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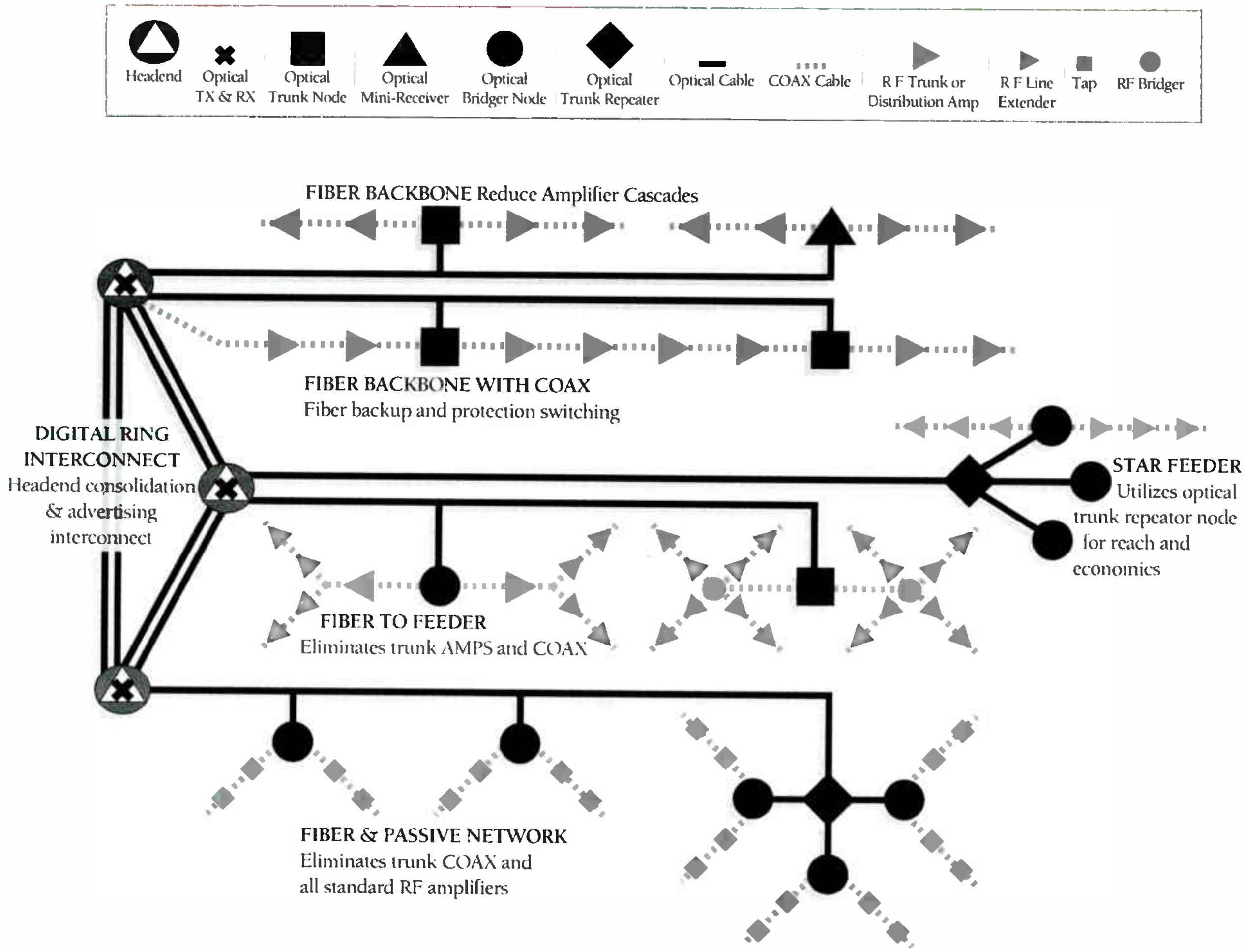

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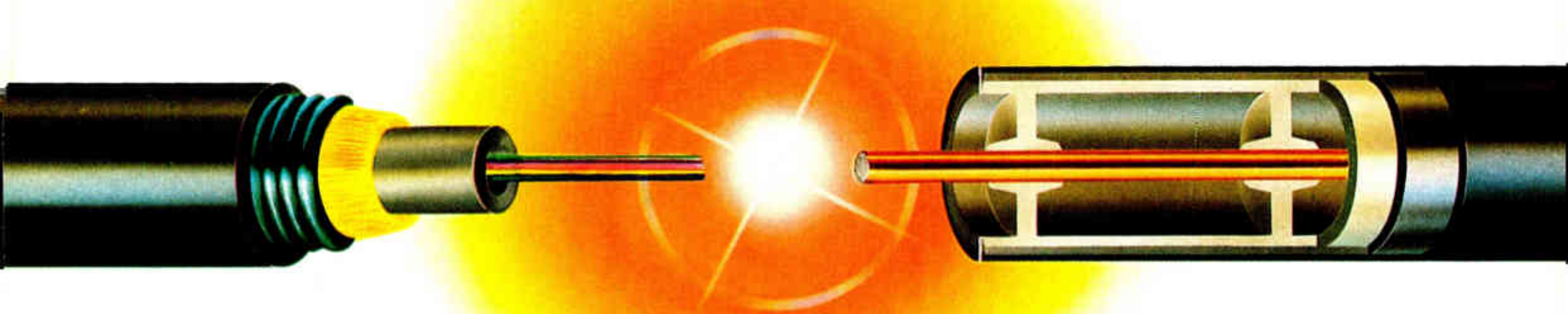

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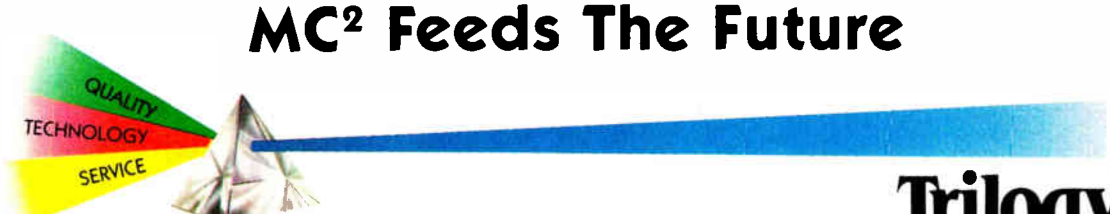

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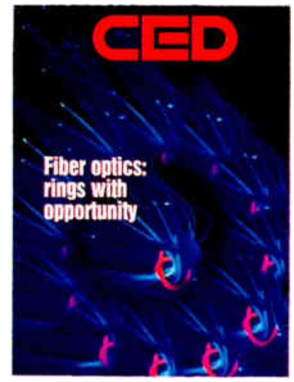

About the Cover
Cable adopts fiber ring technology. Photo by Dominique Sarraute.

DEPARTMENTS

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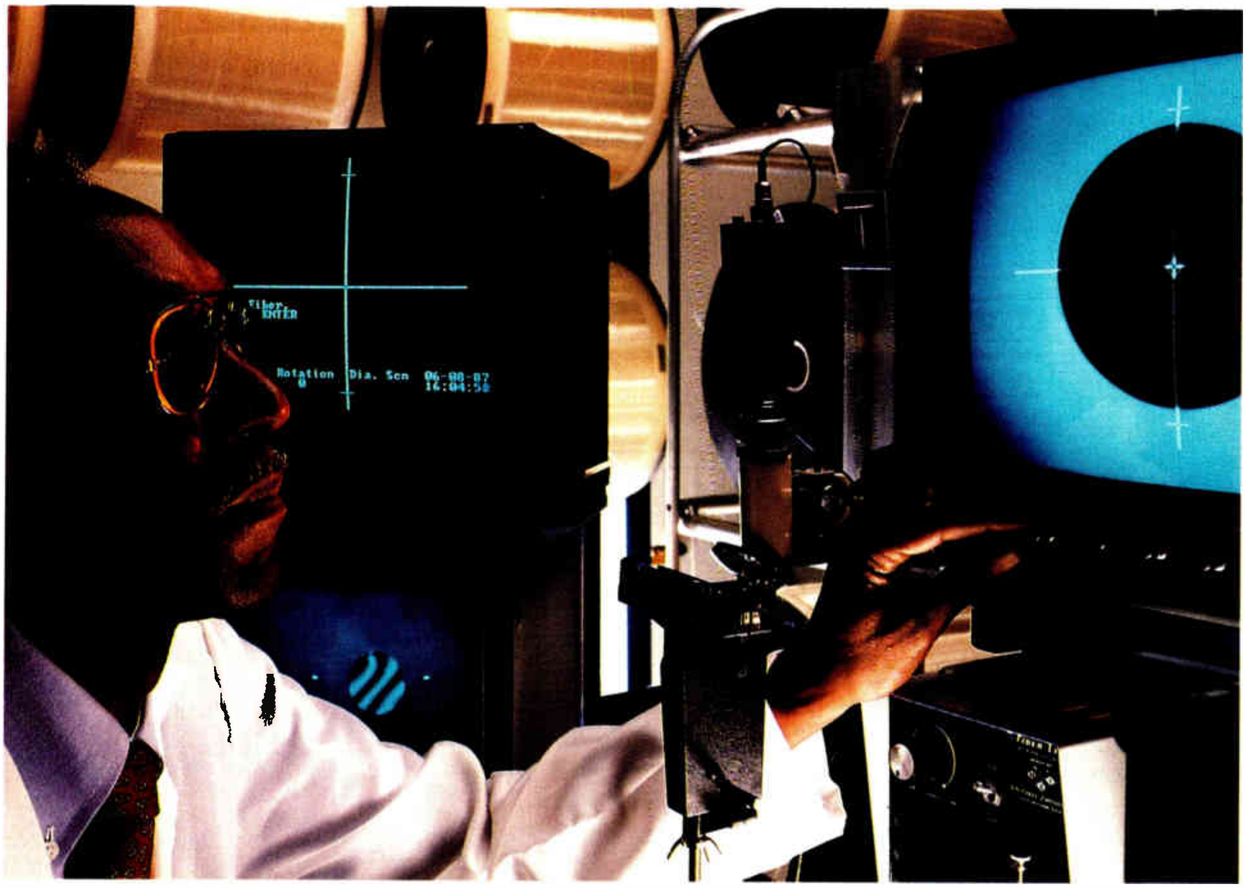

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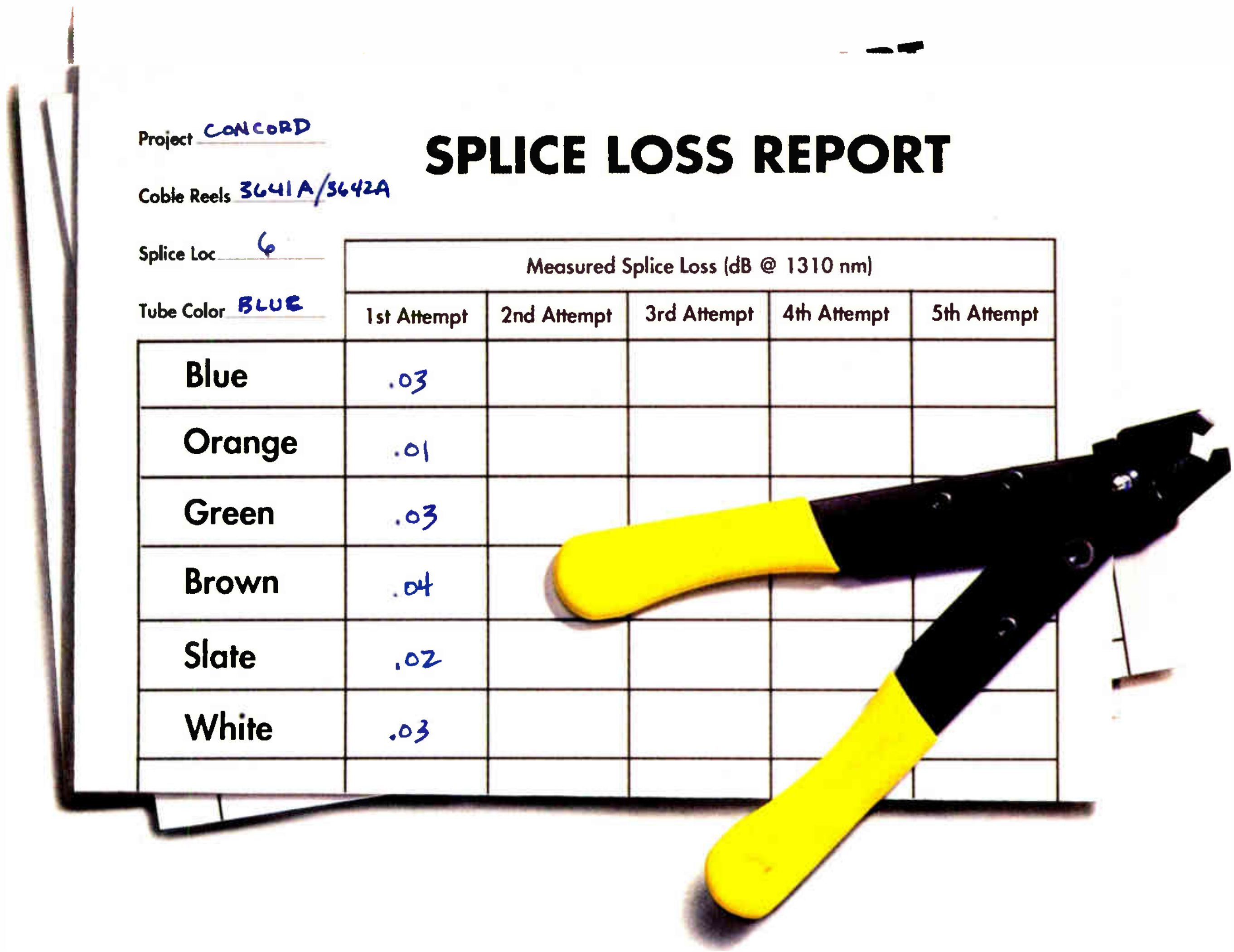
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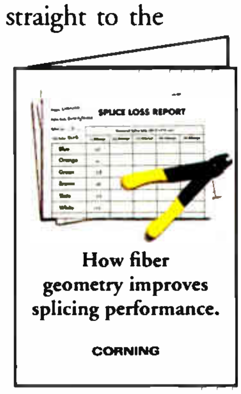

CORNING

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CableLabs issues $2 billion RFP; MSOs proclaim industry unification

In case there were any doubters out there, the cable industry brought out its best and brightest to proclaim their willingness to spend upwards of $2 billion over the next several years to upgrade existing cable television plant to carry telephony signals. Cable Television Laboratories hosted an hour-long press conference last month to outline its request for proposals for such technology, to which replies are due Sept. 23.

Joining Labs President and CEO Dick Green were Dr. John Malone, president and CEO of Tele-Communications Inc.; Brian Roberts, president of Comcast; Jim Robbins, CEO of Cox Cable; and Bill Schleyer, executive vice president of Continental Cablevision. RFP participants Time Warner and Viacom were unable to attend the event.

The others were in New York to proclaim that there is a cable industry unification for entering the telephony business and for developing standards to ensure interoperability across traditional franchise boundaries. There also appeared to be widespread support for the development of a dynamic "bandwidth manager" that would allocate spectrum depending upon the number and type of services being used in the home.

Indeed, Malone said he prefers to adopt a "point of entry" approach that would funnel all incoming and outgoing signals through a gateway device located on the side of the home, thus eliminating set-top devices and making it easier to interface with consumer electronic gear. Malone said he believes such a device, which would "handle all requirements for all services" is just two to five years away.

This is a departure from TCI's present approach to implementing new services, which has relied on digital set-tops with high levels of processing power and resident intelligence. The company has committed to purchase 1 million digital boxes from General Instrument and 500,000 more from Hewlett-Packard.

In addition, Malone said the industry could find success in the telephony marketplace by focusing on the value cable operators can add simply by delivering more bandwidth. For example, he said cable could dedicate 20 kHz to each voice circuit or offer stereo telephony to improve the sound quality over those available today. "There are ways to reinvent the wheel," he noted.

