComm '95, Anaheim Convention Center, Anaheim, CA. Contact (202) 457-4912.
21-22: Scientific-Atlanta training course, hybrid fiber/coax system sweep and balance, Atlanta. Contact Bill Brobst, (404) 903-6306.
21-23: Philips mobile training course, Kansas City, KS. Contact (800) 448-5171.
23-24: Scientific-Atlanta training course, analog headend and earth station system operation and maintenance, Philadelphia. Contact Bill Brobst, (404) 903-6306.
28-30: C-COR training seminar, cable TV technology, Atlanta, GA. Contact (800) 233-2267, ext. 4422.
28-30: Philips mobile training course, Shreveport, LA. Contact (800) 448-5171.
31: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

April
3-6: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Hickory, NC. Contact (800) 743-2671, ext. 5539 or 5560.
4: Scientific-Atlanta training course, fundamentals of the hybrid fiber/coax network, Boston. Contact Bill Brobst, (404) 903-6306.
4-6: Philips mobile training course, Atlanta. Contact (800) 448-5171.
5-6: Scientific-Atlanta training course, hybrid fiber/coax field test and measurement, Boston. Contact Bill Brobst, (404) 903-6306.
5-6: Scientific-Atlanta training course, interactive broadband delivery system overview, Boston. Contact Bill Brobst, (404) 903-6306.
7: SCTE North Country Chapter testing session, BCT/E and Installer exams to be administered, St. Paul, MN. Contact Bill Davis, (612) 646-8755.
11-13: Scientific-Atlanta training course, hybrid fiber/coax operation and maintenance, Boston. Contact Bill Brobst, (404) 903-6306.
11-13: SCTE Wheat State Chapter testing session, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.
11-13: Philips mobile training course, Raleigh, NC. Contact (800) 448-5171.
12: SCTE Bluegrass Chapter seminar, distortions and equalizing, Travel Lodge, Elizabethtown, KY. Contact Max Henry, (502) 753-6521.
12: SCTE Delaware Valley Chapter seminar, safety, Williamson Restaurant, Willow Grove, PA. Contact Chuck Tolton, (215) 657-6990.
13: SCTE Michiana Chapter seminar, hands-on P-III cable splicing, standby power supply status monitoring, Comfort Inn, New Buffalo, MI. Contact Russ Stickney, (219) 259-8015.
13: Society of Cable Television Engineers Tele-Seminar Program, *Demystifying the New Technology*, to be shown on Galaxy 1R, Transponder 14, 2:30-3:30 p.m. ET. Contact SCTE national headquarters, (610) 363-6888.
18-20: C-COR training seminar, cable TV technology, Wilmington, DE. Contact (800) 233-2267, ext. 4422.
20: SCTE Northern New England Chapter seminar, FCC proofs and standards, Ramada Inn, Portland, ME. Contact Bill DesRochers, (207) 646-2672.
24-26: Kentucky Cable Television Association annual convention, Holiday Inn North, Lexington, KY. Contact Randa Wright, (502) 864-5352.
24-27: Siecor training course, fiber-optic installation and splicing, maintenance and restoration for CATV applications, Keller, TX. Contact (800) 743-2671, ext. 5539 or 5560.
24-28: General Instrument training course, broadband communications network design, St. Louis. Contact Lisa Nagel, (215) 830-5678.
25: Scientific-Atlanta training course, fundamentals of the hybrid fiber/coax network, San Francisco. Contact Bill Brobst, (404) 903-6306.
26-27: Scientific-Atlanta training course, understanding hybrid fiber/coax design, San Francisco. Contact Bill Brobst, (404) 903-6306.
28: SCTE Wheat State Chapter meeting, BCT/E exams to be administered, Great Bend, KS. Contact Jim Fronk, (316) 792-2574.