The CableLabs RFP envisions a three-phase approach to implementing new services, starting with a telephony "overlay" on top of cable service, followed by high-speed data and video telephony coming in later. The RFP has been sent to more than 100 companies and responses have been received from about 75 companies, according to a Cable Labs spokesman.

Compatibility effort winds down, decoder interface still iffy

As the decade-long struggle to develop a strategy toward overcoming cable/consumer electronics compatibility issues winds down toward a final(?) ruling from the Federal Communications Commission, the commission last month received nearly a dozen separate filings on the issue, as part of its normal reply comment procedure. More filings, specific to the proposed decoder interface, were due August15.

Specifically, the FCC received documents from the Electronic Industries Association, Consumer Electronics Retailers Coalition, Consumer Federation of America and Home Recording Rights Coalition and Compaq Computer Corp. The FCC also heard from the National Cable Television Association, Zenith Electronics Corp., General Instrument Corp., Cablevision Industries, Time Warner Cable and Hewlett Packard Corp.

Essentially, the most recent filings represent "the end of the pleading cycle," explained Wendell Bailey, vice president of science and technology for the NCTA. The FCC may or may not concede to the wishes of the various interested parties, nor does the FCC have to comply with a specific response timeframe.

Pleas from the various submissions vary widely. The EIA, speaking on behalf of the consumer electronics industry, urged the FCC to "reject petitions for reconsideration," citing specifically the separation of security functions from other features in future decoder interface modules and restrictions on remote control infrared codes.

Fueling an already hot debate between cable and the consumer electronics industry over the demarcation line between cable services and television features, the EIA wrote: "If consumers can only obtain decoders that also include non-security features, the whole purpose of the decoder interface would be defeated, because non-security features would not be competitively provided."

However, Time Warner's filing argues that competition is "lessened, not increased" by prohibiting cable operators from incorporating non-security related features into the component terminal equipment used in the decoder interface. Further, Time Warner argued, a forced separation of security functions and other features translates into added cost, because more than one microprocessor would be needed.

Taking the argument one step farther, the retailers coalition–perhaps envisioning retail riches from set-top box sales–thinks decoding functions used to make scrambled programming watchable should be separated not just from future decoder interfaces, but from future set-top boxes, as well. In its filing, the CERC recommended a solution that requires "the same modularity in set-top boxes as the Commission has required in the decoder interface."

The decoder interface, a subject that epitomizes the opposing viewpoints of the EIA and the NCTA, will make up the bulk of a joint NCTA/EIA engineering committee recommendation, which was due to the FCC August15.

As of press time, Dr. Walt Ciciora, chairman of the decoder interface subcommittee and an expert on the compatibility issues, wasn't sure whether the draft specification would be submitted in its entirety. "We'll probably submit it with two holes," said Ciciora. "One is whether or not the specification is digital, analog or a hybrid of both. The other is the compatibility between the plug-in module and the consumer electronics product."

These subjects have been the focus of lengthy and sometimes heated debate between the two organizations, say insiders.

ANTEC grows company via several new acquisitions

Making good on his statements of a few years ago, John Egan, president and CEO at ANTEC, has announced four new acquisitions and one major investment in the past several weeks that enhance the company's product and service line.

Egan, who told Multichannel News a couple of years ago that he intended to develop more products under the ANTEC umbrella, announced that the company has purchased Engineering Technologies Group, Keptel Corp. and Power Guard, and made a minority investment in Sumitomo Electric Lightwave Corp. Several weeks ago, ANTEC announced the acquisition of Atlanta-based Electronic System Products, a research-and-development company.

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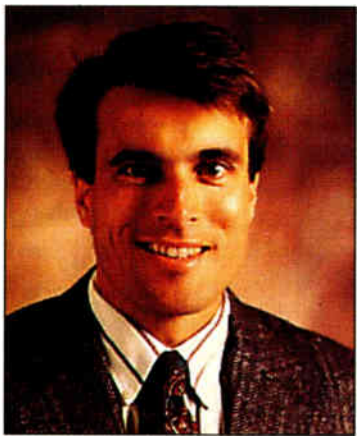
Ken Pyle: Off to a running start

By Dana Cervenka



A fresh-faced, high school junior, soldering certificate in hand, Ken Pyle entered the cable industry with a running start–and he hasn't stopped since. Fate took him first to Tom Olson's Tomco, where Pyle quickly learned the business from the ground up, starting off by assembling cables and graduating into actual product engineering. Pyle worked on everything from agile upconverters to an automatic non-duplication switcher that would compare two channels. And he liked it.

Today, as video product manager for Raynet Corp., he is involved in the definition of the company's broadband product line–helping mastermind which engineering designs are manufactured and built, soliciting feedback from customers, placing the product in a business perspective and supporting sales with technical product presentations. He's quick to give due credit to his colleagues, characterizing his current position as being a member of a team effort.

For someone of his youth, Pyle has been involved with a dizzying number of companies in a variety of positions. He has also seen his share of mergers and takeovers. His first job, at Tomco, led to slightly bigger projects when the company was purchased by Catel. In 1984, he went to Quante, where he experienced one of the defining moments of his career.

Signing on at Quante, Pyle had the distinction of being the seventh employee to join the company. As field service engineer, he was a juggling jack-of-all-trades, working on PC layout, system tests, board tests, "whatever." The company was also one of the early entrants into multimode technology. "(Bigger fiber) is easier to work with—you can even connectorize it . . . but it does give you a lot of problems that don't exist in singlemode fiber, like nodal noise," says Pyle. He quickly discovered that although digital was supposed to be, "you plug it in and it works," it didn't always.

And that defining, life-altering moment? Pyle discovered that the cutting edge of technology can rapidly become the razor's edge when he "single-fingeredly" knocked out service to 167,000 subscribers while working at Quante. Characterizing it as the low-point of his career, Pyle was checking out a board with an oscilloscope test probe one Thursday afternoon around 3 p.m. when the probe shorted across the power supply, ultimately taking it out of commission.

Around 5 p.m., the general manager started to receive calls from customers who had set their VCRs in anticipation of a tasty weekend preview. Fortunately, Pyle, a factory rep, and the actual operator were able to bypass the injured power supply, thanks to a frenetic effort in using microwave for one or two channels and by running electrical wires across the room. As it turns out, the GM had a sense of humor, the power was only down for 30 minutes, and a new power supply arrived over the weekend. Not only did he demonstrate a cool head and a lot of ingenuity, but Pyle also had a "great weekend," even though he was charged with babysitting the system.

At that point in his professional life, Pyle decided to return to school and build on his associate of arts degree in math, graduating from California's San Jose State with an economics degree, math minor.

I want my rocket TV

While attending college, the ambitious Pyle began working part-time at ISS Engineering for his long-time friend, Norman Gillaspie. During his tenure at ISS, Pyle worked on a precursor to video on demand: a factory automation project which allowed workers who were building rockets to order up videos of each model, all while sitting at their PCs.

It was also while he was at ISS that Pyle contributed to the downfall of western civilization, having a hand in building PC receivers for the in-store audio networks that broadcast "elevator" music.

By now well-entrenched in the industry, Pyle went to work for Comlux (now C-Cor/Comlux), where he had the distinction of being the first employee to receive a paycheck. In his capacity as product manager, Pyle worked on a lot of "fun" projects, including digital video transport.

In his professional community, Pyle is committed to the exchange of ideas and information. A member of the Society of Cable Television Engineers (SCTE), he has given talks to local SCTE chapters, has made presentations at the National Fiber Optics Engineering Conference (NFOEC) and has co-written six technical papers, as well as several articles for CED. The body of his work encompasses a range of topics, from T-1 in CATV applications to agile modulator review and Ethernet extensions.

He's equally versatile in his off-hours, as both a devotee of country music videos and self-appointed softball "czar" of the "Half-Fast Batters," the company team. As for his home life, Pyle has lots of family members in-state, but counts among his pets only dust bunnies.

Channel surfing

In conversing with Pyle, it quickly becomes apparent that he is intrigued by technology's effect on society. "I'm looking forward to the day when I can sit back in my lounge chair, and instead of turning on my computer and trying to access Compuserve through a bunch of arcane commands," he explains. "I look forward to being able to channel surf in the Barcalounger."

And as for his personal future? "I don't think I will ever get into a routine, the way the industry is changing, everything is changing," predicts Pyle. "As long as I can continue doing new things, having new challenges, I'm looking forward to that." CED

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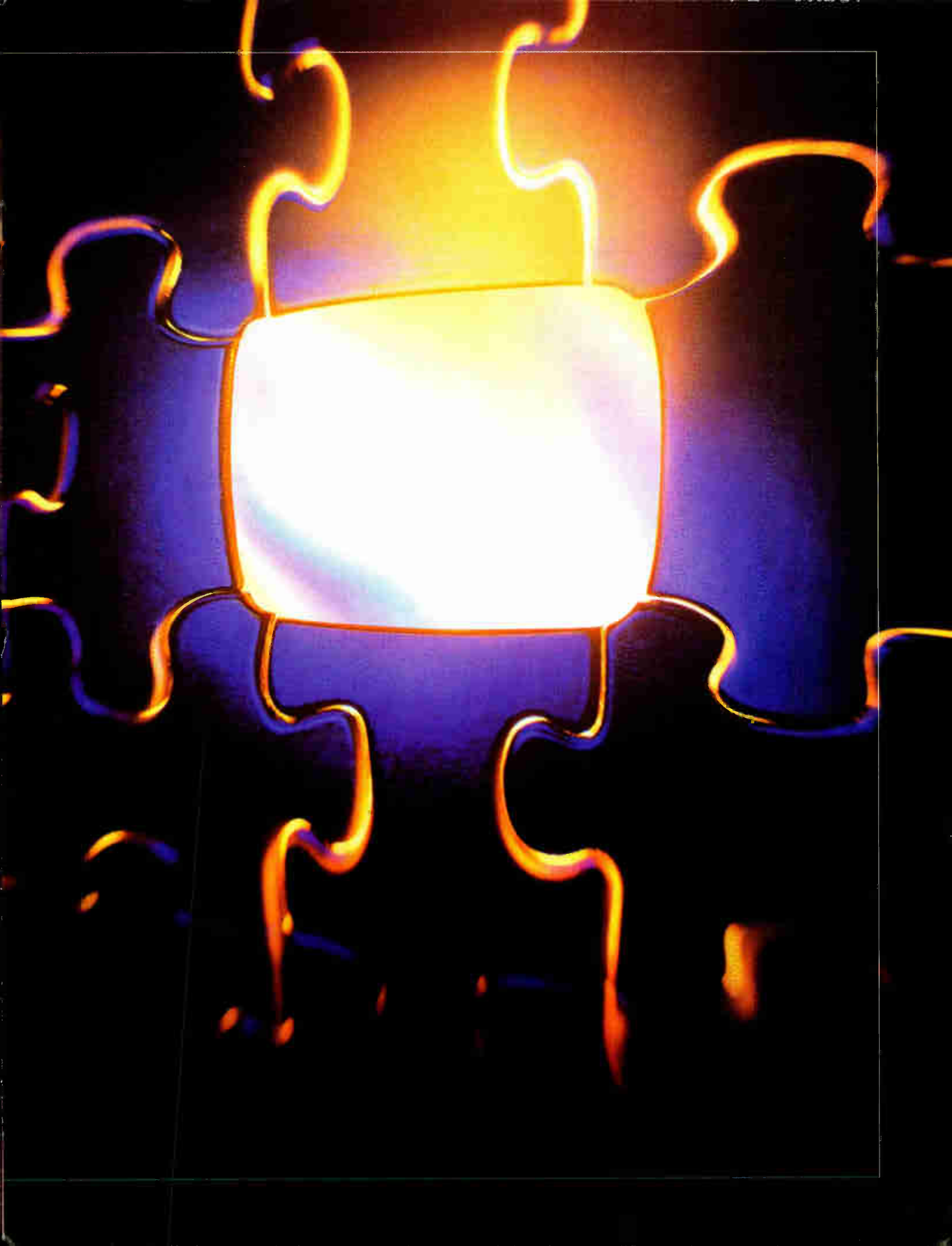

Let's put the cart behind the horse

By Wendell Bailey, VP of Science and Technology, NCTA

After years and years of activity in the digital vs. analog standards issue, I must reluctantly admit that times are changing. This admission comes after attending the most recent NCTA engineering committee meeting and dealing with a highly-charged discussion about the role of digital standards-setting groups and the cable industry. During that meeting, it was decided to form a standards subcommittee.

The fact that this issue came to such a head is indicative of the level of interest (or is it just pure activity?) that has recently surrounded the issue of digital standards. I don't need to reiterate for this audience the fact that the standards-setting debate revolves around whether or not it's good to set a standard which allows, simply because of its existence, manufacturers to build equipment, and purchasers to find equipment they know meets certain criteria.

But the other side of the argument is that if I'm forced to set a standard, and someone has a better idea the following week, it's unlikely that the new idea will be listened to or considered by anyone. This debate is as old as technology itself, and it's always had some relevance to some of us.

Digitize me

Why then, is there such an incredible interest in standards and such a big effort by so many groups to force standards on the digital video world? Part of the reason, I believe, is because "digital" is breaking out all over. Indeed, while the idea that we could digitize analog signals and manipulate them in a variety of ways is not new, the cost of transistors, memory and circuitry to process these digital manipulations has become so low that everyone believes we can–and should–digitize virtually everything.

Why this is so is better left to other discussions. But suffice it to say that this interest in easy accessibility of signals to processing in a digital domain has led to great fear from government and some industries that someone, somewhere, will be prevented from accessing a service, or being connected to a network, unless there are standards.

The problem with this is that there are at least 400 standards-setting committees involved in a variety of issues that could directly affect the cable industry's business practices. With that many people working on that many issues, doesn't someone somewhere see that this whole effort has gotten way out of hand?

I recently attended a very high-level and useful meeting where about 35 organizations came together to discuss the standards-setting issue. The general idea was to begin consolidating some of the activities to focus them toward identifiable goals.

After the better part of a day, which was filled with different viewpoints and featured vigorous discussions, it was suggested that there were already too many issues on the table, and that the best way to make any headway was to form about nine–you guessed it–subcommittees.

Get used to the idea

In my opinion, the cable industry has traditionally not had the available resources in the form of qualified personnel to attend these standards-setting meetings. That is not likely to change anytime soon. With so many committees setting so many standards, one could fear being overwhelmed. I could say that the nice thing about standards is that there are so many to choose from.

I don't believe standards are necessarily bad. I do believe, however, that the timing of a standard and its relevance to a particular service are of absolutely critical importance. We should not be setting standards and then seeing if we can find a market for them; we should instead be trying to figure out what we can offer to our customers and give them products that are acceptable, attractive and valuable.

If there are standards that make that job easier or more repeatable, more reliable or of higher quality, then we should seek them. Too many standards-setting bodies are trying to do this the other way around.

I'm always troubled by groups loaded with people from other industries who decide that the cable industry should do things differently. This is especially harmful because the cable industry typically has little or no active participation.

Taking inventory

What the industry needs is someone who could simply inventory all the standards-setting groups that are currently meeting and report on why they are meeting, the progress they have made toward their goal, which deserve our attention and which could benefit from the application of additional resources from our industry.

Whether we like it or not, the cable industry is going to be working on standards in the future. The engineering committee's decision to establish a subcommittee to work on standards has as its first goal the point I've just made: inventory the standards-setting activities and identify those activities which may be of interest to the cable television industry. Then seek guidance from our principals and business leaders as to which ones we should attempt to influence.

So now there's yet another standards-setting group starting up. Only this time, I hope it can be one that will try to identify problems we have and the need for solutions–before we set off to define how anything can be done. CED

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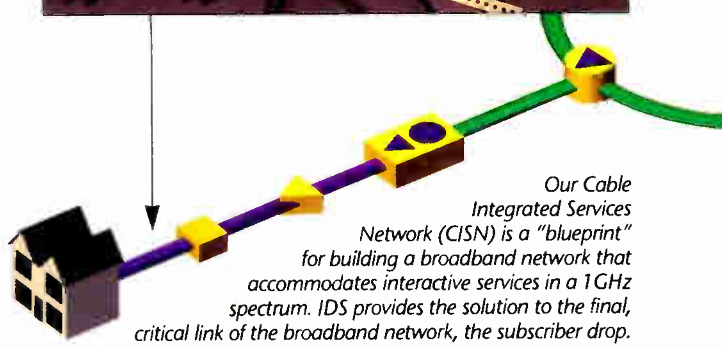

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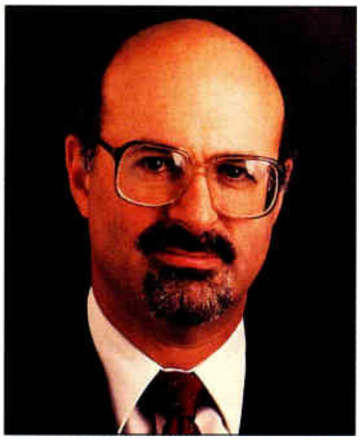
Security issues and the NII



By Jeffrey Krauss, polishing apples in the information supermarket and President of Telecommunications and Technology Policy of Rockville, Md.

The National Information Infrastructure (NII) today is a diverse set of communications networks, carrying diverse types of information and using different technologies, different access philosophies and different security techniques. The Clinton Administration is pushing for interconnection, interoperability and widespread access. Only recently has it given any thought to security. Industry has argued that security and commercial operations are closely intertwined. But there are types of commercial operations that are less worried about security.

Types of security

There are two important types of security associated with electronic information: access control and copy protection. The cable industry uses a variety of hardware-based techniques for access control: scrambling of individual channels, trapping, even disconnecting the drop wire when a subscriber "unsubscribes." Computer networks usually rely on software-based techniques such as passwords for access to the network, and sometimes encryption of individual files and messages.

Copy protection, on the other hand, is a relatively recent entrant in the security wars. Copy protection of analog video recording has been used for about five years. Copy protection of digital audio recordings, using hardware techniques, recently became a part of the copyright laws. Of course, the copyright laws have always restricted the copying of printed information, but the widespread deployment of electronic copiers has made enforcement virtually impossible.

Most access control techniques and copy protection techniques have been defeated by pirates and hackers. To the best of my knowledge, the latest version of VideoCipher-RS scrambling and the encryption system used by DirecTv for its DBS service are still secure, at least for now.

Password-controlled access to computer networks has repeatedly been defeated in recent years, for example, by the use of "sniffer" programs that intercept the login sequences and make copies of the passwords.

Copy protection of digital audio is accomplished by "tagging" the audio recording with a bit pattern that indicates whether copying is permitted, and then requiring (by law) that any device capable of recording the digital audio bitstream must not copy those audio recordings that have certain tags. But there is no technical protection against a pirate modifying the bit pattern of the tag–it's illegal, of course, but easy to do.

In mid-July, the government held its "NII Security Issues Forum" to give industry groups the opportunity to present their views. There were representatives of the banking industry, computer industry, libraries, health services, entertainment and publishing industries. The entertainment and publishing groups, in particular, underlined the need for security in a commercial environment where information (the legal term is "intellectual property") is distributed to subscribers. Security for intellectual property is necessary in order to assure compensation, and this serves the public interest because compensation encourages the creation of new intellectual property.

There has been a suggestion to change the copyright laws to take into account the new networking technologies. In particular, the "fair use" concept in the copyright laws is under review. As more and more works become available on-line (sometimes solely on-line), there is a feeling that researchers, students and the public should have the same right to browse on-line that they now have to browse printed materials in schools and libraries. This may protect against becoming a nation of information "haves" and "have-nots." But applying these concepts to digital on-line information, while retaining security, may be difficult to achieve.

Electronic publishing

One group that testified at the NII Security Issues Forum was the Creative Incentive Coalition. This group is comprised of newspaper and magazine publishers, information (database) vendors, broadcasters and motion picture producers. From the cable industry, it includes Viacom, Time Warner, Times Mirror, Cox and General Instrument. The coalition represents those who create programming and information products, and intend to sell these products to on-line subscribers.

But I have a friend, a magazine publisher, who has a different perspective. She has developed an on-line information product. She is happy to give it away. She'd like to have it copied and redistributed as widely as possible. She makes money by selling advertising, not by selling access. The advertising is embedded in the programming, just like MTV's logo. Of course, as her products develop a "brand name" and consumer demand increases, she may decide to charge for subscription access as well as carrying advertising.

In television today we have three economic models: broadcast television, which is supported by advertising rather than subscription fees; premium program services like HBO, which are supported by subscription revenues; and those that fall in between, satellite delivered channels that both carry advertising and charge for subscriber access.

On-line services will probably develop in this same way. On-line programmers and information services will decide, based on their costs and their evaluation of market demand, which model to choose. One of those costs that must be considered is the cost of security: hardware, software and enforcement. That's a real cost. Sometimes, giving it away free does make economic sense. CED

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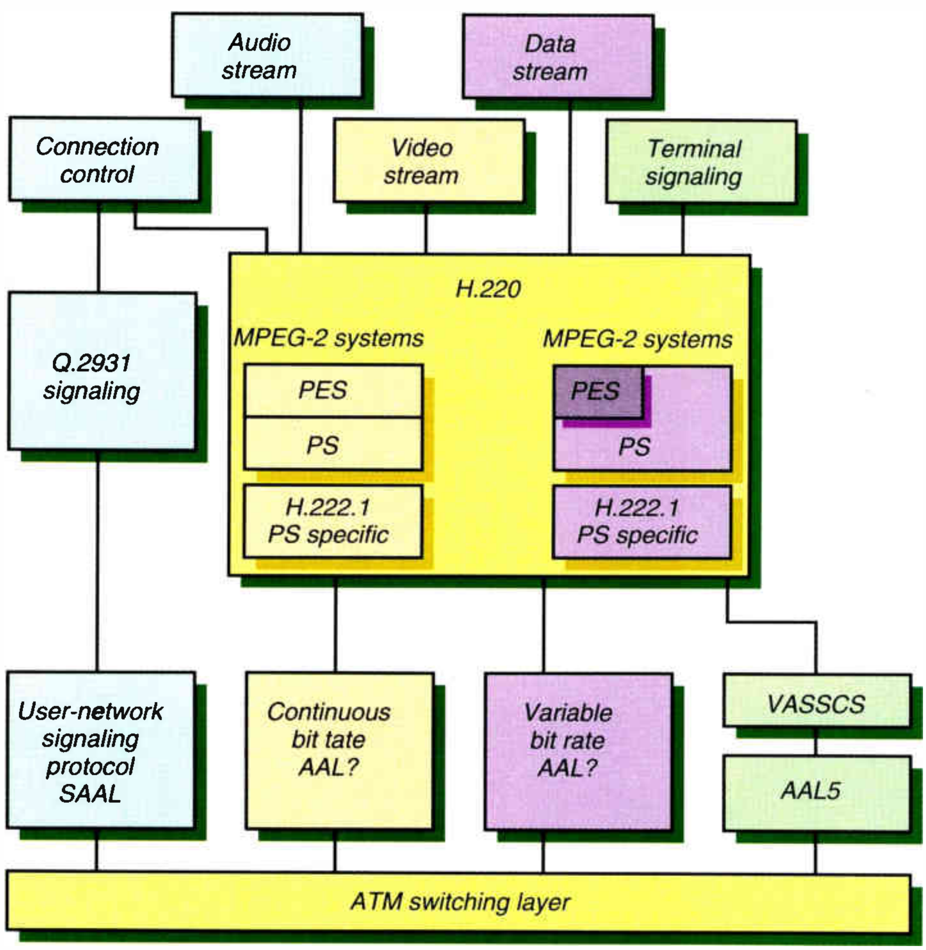
ATM and MPEG protocol issues concern CableLabs officials

Audio visual services over ATM



PES: Program elementary stream

VASSCS: Video and audio service-specific convergence sublayer

AAL: ATM adaptation layer

TS: Transport stream

PS: Program stream

What would happen if two core technologies of future full-service networks, namely Asynchronous Transfer Mode (ATM) and the Moving Picture Experts Group's MPEG 2 standard, didn't get along very well?

Sounds serious, right?

CableLabs is concerned about ensuring interoperability of MPEG 2, the industry's emerging video compression standard, and ATM, the favored high-speed link layer cell technology.

And CableLabs is pushing–through an organization of vendors and users called the ATM Forum, through standards bodies and in direct contacts with vendors–for an open-systems approach to ATM-MPEG 2 "mapping" that won't force the cable industry to rely solely on proprietary vendor solutions. ("Mapping" refers to the way in which one data format is enveloped in another, more global format–like containers loading onto a container ship.)

The two outstanding mapping issues are cell loss and cell-delay variation, explains Rhonda Hilton, who represents CableLabs before several ATM-related groups.

Parameters must be defined in both these areas if an FSN is to avoid degradation or outright failure of an FSN-delivered signal, according to Hilton. "When somebody in a home says 'I want to view a film,' a message has to go through the network saying, 'This person wants to view a film, let's get the video on demand-quality connection set up to this person's home.' That will probably imply a certain amount of guaranteed nearly error-free transmission, in addition to low delay. It is these kinds of quality-of-service parameters that should be established."

Cell loss

The main potential cause of cell loss is that "MPEG 2's 188-byte payload and ATM's 53-byte cell do not necessarily map neatly," Hilton says. "You go over a cell boundary and it fills up more than one cell"–potentially causing a picture to break up if a single ATM cell carrying key MPEG data is lost.

ATM Adaptation Layers (AALs) are ways of mapping a higher-level protocol onto the ATM protocol. The MPEG transport stream is such a higher-level protocol–specifically, a Layer 4 or Transport Layer protocol in the well-known, seven-layer ISO data communications protocol chart. The ATM Forum has been trying to agree on and recommend to standards-setting bodies the best AAL for MPEG 2-to-ATM mapping.

(Figure 1 conveys a sense of this "mapping" process, showing the interfaces and functionalities associated with both the ATM and MPEG 2 levels of the architecture.)

"Smoothing"

When the transport of ATM cells is delayed in a switch or elsewhere in the network, the resulting "jitter" can degrade or freeze a signal or even cause the receiver to think it has lost the feed, explains Hilton. Delays will vary in length according to the remoteness of the signal source or the time of day.

"Transporting a movie in prime time could be very different from transporting it in the

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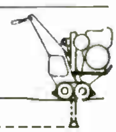

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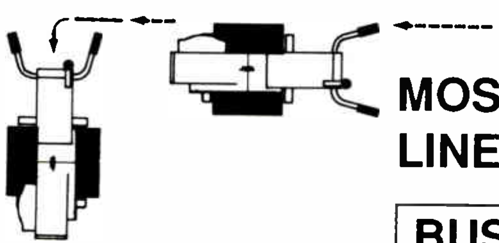

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Table 1

Bandwidths Associated with MPEG 2 Transport

Entertainment	4 Mbps
Action	6 Mbps
Studio	9 Mbps
MPEG 2 "Main Profile"	15 Mbps
HDTV distribution	18 Mbps

Source: CableLabs

middle of the night. At 7:00 in the evening, the cells to a given location will be far less likely to all have exactly the same flow throughout the whole evening," Hilton said.

CableLabs sees its role before bodies like the ATM Forum as "stating our requirements and the developments in our industry, but letting (these groups) work out the implementation of solutions. We try to make contributions toward expedient solutions," Hilton says.

In July, for instance, Hilton and CableLabs Vice President of Engineering Dr. Rich Prodan submitted a paper to the ATM Forum's Services Aspects & Applications Subworking Group. It noted that for all MPEG 2 data rates–ranging from 4 Mbps for entertainment to 18 Mbps for HDTV (see Table 1)–"the bit-error rate should correspond to a maximum of one error event in 15 minutes."

Hilton thinks getting a timely solution to the mapping issue will be "an uphill battle."

The paper also discussed several reasons why cell loss, alone, is of limited value as a performance parameter. It also examined ways in which ATM cell-delay variation could be kept from harming the delivery of video signals. Hilton also represents CableLabs on a newly formed group within the ATM Forum studying the needs of residential and small business users.

"An uphill battle"

Hilton thinks getting a timely solution to the mapping issue will be "an uphill battle. It's going to take an effort that is not just technical but will involve working with vendors so they get product to cable operators." Ideally, she says, the mapping solutions should come from formal standards bodies, such as the International Standards Organization and the International Telecommunications Union.

Hilton calls it "a good trend" that traditional cable vendors, in particular, General Instrument and Scientific-Atlanta, have joined the ATM Forum and have begun actively participating.

The ATM-MPEG mapping process is "a slow courtship," says Hilton. "Delays in mapping will make both protocols less desirable to the cable industry. It's not just that you miss out in synergy; the longer we wait, the higher the risk in deploying one or the other or both." CED

This article was prepared specially for CED by Bob Wells on behalf of Cable Television Laboratories Inc.

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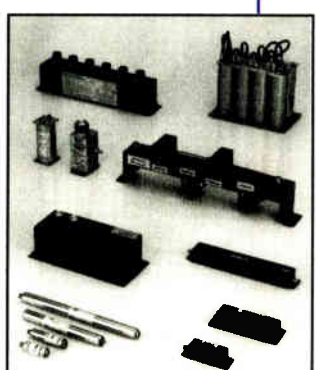

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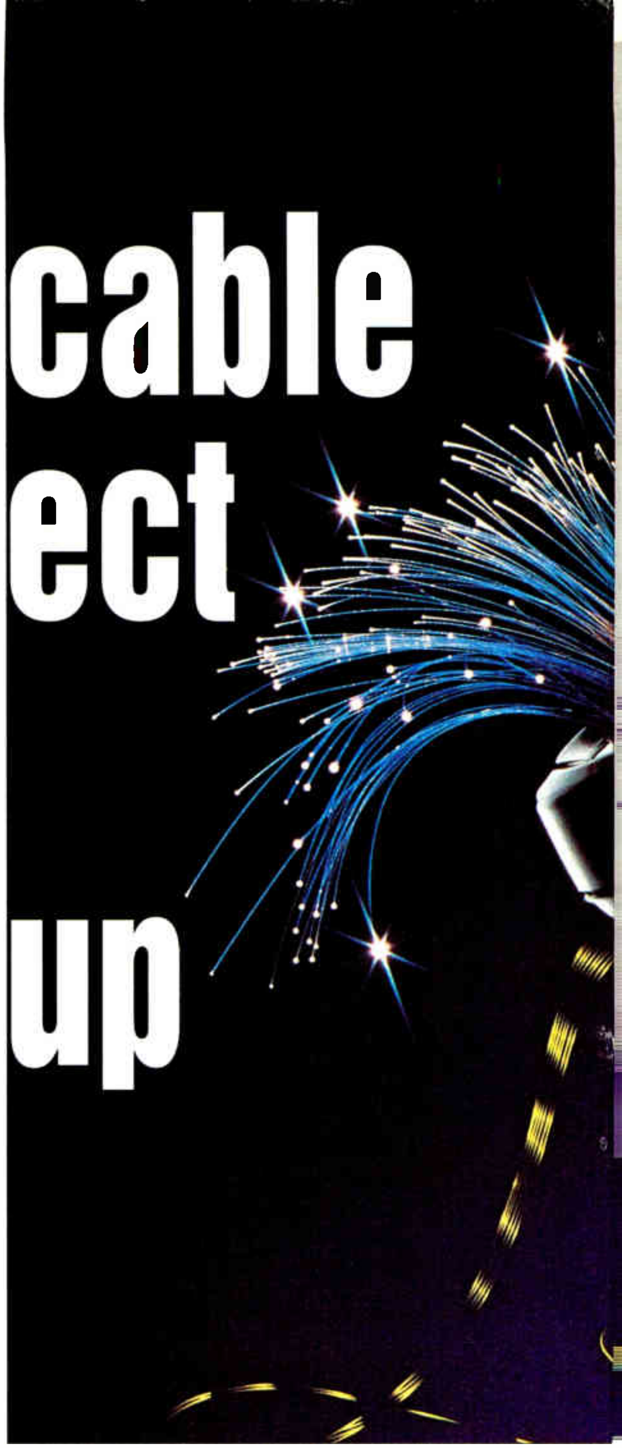
National cable interconnect activity heats up

From San Francisco to Pennsylvania, regional interconnects are taking hold



By Leslie Ellis

Like Charlotte's famous web, cable operators from coast to coast are gearing up to weave optical networks that link systems within towns, boroughs, counties, cities and states.