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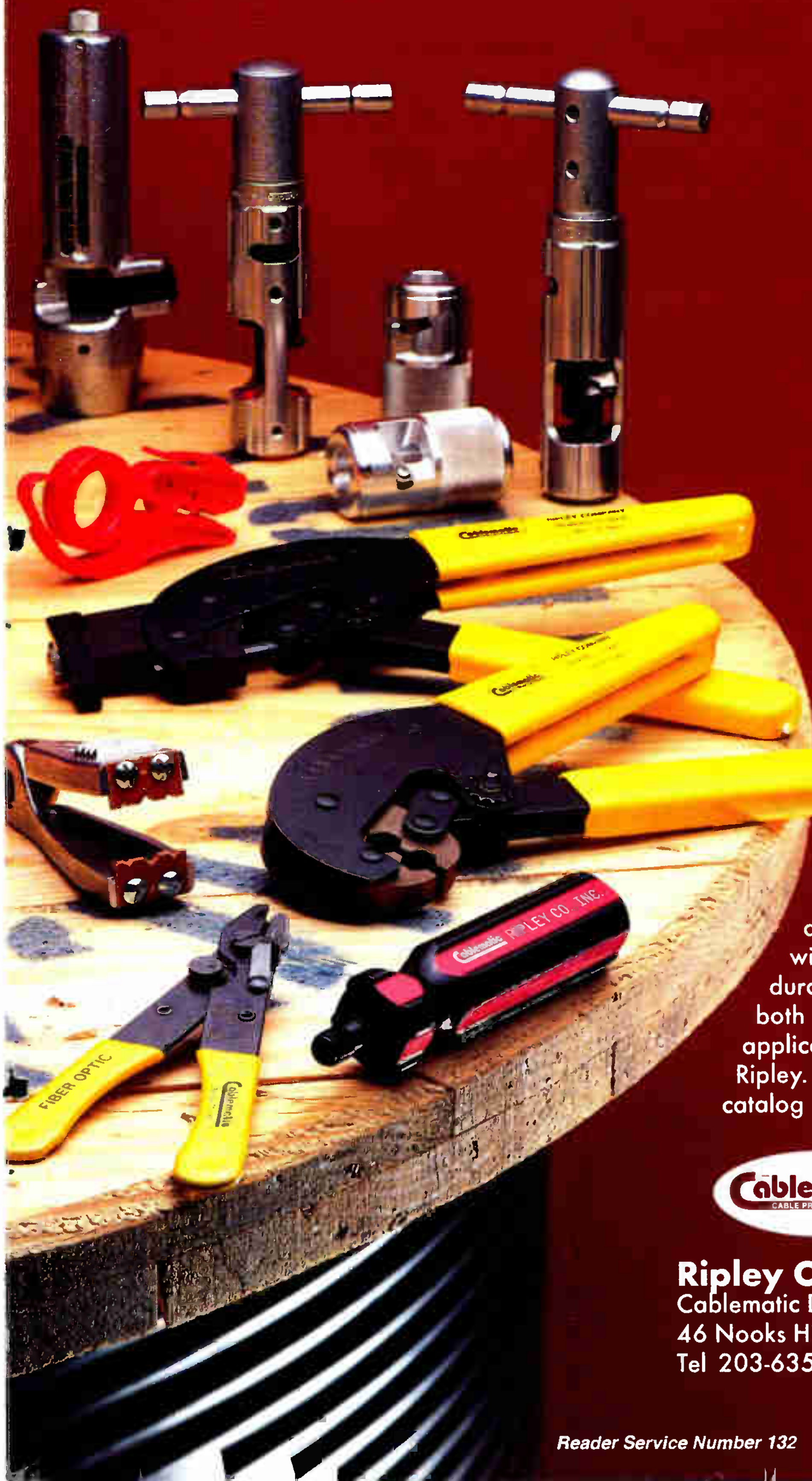

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Reader Service Number 132

Be a winner at Cable-Tec Expo '95!

By Bill Riker
President, Society of Cable Television Engineers

It is my pleasure this month to inform you that plans are well under way for the 1995 Cable-Tec Expo, to be held June 14-17 at the Las Vegas Convention Center in Las Vegas, NV.

It would seem that the 1994 Expo, which was held in St. Louis and broke all previous Expo records by hosting 2,800 attendees and 2,400 exhibitor personnel, would be hard to top. But, with the excellent program we've assembled for this year's event, I am certain that Expo '95 will be another well-attended record-breaker.

The exhibits

Exhibit space is currently being reserved for the Expo, which, I am proud to say, is commonly recognized as the cable telecommunications industry's premier technical training event and trade show. As this issue went to press, nearly 200 of the industry's leading manufacturers and service providers have reserved space in the 1995 exhibit hall, which will offer attendees the opportunity to enjoy hands-on demonstrations in a relaxed, noncommercial atmosphere.

Cable-Tec Expo 1995 will offer 13 exhibit hours at the following times: Thursday, June 15: 11 a.m. to 6 p.m.; and Friday, June 16: 11 a.m. to 5 p.m.

Tutorials, engineering conference

Cable-Tec Expo '95 will kick off with a new addition to the program, three preconference tutorials that will be presented on Tuesday, June 13 from 2 to 5 p.m. Preconference tutorials have been well-received at our Annual Conference on Emerging Technologies because they offer attendees an opportunity for in-depth presentations on topics that are key to our industry's professional growth and development. I'm sure many attendees will welcome this new opportunity to gain additional training and "brush up" on the latest in broadband communications technology.

The three sessions to be presented as preconference tutorials are: "Organizing Safety Training Programs at the System Level," "Audio Quality" and "Effective Learning Strategies."