Cable's goal is anything but humble. In return for transporting data, telephone and video over the interconnected web of interlinked systems, operators hope to cash in on terrifically high revenues.

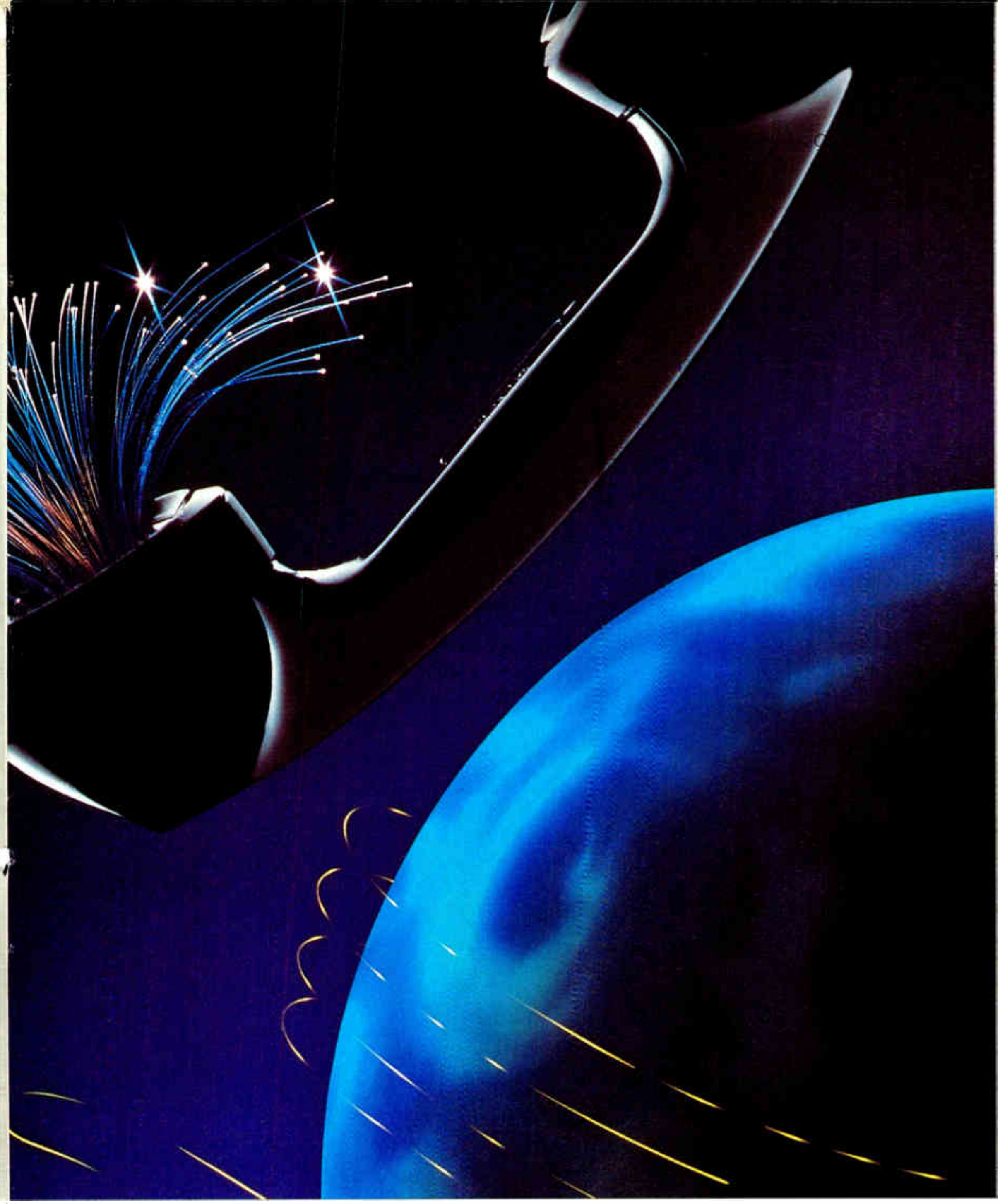
How high? Telephony alone could reap multiple billions of dollars from the effort, industry executives predict. Certainly, current regulations restrict operators from providing dialtone service in most areas, but judging from a $2 billion RFP issued by CableLabs last month for telephony-over-cable equipment (see related story, p.10), operators are confident those barriers will soon dissolve.

Economies of scale also play a critical role in regional interconnects, operators say. As a first step toward regional system interconnection, MSOs nationwide are actively collapsing multiple headends into one or two "master" headends that feed smaller distribution hubs via optical fiber paths.

"Two or three years ago, the question was not if, but why headends should be interconnected," says Andy Paff, executive VP of strategic planning and technology for ANTEC. "These days, the 'if' question is obsolete, and the 'why' question is obvious."

"The number-one issue (in headend consolidation) is always economics," says Charlie Cerino, director of technical operations for Comcast Corp., which is considering headend consolidation in six Detroit communities and in Indianapolis. "With fiber improvements, it's becoming more and more feasible to run larger systems from one place, where you build a superheadend instead of the redundancy and cost associated with five identical facilities."

Also, a superheadend can process digitally compressed MPEG-2 video, electronic program guide, games, digital music services or other signals onto a fiber ring using variable rate multiplexers, which format lower-speed, non-standard rate data streams into packets that ride within higher-speed, standard-rate data streams, says Paff. The variable rate multiplexer, in turn, connects to a line card customized for the application, which spits out a higher and standard-level



Across the nation, headend consolidation is becoming a common consideration in technical plans

data rate.

At a remote hub site connected to the master headend, the digitized, compressed and multiplexed bit streams undergo an opposite process, then are modulated onto a cable channel for delivery to set-top boxes, Paff explains.

Generally, says Cerino, master headends are large enough to house the needed additional laser transmitters, video on demand, signal processing gear and advertising insertion hardware. It is the latter category that stands to provide the kind of terrific–and as yet, unregulated–riches operators are seeking, says Paff.

"Ad insertion revenues, at this point, are much bigger than commercial telephone or alternative access," Paff says, particularly if ads can be segmented for niche delivery to subscriber nodes. "The economics are interesting, especially with a consolidated ad system. Instead of disparate systems in each headend, with a superheadend you can have one central system that feeds node-specific ads to specific demographic markets."

For example, says Paff, advertisements specific to one or more hubs on an optical fiber ring could be stored at the master headend, then transmitted to hopefully transfixed eyeballs at the appropriate time.

And, Cerino says, headend consolidation supported by route redundancy significantly fortifies signal reliability. "Short of getting hit by a nuclear bomb right next to the headend, you're OK," says Cerino.

A nationwide trend

Across the nation, headend consolidation is becoming a common consideration in technical plans, operators say. For example, in San Francisco, operators TCI and Viacom are building an optical ring to encompass the headends in and around the city. Nearby, in Intermedia Partners' territory, the MSO has already consolidated six community headends into one. That one headend also houses alternate access carrier Teleport.

The list goes on and on. In New England, Continental Cablevision is working to link 1.2 million subscribers within Massachusetts, New Hampshire, Maine and Connecticut; in May, Greater Media Cable added another 152,000 subscribers to the effort within its Worcester, Hampden and Hampshire, Mass. counties.

In the Dallas/Fort Worth area, Sammons Communications is acting out a plan to collapse 12 headends into one; Jones Intercable is weighing the feasibility of digital optical rings around its Chicago systems.

MSOs including Adelphia Communications, Newhouse Broadcasting, Metrovision, Wometco and Time Warner Cable are also considering or acting on headend consolidation plans.

Technical issues also play a role in regional interconnect projects. Because of that, says Wendell Bailey, vice president of science and technology for the National Cable Television Association, the NCTA engineering committee recently activated a regional interconnect subcommittee. The committee's job, says Bailey, is to identify the technical questions related to interconnects–then to answer those questions.

The group has met twice and has the list of questions in rough form, says Bob Harris, a senior engineer with C-COR Electronics who is moving to Northern Telecom.

Once the headends are consolidated and linked with fiber, operators can start planning for metro area networks, which use fiber to link businesses and other facilities within cities to a multiple operator network, explains Ron Cotten, president of Engineering Technologies Group.

The holy grail: a web of interconnected systems, regardless of MSO ownership, which can carry data or local voice traffic within a region or hand it off to the public switched telephone network for carriage to long distance carriers.

It's a concept which some see as the only way to combat burgeoning telco overbuilds. Like the "eye for an eye, tooth for a tooth" adage, operators facing telco overbuilds are eager to nab telephone revenues as soon as possible.

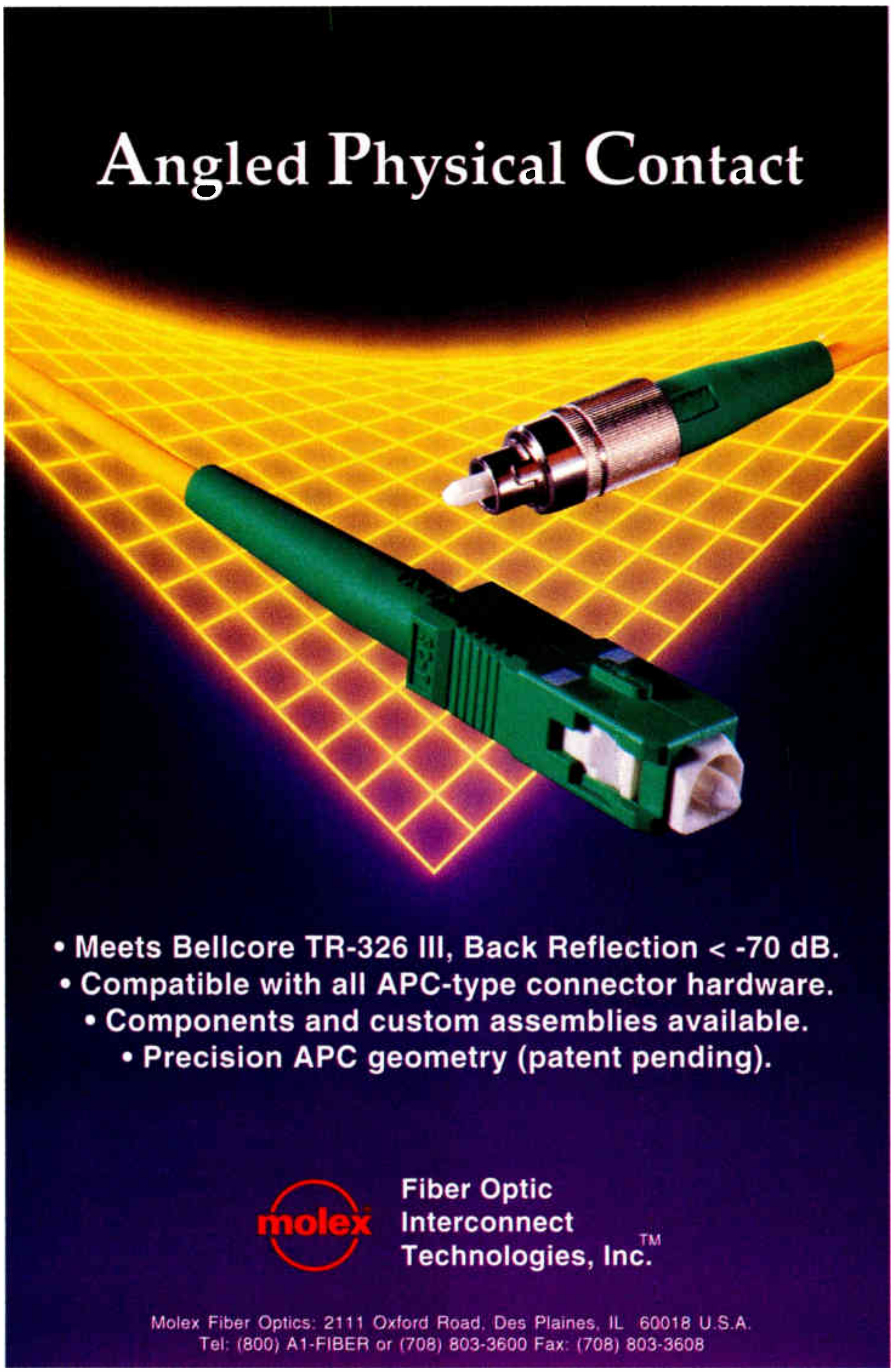
At press time, cable MSOs faced telco overbuilds in more than two dozen U.S. cities. Cox Cable, for example, is being overbuilt "from coast to coast," said VP of engineering Alex Best at the Eastern Show last month.

"In Virginia Beach (Va.), it's Bell Atlantic. In Omaha, it's US West. In San Diego, it's Pacific Bell," Best said. MSO giants TCI and Time Warner also face telco rebuilds. Hence, the push into telephony territory.

"Telephony could be a model for anybody playing defense," says ETG's Cotten. "Cable has the broadband local loop, but no interconnectivity between systems to compete directly in the phone companies' core business: telephony." The real driver of interconnects, then, will be telephony, Cotten predicts.

Cotten should know. For the past nine months, he has spent considerable time on all fours, literally crawling over giant-sized maps of Pennsylvania that are spread out on the floors, walls and any other available surface of his Denver-area office. The project: FiberSpan Pennsylvania, perhaps the most aggressive interconnect study commissioned in the cable industry to date.

That study is now complete, says Cotten. Pending FiberSpan approval, the next step is a



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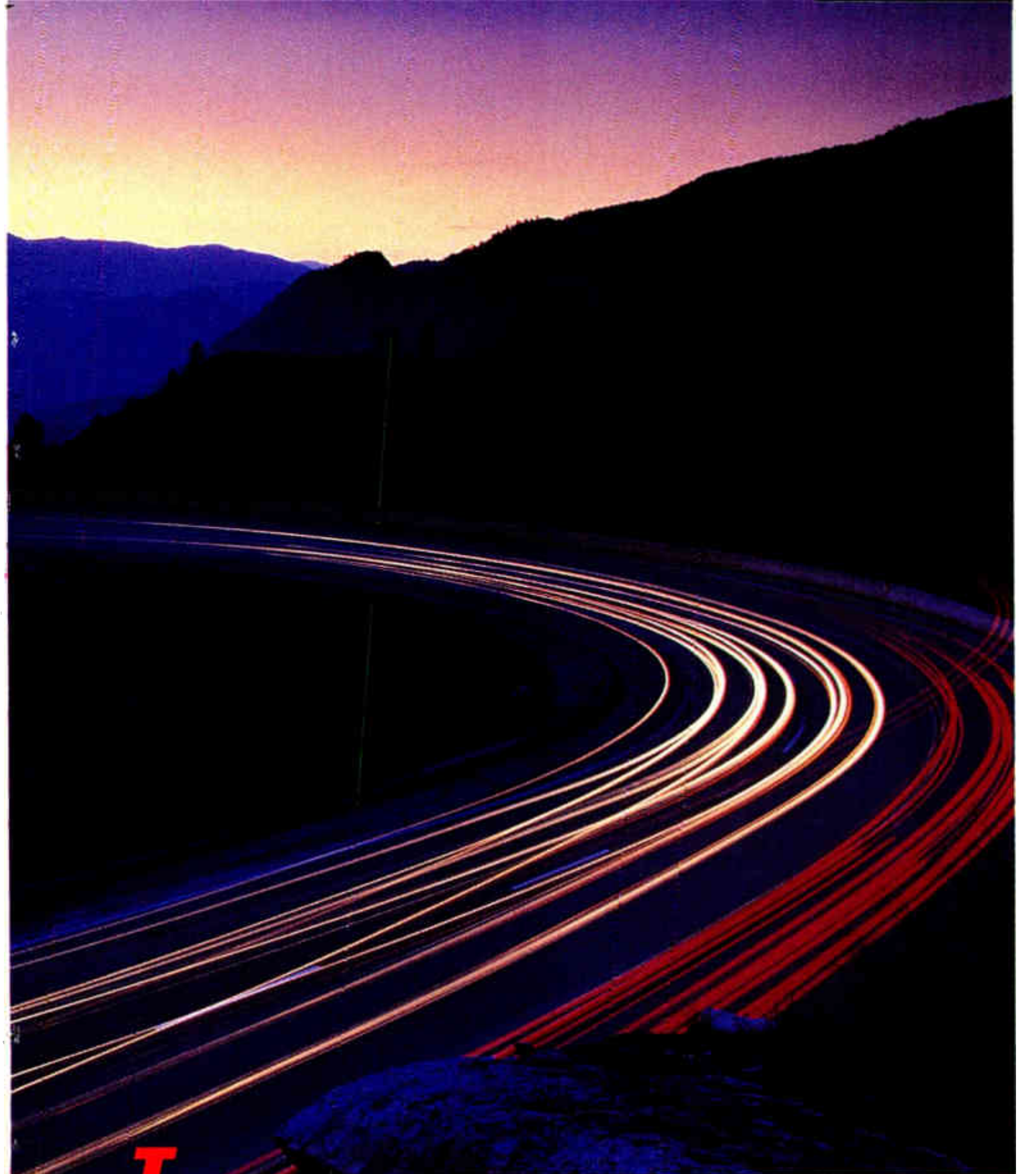

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While results of the ETG report haven't yet been made public, Cotten was willing to discuss some economical and technical ramifications which will likely apply to other operators considering an interconnect.

High on the list of concerns is the cost of carrying digitized video from city to city. Using a hypothetical model of 6,000 simultaneous digital video streams requiring transport from one city to another, Cotten says, the cost could well fall in the $3 million range.

High on the list of concerns is the cost of carrying digitized video from city to city.

"A video signal compressed at MPEG-2 rates takes up about 4 megabits," explains Cotten. "If you use OC-48 terminals at each end–which cost in the range of $180,000 each–you can carry about 600 simultaneous video streams." To handle 6,000 simultaneous streams, then, the operators involved in Cotten's hypothetical interconnect would need 10 OC-48 pairs, at a cost of $3.6 million–and that's just for transportation.

Costs for digital video transport on optical rings "can get ugly," agrees ANTEC's Paff. "There's no product today that's economically feasible for Sonet delivery of entertainment video," says Paff (see related story, page 34).

"Video carriage, at this point, gets into the mega-expensive range," Cotten says. "That's why when telcos talk about over-provisioning (telephone interconnects) by 50 percent, they don't need as much fiber as a cable operator would need to do the same thing for broadband. Cable services are high bandwidth applications, which aggravates the cost model."

Technical issues abound, Cotten says. At the top of the list, ironically, is capacity provisioning. "Up front in any interconnect plan, you have to size the optical capacity for the anticipated service requirements," Cotten says. "Because the whole idea of an interconnect is to provide the platform for new business opportunities, you have to decide what those opportunities are, first," Cotten continues. "And that's probably the hardest part, because it drives what you'll ultimately spend. You have to cover all these new applications, without breaking the bank."

Provisioning for digital video-on-demand is another tricky issue, Cotten says. Because of the current high costs associated with storing compressed movies and transporting digital video streams over an optical network, a "nested" file server approach, where digital file servers are strategically located within the network, may make more sense, he says.

That approach is already under development by vendors including Scientific-Atlanta, ANTEC and Philips Broadband Networks. "The idea is to store the top-run movies on a server closer to subscribers," explains Bob Luff, chief technical officer for Scientific-Atlanta. "So, a movie like "Sleepless in Seattle" might be stored multiple times on the local server, to meet current demand. A less popular title might be housed on a regional server, or even a national server."

Philips Consumer Electronics apparently agrees. Later this year, the Dutch manufacturing conglomerate plans to integrate product lines within its U.S., France and Holland divisions to offer network operators a true end-to-end, server-to-convertor system. Central to that system is the nested server concept.

"We see a market for mini-servers, which hold roughly 100 movies, for headends or nodes," says Al Kernes, vice president of sales for Philips Broadband Networks. "Less popular titles would be stored on a larger server and communicate with the mini-servers to download requested titles at very high speeds."

Design issues

Designing the regionally interconnected network is also a major challenge, Cotten says. "In Pennsylvania, for example, we had 200 or so cable systems, each one of which represented a point on a map. The network had to interconnect all those points," Cotten says. "Some points are bigger, with more homes passed. Others are very small. Some are along branches; others are positioned for rings."

As a result, Cotten says, network layering almost has to start with the larger, higher density systems. As density lessens, design tends to migrate to a branch structure, "depending on the total homes passed and the total distances between more rural systems."

Interconnection and digital standards also represent a potential roadblock for regional links. Says ANTEC's Paff: "It'll probably be the middle of next year before issues like mid-span meets are worked out, where one operator is using one vendor's OC-48, and another operator is using a different brand OC-48, and the two can talk together and interoperate.

"The standards aren't quite there yet," Paff continues. "At this point, the (data) payload is interoperable, but the software alarm conditions and other software pieces are not."

Comcast's Cerino says network monitoring will likely be a necessity as the number of homes per node shrink and interconnect activity increases. "A potential problem with small node sizes is that you don't know when there's been a neighborhood outage," says Cerino. "If you have 600 passings and 300 subs, maybe you have 10 percent watching TV in the middle of the day. So that's 30 people.

"If something goes dark, human nature says that maybe five or six people of that 30 person group will call in," Cerino continues. "We're used to getting 10,000 calls as a definite indication of an outage. "

But, if the riches from transporting video, telephony and data tip the scales as generously as operators like TCI, Comcast and others hope, those issues will likely iron out–quickly–and cable will give telcos the same dose of competition MSOs are already feeling in telco overbuild areas.

"If there's one thing I've learned in studying interconnects, it's that cable is positioned to provide very, very competitive telephone services to customers," says ETG's Cotten. "I know that's not necessarily what the telcos want to hear, but it's the truth." CED

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ADC Telecommunications

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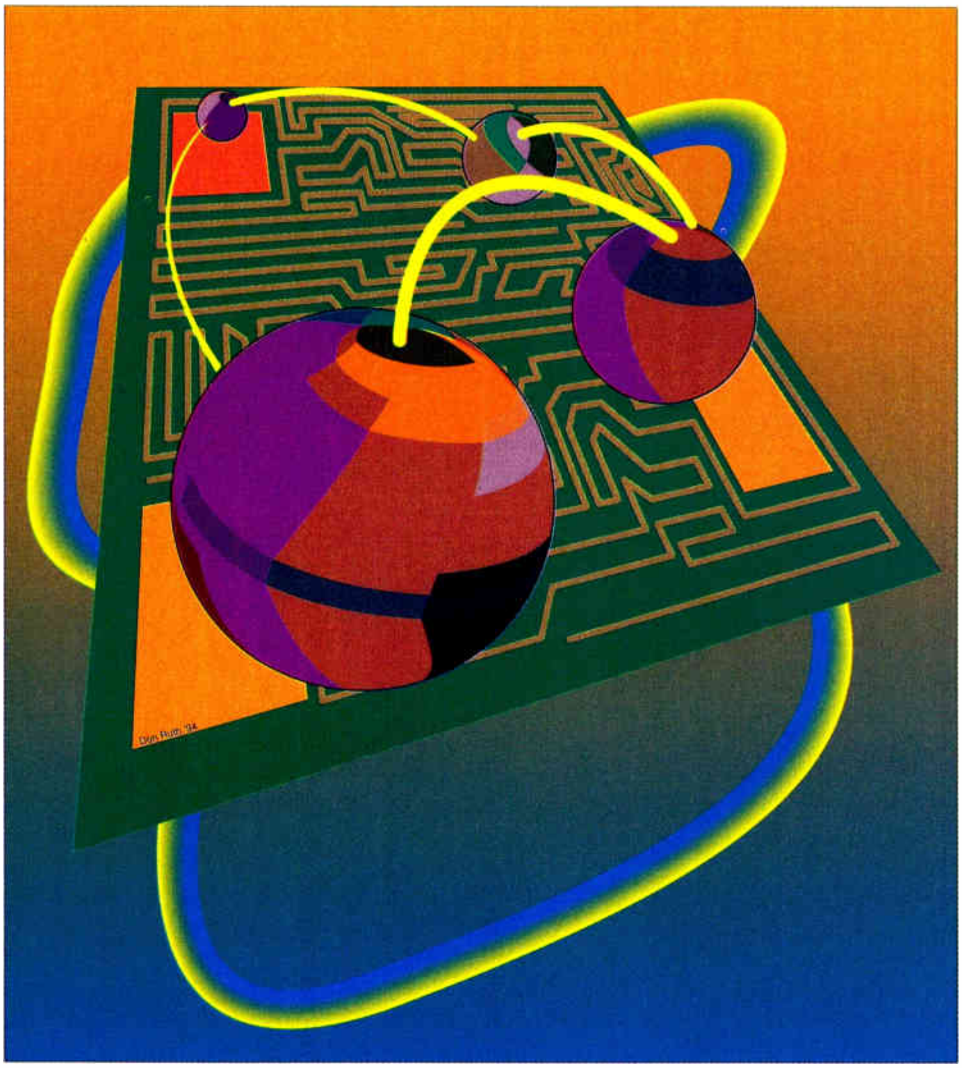
Does Sonet play in cable's future?

AM, PCM much less expensive



By Roger Brown

As cable operators begin to upgrade their network infrastructures to support new services, they are increasingly collapsing headends into regional "superheadends" from which they launch signals over fiber to a series of hubs in a ring-like fashion. But as they do that, they're faced with a big decision: should they deploy Sonet (Synchronous Optical Network) gear that promises to bring future benefits, or put in a vastly less expensive analog or proprietary uncompressed digital solution?

The answer depends upon the applications each system expects to support, according to most equipment vendors, but some say the need for Sonet compatible equipment is overstated and at least several years away.

Sonet proponents note that it's a global standard that was developed to:

✔ transport high-speed optical signals,
✔ improve reliability by providing for route redundancy and other survivability features,
✔ provide for service add/drop capability and
✔ provide better network management.

Its detractors, however, note that Sonet is no panacea; in fact, they say it's a wildly expensive solution that also has some serious technical shortcomings when used to transport video.

The bottom line appears to be that Sonet as it is known today is an expensive technology that offers little benefit to the transport of broadcast entertainment video. Nevertheless, virtually everyone believes Sonet is a key part of cable's future as the industry becomes more transaction-oriented and begins delivering telephony and data traffic.

Case studies

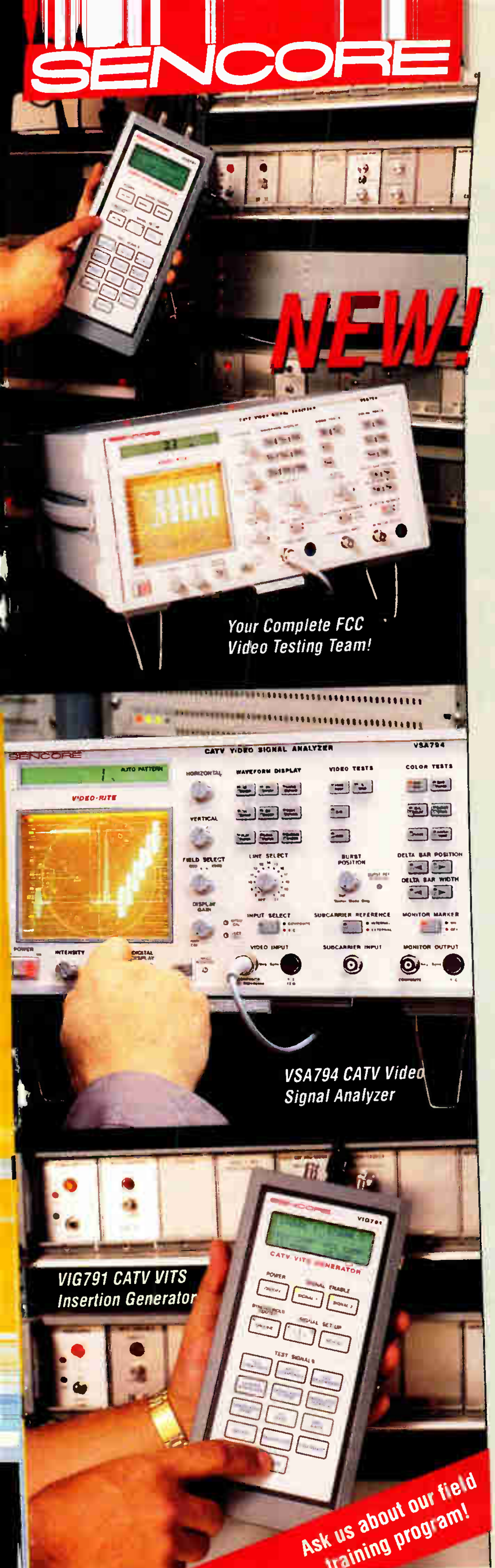
Engineers who built two of the industry's largest interconnects–the 180-mile Viacom/TCI fiber ring around the San Francisco Bay area and the 200-mile ring built by Continental Cablevision in New England–compared the two alternatives and both chose an uncompressed digital solution based on pulse code modulation (PCM).

Viacom chose to use equipment manufactured by American Lightwave Systems for its Bay Area interconnect because it would have "maxed out the capability of an OC-48 Sonet network almost from day one," says Del Heller, vice president of engineering at Viacom Cable.

The Sonet approach would have compressed two video channels into each DS-3 circuit, meaning that the OC-48 ring had a capacity of 96 video channels. But with more than 90 channels of analog video and plans to add 200 MHz of compressed digital channels, a Sonet solution would have cost Viacom almost $1.5 million more than the ALS gear it bought. "If video had represented only about half the capacity, we may have looked upon it more favorably," Heller says.

But the problems didn't stop there. If Viacom had chosen to use Sonet gear, Heller says the network would have suffered about a 5 dB performance hit when compared to the ALS gear. "It just wasn't as transparent as we would have liked," he notes, especially when the proprietary systems can offer medium-haul video specs over the backbone.

Also, there was no way to transport BTSC stereo audio as a 4.5 MHz subcarrier, which meant the MSO would have needed a receiver for each stereo channel at each hub. With 50 channels and seven hubs, Viacom would have needed about 350 receivers if it had used Sonet; that alone would have cost between $250,000 and $500,000 more, Heller says.



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based on Staten Island. Teleport is a so-called competitive access provider that competes vigorously with the LECs by building fiber metropolitan area networks (MANs) to serve large volume users and/or long haul carriers such as AT&T, MCI and Sprint. In addition, Comcast and MCI are heavy investors in Nextel, which offers wireless services called Enhanced Specialized Mobile Radio (ESMR).

Has consolidation collapsed?

The short answer is no. Megadeals collapse for a variety of reasons, many of which do not invalidate the movement toward consolidation. Bell Atlantic, TCI, Southwestern Bell and Cox placed the blame on the FCC and its infamous rate rollback. But this is only a small part of the story. More likely explanations include:

✔ A pull back by the regional Bells: There is a realization that the cable TV companies had less to offer than was originally believed or promised, and that the telcos were being asked to pay far too much money for them and their outdated networks.

✔ Corporate culture conflicts: Telcos have a strong commitment to their subscribers, while cable TV companies are dedicated to making money, whatever the impact on their customers.

> **Do not expect the existing structure or players to remain undisturbed as this industry matures.**

✔ The attitude of the program providers: The studios do not necessarily like the cable TV companies with whom they are currently forced to do business, primarily because of a lack of viable business partners.