Traditional Expo offerings will begin on Wednesday, June 14, with the our Annual Engineering Conference. Over the course of six hours, technical and management papers will be presented by many of the industry's engineering leaders in the following panels: "Improving System Operations — Building On a Firm Foundation" with Ted Hartson of Post-Newsweek (moderator); "Designing Tomorrow's Broadband Network" with Hugh McCarley of Cox Cable (moderator); "Advances in Digital Technology" with Rex Bullinger of Hewlett-Packard (moderator); and "Telephony and the Cable Industry" with Joe Van Loan of Cablevision Industries (moderator).

Membership meeting

The conference will be followed by the 1995 Annual Membership Meeting. It affords members, as well as representatives from the Society's 74 chapters and meeting groups, the opportunity to meet with the national board of directors and pose questions concerning Society policy and future plans.

Workshops

Expo workshops attracted standing room only crowds at Expo '94, and the workshop program for Expo '95 ensures more capacity audiences. The workshops offer attendees hands-on training and extensive interaction with instructors and will be held from 8 a.m. to 12:15 p.m. on June 15 and 16.

Workshops scheduled for Expo '95 include: "Ask the FCC," "BCT/E Technical Certification," "Communications Applications for Today's Fiber," "Digital Technology 101," "Emergency Alert System (EAS)," "Network Architectures," "Powering for Reliability," "Practical CATV Networks," "System Tests and Measurements" and "Telephony 101."

Attendees can benefit from the additional training opportunities that will be offered at the exhibit floor's Technical Training Center, which will feature in-depth product-specific equipment demonstrations.

This year's Expo Evening, to be held June 15, will be a "Western Party and Casino Night" that will feature a barbecue buffet, line dancing instruction, mechanical bull rides, a country/western band and professional instruction in blackjack and craps. Attendees will be able to play at the party's casino gaming tables to win prizes.

The Las Vegas Convention Center will be the hub of Expo '95.

BCT/E and Installer Certification exams will once again be offered throughout the convention, and are set to be conducted Thursday, June 15, and Friday, June 16, from 10 a.m. to 2 p.m., and on Saturday, June 17, from 8:30 a.m. to noon.

Win a trip to Expo!

One possible way to get to Expo '95 may be at your fingertips, in the form of the 704 field strength meter! SCTE is holding a contest prior to the conference in which contestants will submit photos and proof of ownership of one of this classic series of early CATV industry hardware. The winning entry will be chosen on the basis of lowest serial number, service history and overall condition and appearance. The winner, who will be required to display the winning entry at Expo '95, will receive complimentary air travel, lodging and registration to the event. To receive an entry form, contact SCTE national headquarters at (610) 363-6888.

Registration

The full-color Expo '95 registration package, containing information on hotel accommodations and Las Vegas area attractions as well as the technical program and agenda, is currently being sent to all active SCTE members. Nonmembers interested in obtaining a registration package should contact SCTE national headquarters at (610) 363-688 or fax your request to (610) 363-5898 and we will be sure to send one out to you.

I hope all of you will join us in Las Vegas for Cable-Tec Expo '95, and "win a jackpot" of technical training and education. **CT**

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The only system to give you Frequency Agile RF Modems

A status monitoring system is only as reliable as the return path. Accumulated noise and ingress on the return path may cause problems with your status monitoring system. You avoid these problems with the Cheetah System™. By using frequency agile RF modems in all field devices, the Cheetah System™ allows you to adjust frequencies from your headend or main office. You never have to roll a truck or physically adjust field devices.

Frequency agile modems also ensure that Polling Never Stops! When one channel is in use for polling and an alarm occurs, the alarming device may be queried for more detailed data on the next data channel. The Cheetah System™ continuously monitors your entire network even when you are performing tests and taking measurements at a problem location. For a reliable status monitoring system, be sure to require frequency agile RF modems.

Call (813) 756-6000

SUPERIOR ELECTRONICS GROUP, INC.