✔ A growing tendency on the part of the RBOCs to lay down the law. Richard McCormick, chairman and CEO of US West, testified that the company may not deploy broadband networks if it cannot provide video services right away. Naturally, this remark did not go down well at the White House.

✔ The RBOCs are under a growing attack by local municipalities for trying to slip video programming in by the back door to avoid franchise fees. Their plans for video on demand in Dover County and in northern Virginia are being challenged for this reason (see switched video section in sidebar).

The bottom line

Consumer demand is pivotal to the future plans of both the cable TV and major telcos. If a mass marketplace emerges, an infotainment industry will emerge that will involve both cable TV and telephony. It will be an industry that will be rife with mini-deals, joint ventures and acquisitions, just as the cellular industry has been for the past decade.

Do not expect the existing structure or players to remain undisturbed as this industry matures. It will disturb the established order all the way to the boardrooms of the major TV networks. Intelligent broadband multimedia equipment has the ability to transform TV as we know it today. Once this market emerges, vendors that make this equipment will benefit immensely. Here are a few examples:

✔ Fiber cable upgrades, two-way amplifiers, multiplex equipment

✔ ADSL, ATM and Sonet hardware and software

✔ Intelligent headend equipment, crossconnects, network managers

✔ Set-top boxes, interactive software, applications software

✔ DBS equipment, compression algorithms, service agreements

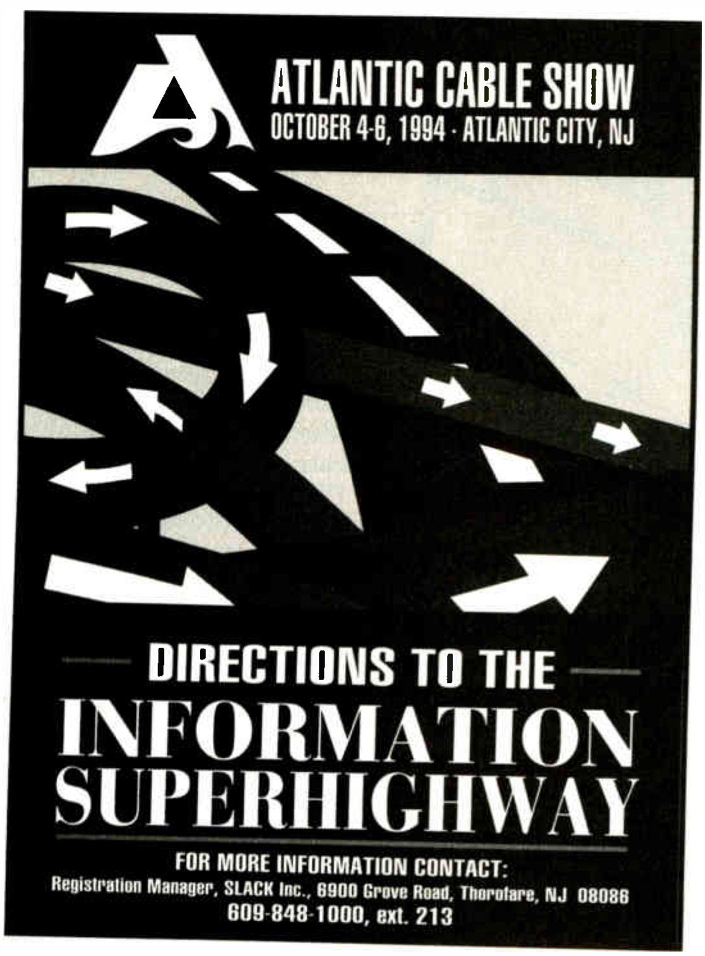
✔ Interactive program provision

✔ Cable voice/data networking, remote power and security systems.

Watch for changes in the way this infotainment industry is administered. The White House will view it as part of the NII, so it will adopt policies that promote it. Congress will roll it into the various infrastructure bills and free up the telcos to compete in it. The courts will relax the MFJ to accommodate it. The FCC will take over much of the states' rights to regulate it. Big government will benefit because the information that goes over the network will become a source of revenue through taxation, tariffs and franchise fees. By 1995, infotainment will be a $10 billion business. By the year 2000, it could be $50 billion. CED

Alan Stewart, president of Network Interface Corp., is an independent industry editor, consultant, lecturer and analyst located in the Chicago area.

Dr. Alan Pearce was chief economist at the FCC and the White House during the Carter and Nixon administrations. He is president of Information Age Economics based in Washington, D.C.



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How BA's New Network Works

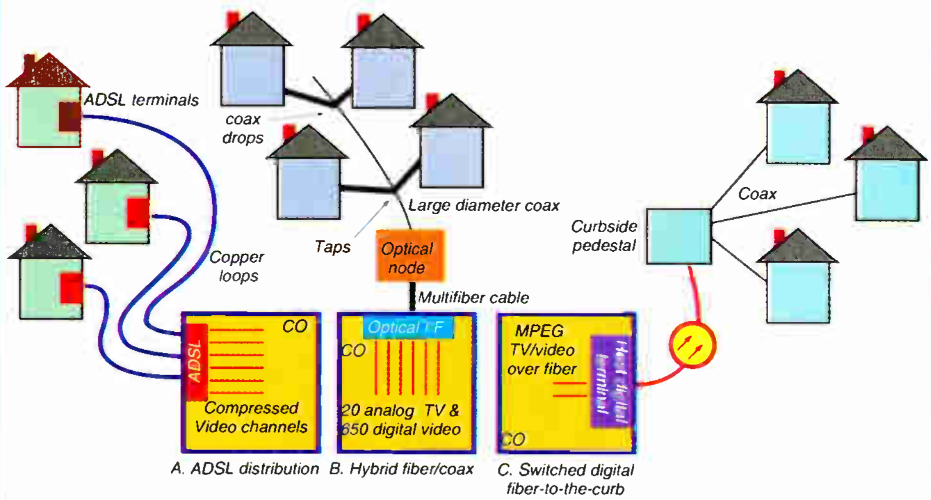
The technologies include a switched digital hybrid fiber-coax platform, a switched digital fiber-to-the-curb platform and an asymmetric digital subscriber line (ADSL) approach.

Switched Digital Hybrid Fiber-Coax (HFC)

In BA's system, 20 channels of analog AM-VSB (Amplitude Modulation-Vestigal Side Band) video and more than 650 digital signals are combined at the local exchange. A linear analog laser transmitter converts the radio frequency (RF) electrical signal to an optical one which is split and sent over multiple feeder fibers to an optical node. An optical receiver converts the signal back to an RF electrical signal. The signal is amplified and broadcast over a large diameter coaxial backbone cable. Finally, the signal is delivered to individual subscribers over taps and coax drops.

The technology for mass deployment can provide 100 or more analog channels using a bus architecture. This tree and branch structure allows many customers access to the same information and associated electronics.

Figure 3: Bell Atlantic video distribution alternatives



Switched Digital Fiber-to-the-Curb

Video programming and information are provided in a digitally compressed format (MPEG) by the video information providers and transported digitally by fiber optical equipment to the central office. The digital video signals from all providers are combined on a video distribution element known as a Host Digital Terminal (HDT). Fibers are extended from the HDT to the pedestal. Coaxial cable carries the signal from the pedestal to the home. Only programs that are requested by the subscriber are transmitted.

BA plans to deploy a switched digital fiber-to-the-curb platform, supplied by BroadBand Technologies, in Morris and Dover Township, N.J.

ADSL

ADSL permits the multiplexing and transmission of a one-way, 1.544 Mbps digital signal along with regular telephone service and basic rate ISDN signal, and a two-way signaling channel on an integrated basis over a single non-loaded copper pair. Advances in both ADSL technology and video decoding technologies will provide for real-time broadcast capability in 1995, at a channel rate of 3 Mbps up to 6 Mbps (over a single twisted copper pair).

The ADSL central office unit works with an ADSL remote terminal located at the customer's premises. The terminal separates the telephone signals from the compressed video signal. The broadband signal is delivered via standard twisted pair copper facilities to a set-top. Video programming over the system must be pre-encoded, digitized and stored on a video server.

Using the ADSL approach, Bell Atlantic plans to serve up to 2,000 customers in northern Virginia this summer. CED

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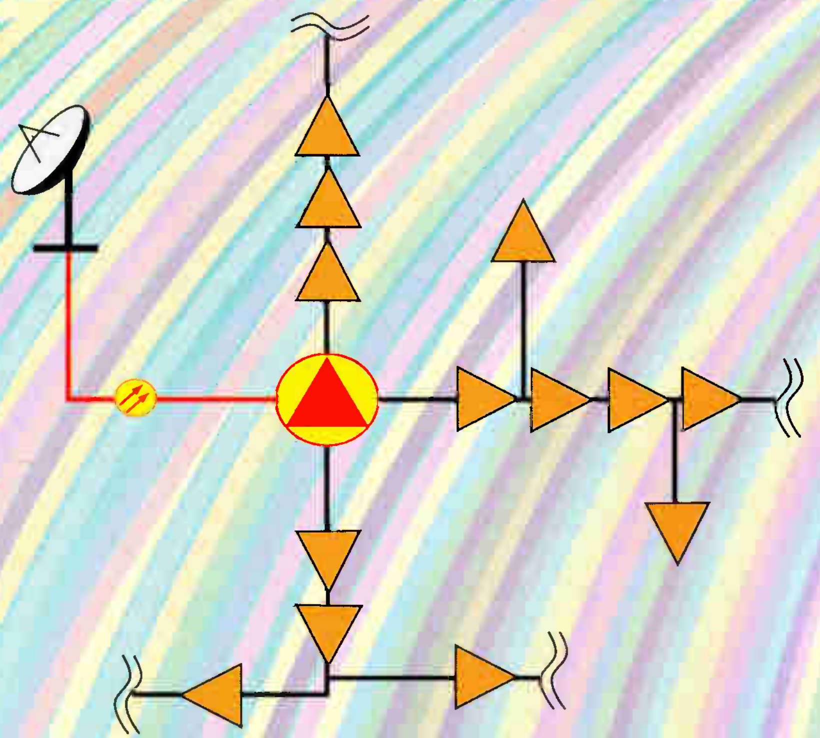
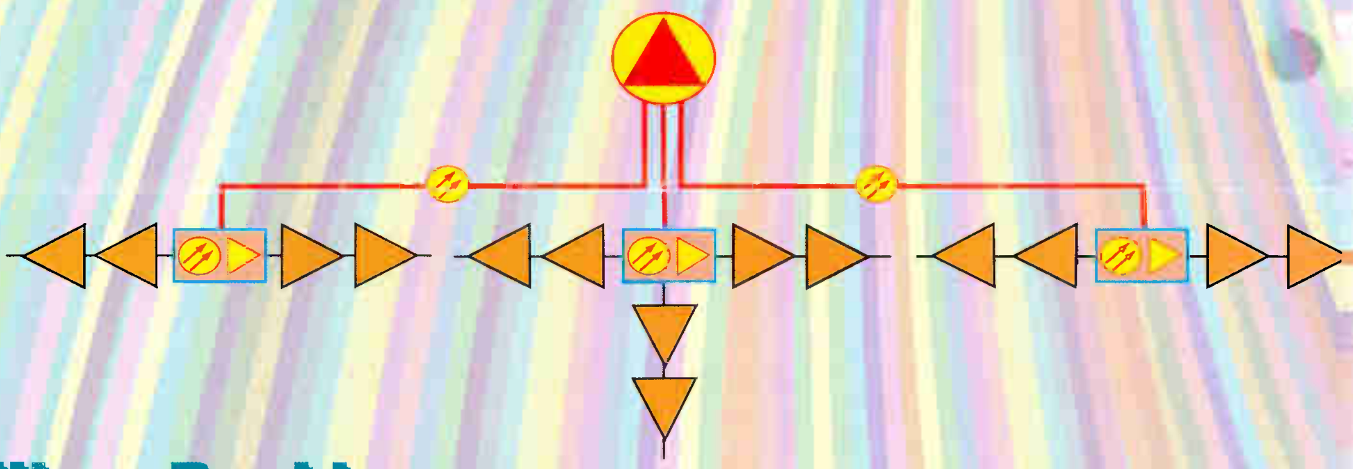
1994-95 C

Fundamental fiber optic topologies for CAT



Supertrunks

*Transport high-quality video signals on a point-to-point ba
Examples include interconnects between remote antennas
headends, headend interconnects for program sharing an
multiple system interconnects for advertising insertion. Al
could be used to provide route diversity for data delivery,
personal communications, alternate access, etc.*

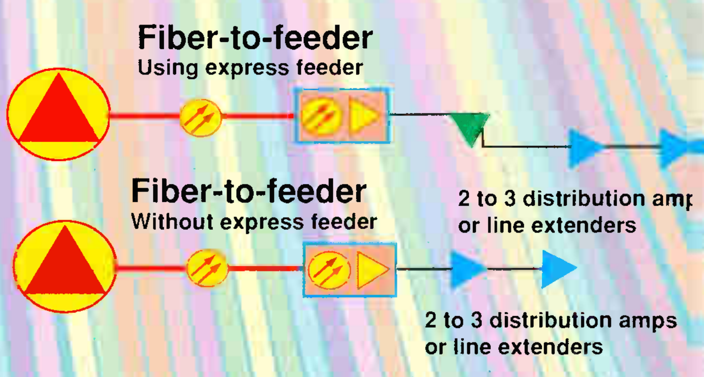


Fiber Backbone

Used primarily to reduce length of broadband amplifier cascades to improve carrier-to-noise ratio and distortion performance while reducing networ maintenance. Designed for system upgrades and rebuilds to higher bandwidths. Defined by Time Warner Cable as having fewer than four amplifiers cascade on any trunk run.

Fiber to the Feeder

Originally designed for complete system rebuilds, now used increasingly in upgrades. Also called hybrid fiber/coax. Replaces nearly all coaxial trunk cable with fiber cable. Reduces amplifier cascades to no more than three active devices. Coaxial "express" feeder serves area immediately adjacent to headend and optical receivers. Concept originally termed Fiber Trunk and Feeder by ATC engineers. Also known as All Fiber Trunk and Fiber to the Bridger.



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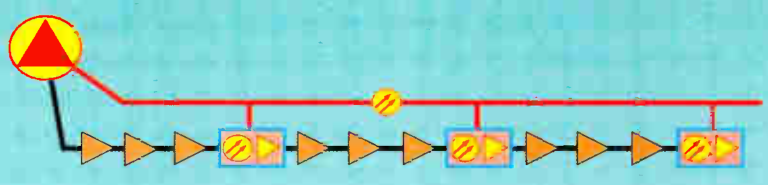
1994-95 CED CATV Fiber Topologies Comparison

The cable television industry first embraced fiber technology as a cost-effective upgrade to its traditional all-coaxial plant several years ago. Since then, cable television has become the fastest-growing market segment for sales of fiber optic cable. Cable operators and equipment vendors have since developed new and innovative methods to integrate fiber deeper into cable networks, bringing the benefits of lightwave technology ever closer to the home. This chart graphically illustrates how fiber started as a method to tie headends together, then rapidly became the transport method of choice for virtually every cable operator.

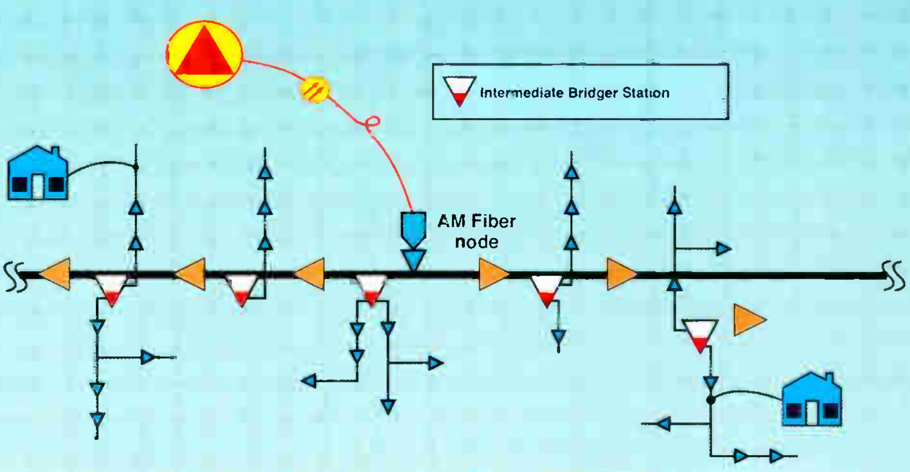
CED Fiber Top

Specialized topolog



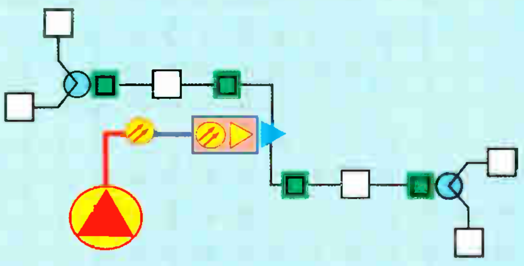
Jones Intercable's Cable Area Network

Designed by Jones engineers to leave coaxial trunk in place as redundant signal path for new fiber optic network. Coaxial route serves as back-up in the event of a fiber outage. A/B switch in optical receiver housing senses loss of signal on fiber, switches to coax input and triggers status monitoring alarm.



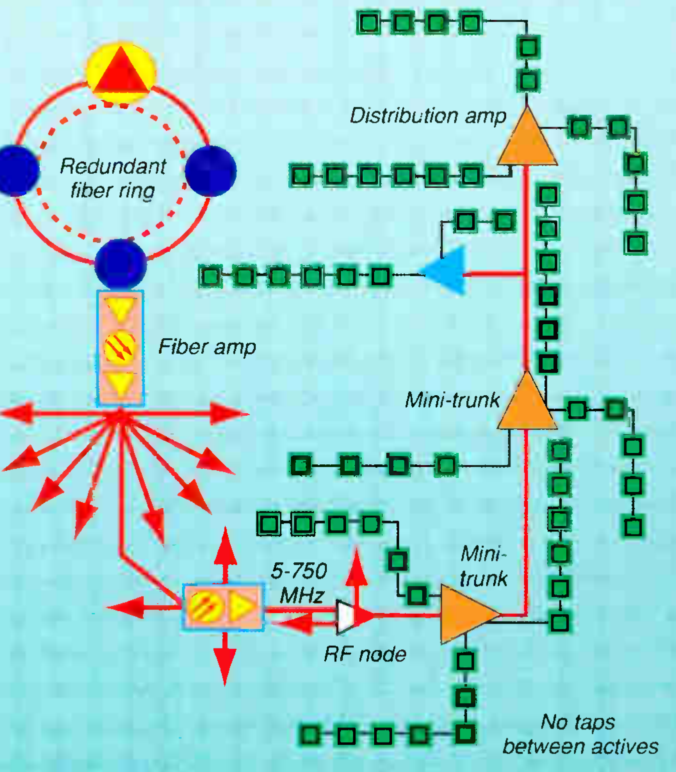
Scientific-Atlanta's FITT

The Forward Intermediate/Terminating Trunk topology is similar to the fiber backbone concept. The approach provides an upgrade path to 550 MHz capacity. Existing trunk locations are converted to FITT stations with dual output parallel hybrid bridgers. System or distribution amplifiers are placed between FITT/bridger stations to provide forward signal amplification.



Philips Broadband Networks' Diamond

Topology specifically designed for high density, urban areas. Utilizes just one active device between fiber receiver and subscriber. Optimized for expanding existing 550 MHz systems to 1 GHz. Also applicable for 750-MHz system expansions.



Texscan's Cell Network Opto/RF Architecture

Utilizing externally modulated 1550 nm transmitters and erbium-doped optical amplifiers, this topology supports point-to-point and/or self-healing optical ring systems. The distributed lightwave hub feeds nodes with four individually driven high-output ports. These ports feed RF nodes with three or four individually driven ports to an RF distribution network of no more than three additional devices. RF legs serve a maximum of 250 homes each. Return path may also be split to add bandwidth without RF block converters.

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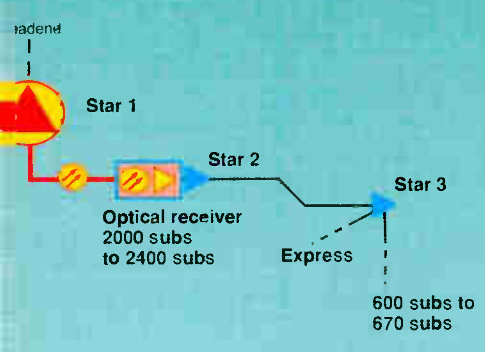
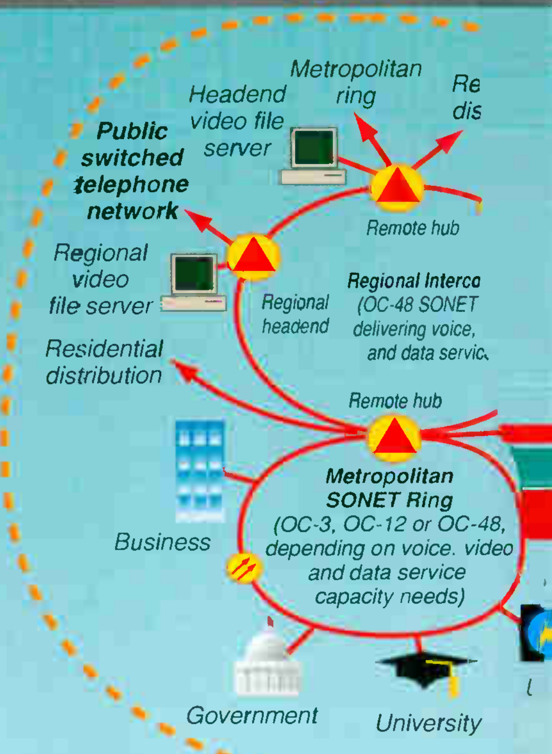
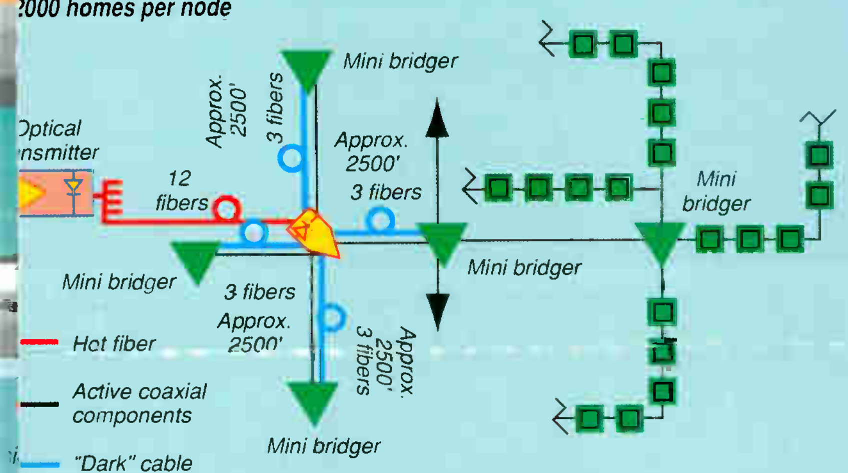




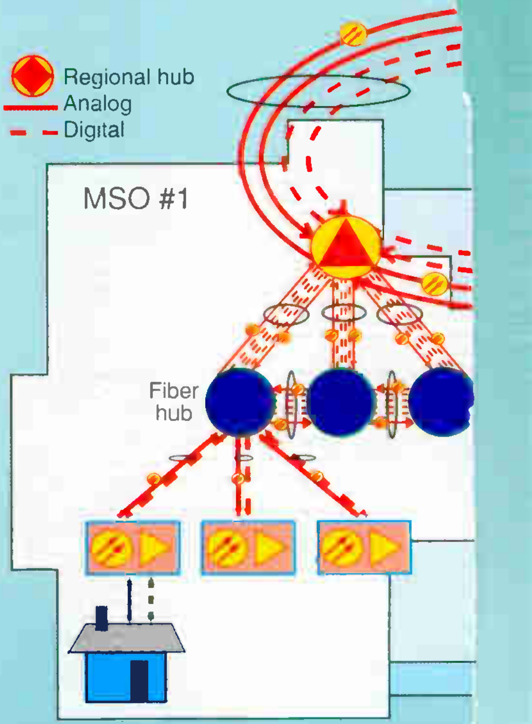
Scientific-Atlanta's Fiber to the Serving Area

A design concept that enlarges the area serviced by fiber optics by utilizing "express" or untapped feeder lines. Encompasses both FTF and backbone basic topologies.



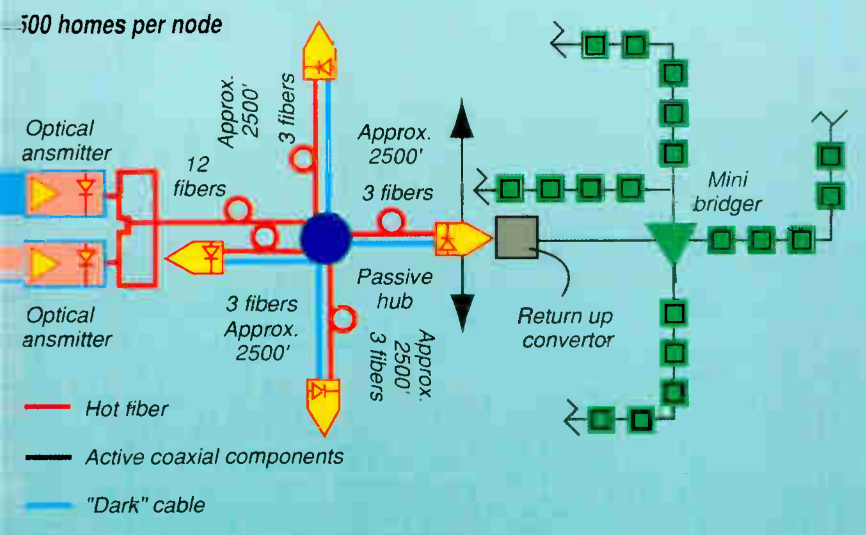
Antec's Cable Integrate

ANTEC's CISN uses a building block approach based on r
video on demand) and operational cost savings (e.g. redu
drive implementation of regional interconnections. Metrop
services to businesses (e.g. teleconferencing, telemedici
network, CISN pre-provisions fiber to ultimately extend t
from 150 to 500 homes, depending on plant topology. I
low- and high-end return paths for multimedia service



General Instrument's Broadband Telecommunications Architecture

he BTA architecture was developed to minimize initial installation costs while redefining system
perational capacity without relocating devices or re-cabling. The architecture is shown serving as
any as 2,000 homes per node and as few as 500 homes per node. The advantage of the BTA is an
specially low active count, combined with the ability to migrate to smaller service areas for both
rward and reverse services, as the need arises.



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vide "virtual" ring capability and route diversity.
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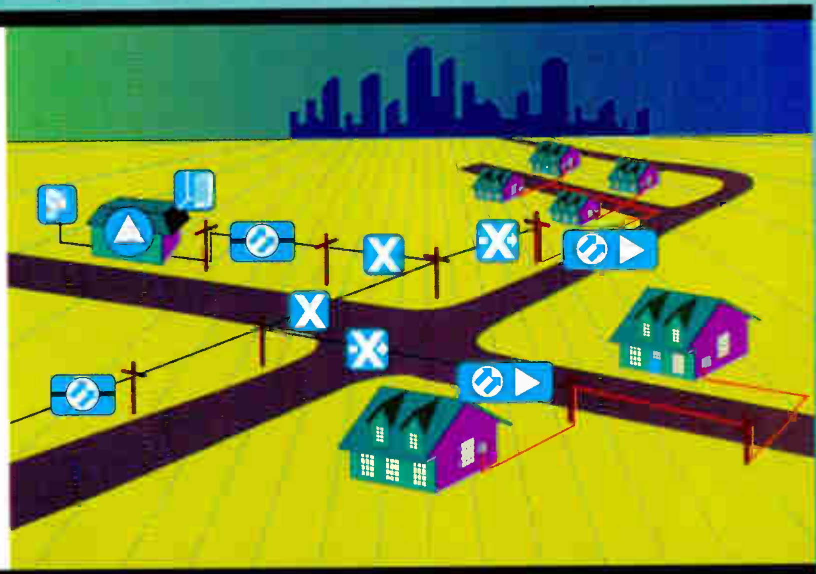

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CALAN STAR

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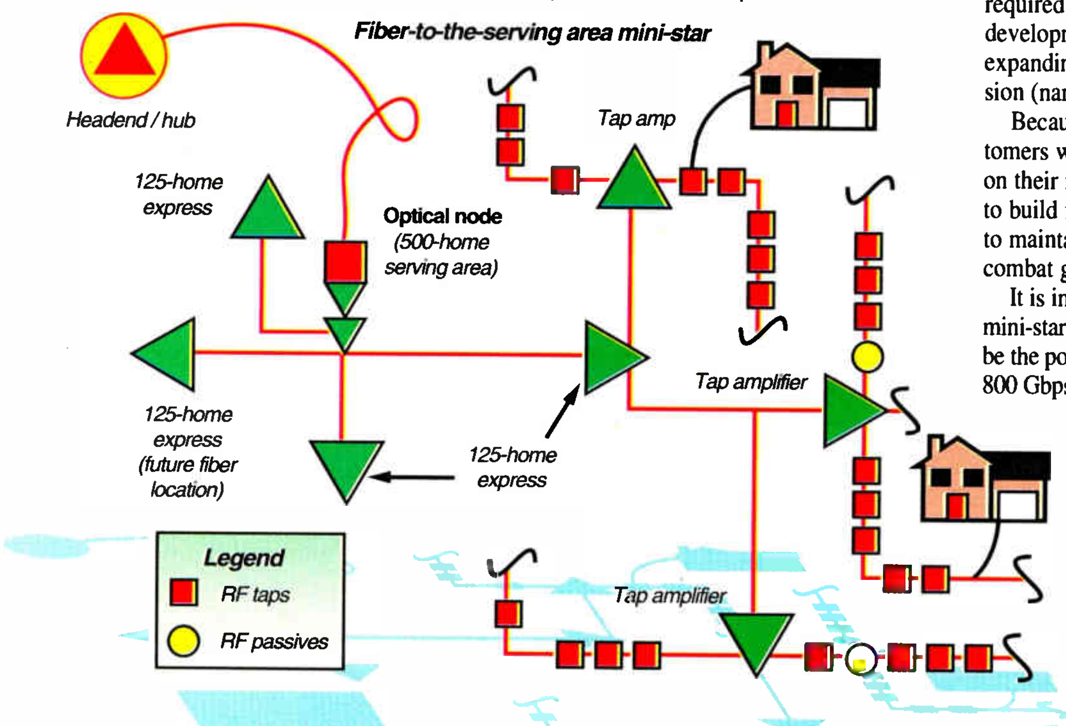
Circle Reader Service No. 38

Evolving from FSA to passive cable networks

Cost considerations

Figure 1: 500-home serving area with migration paths to 125-home pockets



By Gary Lyons, Marketing Manager, Scientific-Atlanta Inc.

With fiber commonly being deployed to within three to five actives of a subscriber, it is understandable why many in the industry are asking about the viability of passive cable networks (PCN). A true PCN is defined as a network having no RF active electronics between the optical receiver node and the last tap. This question about PCN's viability has led to Scientific-Atlanta's evaluation of the merits of such a network in light of current equipment costs and services required.

In the past three or four years the CATV industry has witnessed a transition from the initial fiber-to-the-feeder (FTF) architecture feeding pockets of homes of 1,600 to 2,000 passings to today's FSA architecture which yields 400 to 500 home passings per node.

The FSA concept has since evolved into the FSA mini-star (see Figure 1) which has reached cost parity with an FTF system (assuming a typical metropolitan area system with 90 or more home passings per mile). FSA mini-star systems support the services which dominate today, and adequate bi-directional bandwidth exists in both architectures to support most of the cutting edge services.