6432 Parkland Drive • Sarasota, Florida 34243 • (813) 756-6000 • Fax (813) 758-3800

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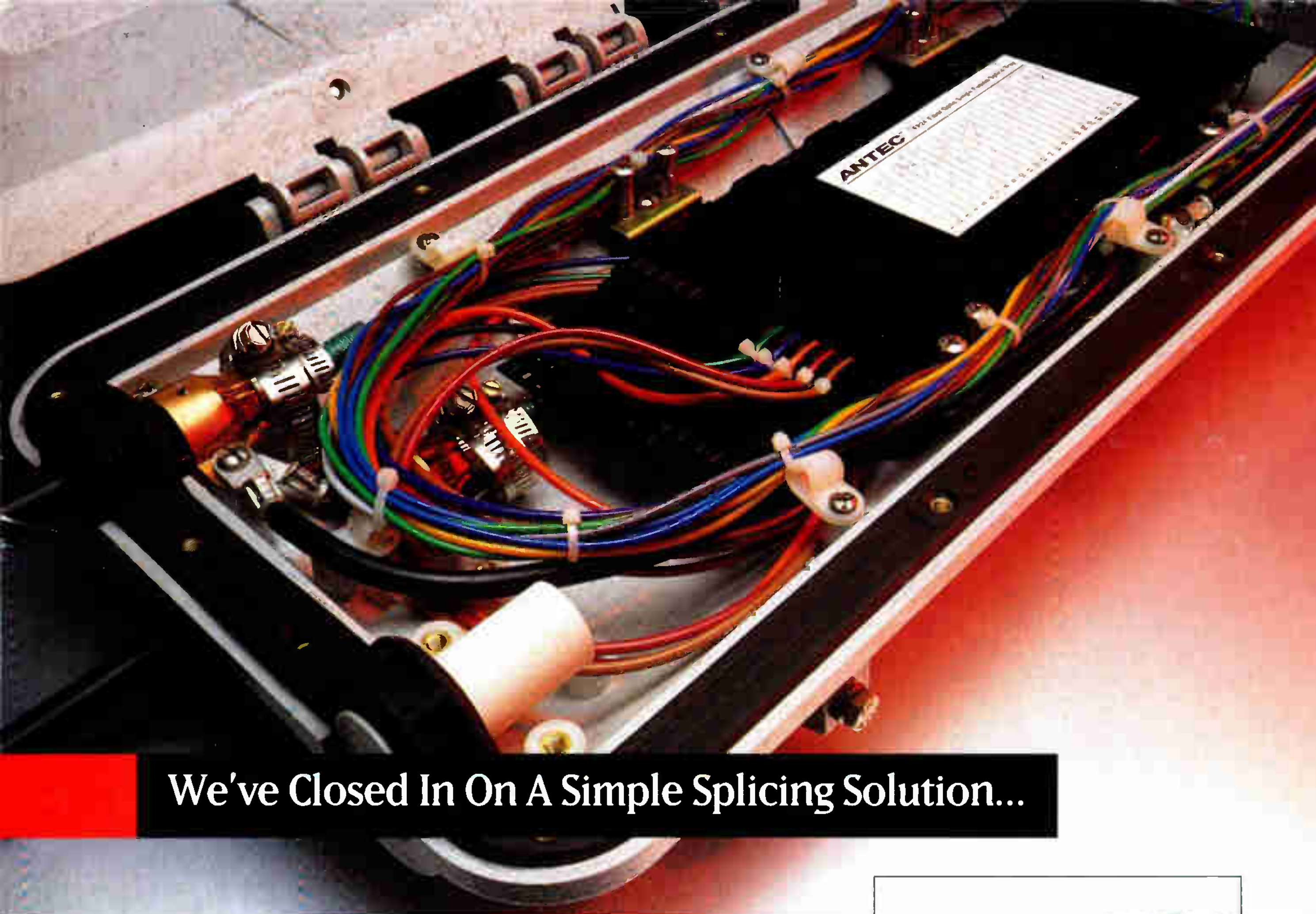


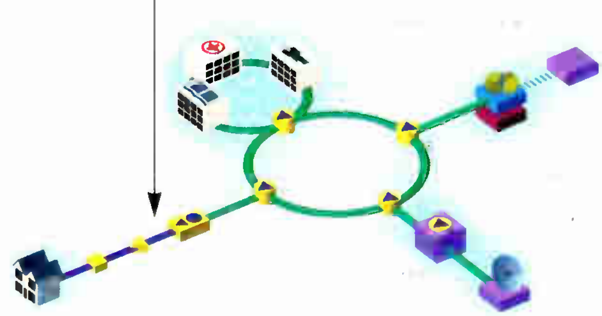
...The FiberPak™ by ANTEC

Now, there's a simple way to splice fiber optic cable. The new FiberPak™ splice closure from ANTEC is so easy to install, no special tools, heat adhesives, drills, power equipment or complicated instructions are required.

Suited for strand, pole, or underground mounting, FiberPak closures seal and protect fiber optic splices in butt or in-line configuration. Eight cable ports, splice trays and expansion kits allow easy expandability as your network grows. And FiberPak's solid, nonflexible housing protects splices in every environment and meets 1994 Bellcore specifications on fiber optic splice closures.

If you're adding fiber optics to your system, you need a splice closure that's easy to install. To learn more about the FiberPak, call your local ANTEC Representative or 1-800-TO ANTEC.

Our Cable Integrated Services Network (CISN) provides a blueprint for building a broadband network that accommodates interactive services in a 1 GHz spectrum. The FiberPak allows easy port expansion as your network grows.



ANTEC
Network Know-how

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