The FSA mini-star, however, provides certain operational benefits such as reduced powering costs because of a reduction in the number of actives in the system. In upgrade scenarios, the mini-star has also proven to be particularly effective at utilizing the pre-existing "express" trunk and feeder cables, resulting in major capital cost savings.

As both service penetration and individual customer demand grows for interactive services, broadband service providers may come to a point where the available upstream and downstream bandwidth is inadequate to support all services simultaneously. Telephony services alone could consume as much as 25 MHz of bandwidth, per 500 home pocket, if 100 percent availability is assumed (500 subs x 50 kHz/line).

When multi-line requirements for many homes and businesses are factored in, it becomes evident that a sizable chunk of the available upstream bandwidth is consumed. Furthermore, to the extent the downstream transmitters are optically split to feed multiple nodes, an excessive amount of downstream bandwidth (i.e. 75 MHz to 100 MHz) could be required to provide telephony service. This development clearly supports the rapidly expanding interest in point-to-point transmission (narrowcasting).

Because telephony and high speed data customers will accept very little contention time on their network, operators may be motivated to build fiber deeper as a pre-emptive measure to maintain high customer satisfaction and to combat greater competition.

It is interesting to note that in a 750 MHz mini-star system of 100,000 passings, there will be the potential to transport as much as 600 to 800 Gbps on the system, assuming the use of 32 QAM or 64 QAM. This assumes 200 to 250 home passings per node, 200 MHz of available digital bandwidth per node (550 MHz to 750 MHz) and a conversion rate of 6 to 8 bits per hertz.

Segmentation of the system into small serving areas makes this massive amount of bandwidth available for the first time. Additional digital bandwidth can be provisioned by either reducing the node size further or by replacing some of the broadcast analog channels with digitally compressed channels. This clearly points out the tremendous power and flexibility provided by today's analog/digital HFC systems.

Network evolution

The migration path for the FSA-PCN evolves naturally from the mini-star design. In an ideal situation there are four express RF amplifiers off of each 500-home node. These express amplifiers are upgraded to integrated optical receiver amplifiers each serving 125 homes. In this scenario, Figure 2 shows how a 500-home node is replaced by a splice enclosure containing four, two-fiber "tails" which feed 125 home passings. In systems exceeding densities of 200 homes per mile, this level of fiber penetration could result in a truly passive network. In most cases, there will still be at least one multi-port tap amplifier remaining

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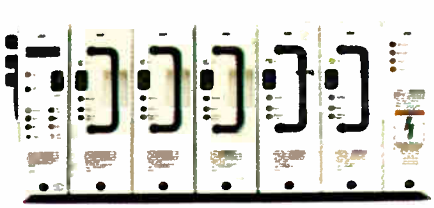

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Economics

Design studies have revealed that in a typical metropolitan area averaging 125 passings per mile, the serving area would have to be reduced to approximately 0.3 to 0.75 miles per node in order for the network to become truly passive. When compared to a current serving area of four to five miles per node, a passive cable network could have up to 15 times as many optical nodes as an FSA mini-star (500), and two to four times the number of nodes in an FSA mini-star with fiber feeding 125 home passings.

Even if it is assumed there will be an increased amount of optical splitting of the downstream signals, the fiber cable costs increase dramatically. Figure 3 reveals that fiber related costs increase over threefold (from $5,570 per mile to $18,397 per mile for aerial construction), which far outweighs the savings realized by eliminating RF electronics from the network.

In fact, coaxial related costs, due primarily to the elimination of the RF electronics, decrease by only $1,826 per mile. It's interesting to note that even though the fiber cable is pulled closer to the home in the FSA-PCN, the coaxial cable costs are slightly higher due to the use of more expensive low-loss (larger) coaxial cable. The net result is that the total cost for aerial plant in a passive cable network is currently 60 percent to 70 percent higher than the mini-star, while the cost premium to build underground plant is 45 percent to 50 percent greater.

Furthermore, the FSA-PCN cost analysis assumes that the reverse path signals from four 70-home nodes are collected via coax at a central point, block converted and fed back to the hub through fiber. The FSA-PCN analysis also assumes that the downstream DFB transmitter is optically split at least four ways. Both of these techniques prevent fiber counts from increasing further and dramatically raising optical cable, splicing and hardware costs.

If neither cost nor bandwidth can justify fiber to the last active today, can a case be made for fiber deeper due to improvements in either system performance or reliability? Clearly, system performance does not improve appreciably with a passive cable network, unless one is willing to pay an even greater premium for additional opto-electronics.

The analysis in Figure 3 assumes the same end-of-line (E-O-L) performance in both the mini-star and the PCN scenarios. The optical power levels at the node in the mini-star architecture are actually higher than in the PCN architecture due to the shorter optical loss budgets (no optical splitting). The additional RF amplifier in the mini-star architecture, however, mitigates a slightly better CNR performance, leading to comparable E-O-L specifications.

Modeling of systemwide reliability data collected by TKR Cable from its Tri-System area in central New Jersey reveals the dramatic improvement in reliability when serving areas are reduced to 200 to 500 homes versus a conventional coaxial network (see Figure 4). The model also revealed that system reliability quickly approaches a point of diminishing returns when fiber is deployed to serving areas of less than 500 homes.

Few operators can justify the cost associated with such a small incremental improvement in system reliability gained by eliminating the last couple of actives. It is interesting to note that power was the cause of roughly 80 percent of TKR's system outages during 1992. Because a large percentage of power outages are related to power grid fluctuations and outages, one would think that a reduction in the number of power supplies in a passive cable network should improve system reliability and provide some benefit to system operations.

Figure 2: *Fiber-to-the-Serving Area mini-star migration path*

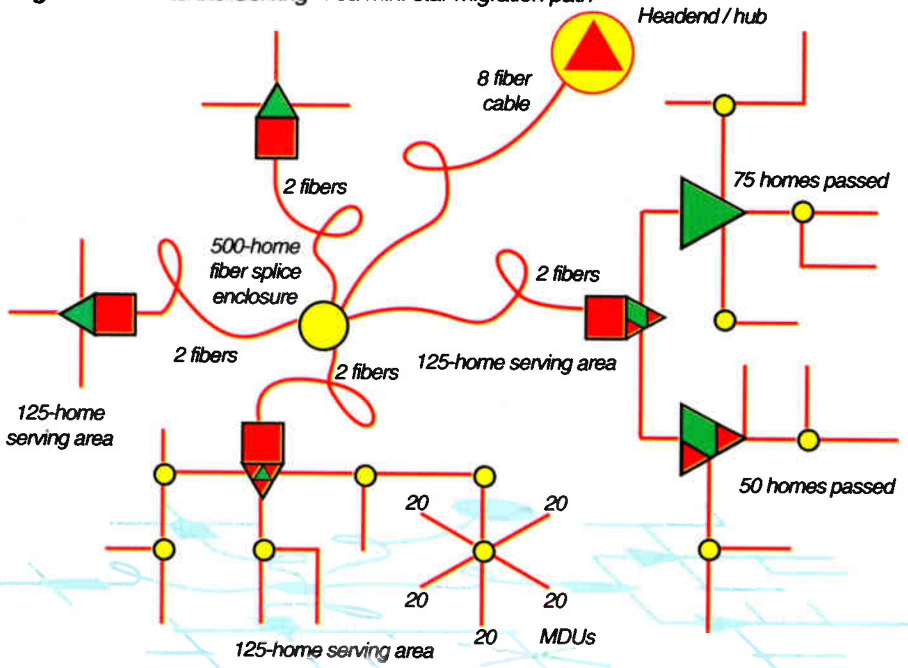
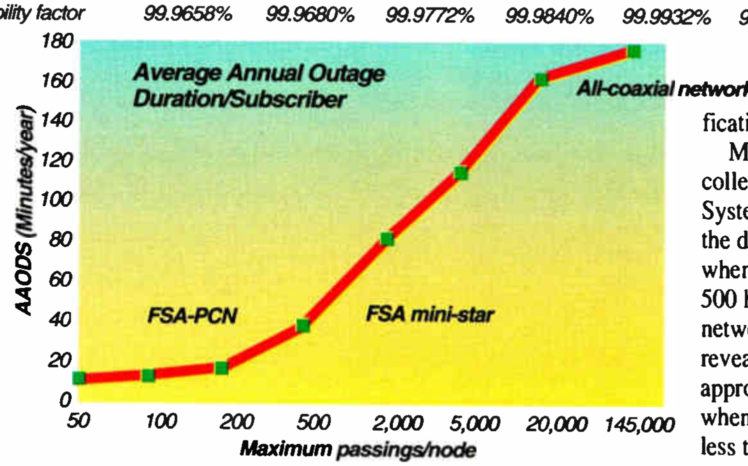
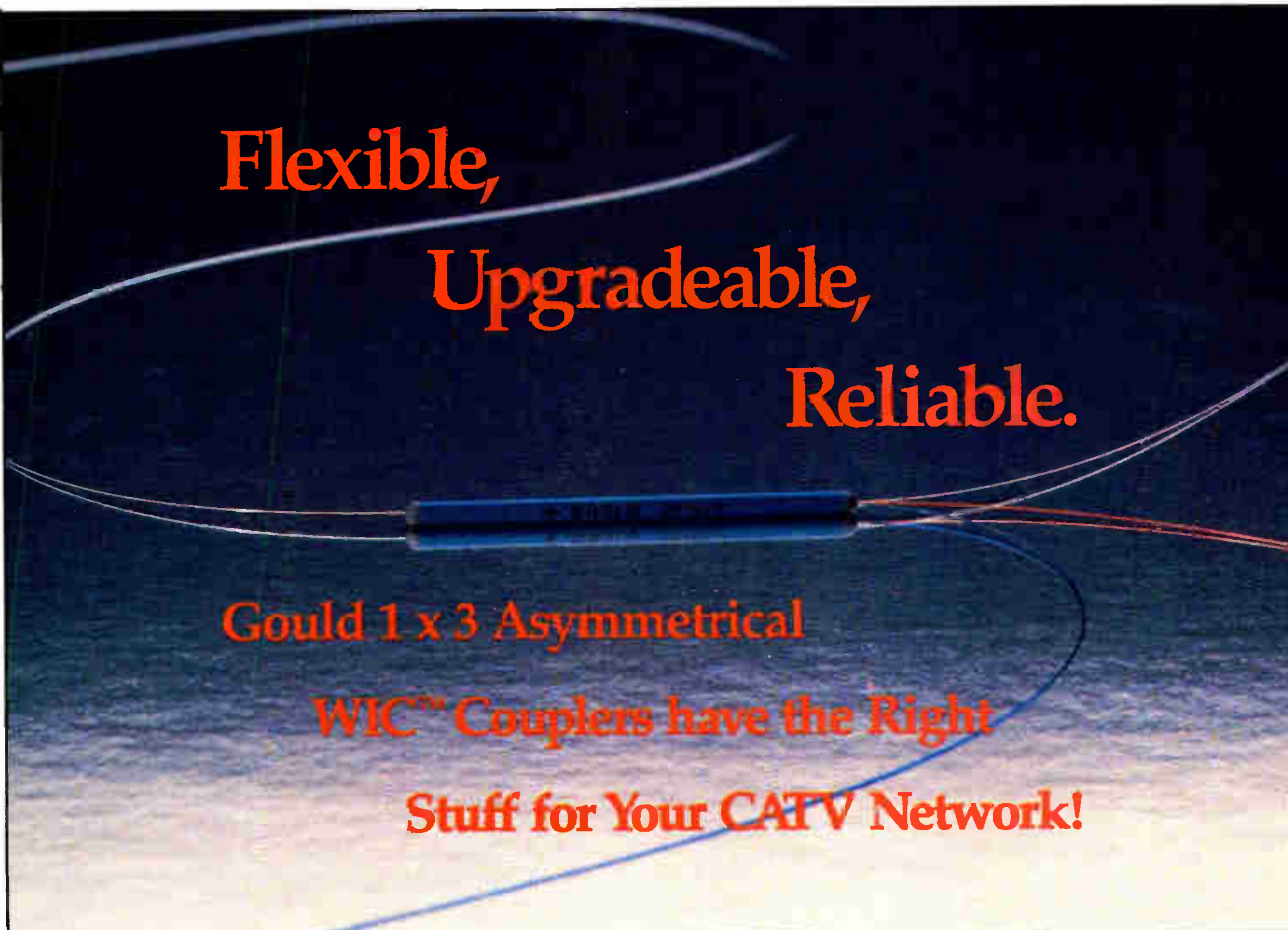


Figure 4: *TKR (Warren, N.J.) Tri-System outage data analysis*

Subscribers/node	145,000	20,000	5,000	2,000	500	200
Est. no. of nodes	0	7	29	73	290	725
AAODS (hours)	3	2.8	2	1.4	0.6	0.3
AAODS (minutes)	180	168	120	84	36	18
Reliability factor	99.9658%	99.9680%	99.9772%	99.9840%	99.9932%	99.9966%



Definitions: AAODS = Average Annual Outage Duration/Subscriber
AAODS is the number of minutes per year that a typical customer would experience an outage



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It would appear, at least from the metropolitan area analyzed in this paper, that system reliability and performance are optimized from a cost/benefit perspective when fiber is deployed to the 400- to 500-home passing level in most cases and down to the express amplifier (approximately 125 homes) location in extreme cases. In the CATV world, where rate of return is not guaranteed, passive cable networks are currently feasible in only high density urban areas where extraordinary service (bandwidth) requirements dictate smaller serving areas or where other external forces (i.e. competition, politics, etc.) provide the impetus for PCN deployment.

Given the relatively rapid migration from the fiber-to-the-feeder to FSA mini-star architectures, it would appear that when capital cost differences diminish, the operational benefits of the FSA-PCN architecture will provide the motivation to build fiber to the last active in most broadband networks. Until then, the FSA mini-star architecture will continue to serve as an outstanding platform for the passive cable network. CED

Acknowledgments

The author would like to thank Craig Busch, director of engineering at TKR Cable, and Bob Loveless, applications engineering manager at Scientific-Atlanta, for their contributions to this paper.

Reference

Thomas E. Chapuran and Kevin W. Lu, "Optimization of Fiber/Coax Upgrades for FITL Systems with Analog and Digital Video Transmission," Proceedings 1994 NFOEC, San Diego, Calif., vol. 2, pp. 329-340.

Figure 3: ***750 MHz FSA plant cost analysis***

Typical service area=415 miles, 125 home passings/mile (78 analog channels, 200 MHz digital)

FSA mini-star, avg. 500 passings
(4.21 avg. plant miles/node)
dedicated laser per receiver
3.8 actives (RF amps & receivers)/mile

Description	$/mile	$/passings
Fiber optics		
Optoelectronics	$3,787	$30.30
Optical cable & hardware	$1,177	$9.42
Optic labor (aerial)	$606	$4.85
Optic labor (underground)	$240	$1.92
Optic total (aerial)	$5,570	$44.56
Optic total (underground)	$5,204	$41.63
Coaxial		
Electronics, taps, passives, connectors, power supplies, etc.	$3,860	$30.88
Cable (aerial)	$2,056	$16.45
Cable (underground)	$2,467	$19.74
Coax labor (aerial)	$5,246	$41.97
Coax labor (underground)	$11,963	$95.70
Coax total (aerial)	$11,162	$89.30
Coax total (underground)	$18,290	$146.32
Total plant cost (aerial)	**$16,732**	**$133.86**
Total plant cost (underground)	**$23,494**	**$187.95**
Cost premium		
Aerial		**N/A**
Underground		**N/A**
Specifications	At node	End-of-line (*)
CNR	51 dB	48 dB
CTB	-66 dB	-53 dB

FSA PCN, avg. 70 passings
(0.60 avg. plant miles/node)
1 laser per 4 receivers, 300 passings
1 reverse transmitter per 4 nodes
1.88 actives (receivers) per mile

Description	$/mile	$/passings
Fiber optics		
Optoelectronics	$13,771	$110.17
Optical cable & hardware	$2,498	$19.98
-2 fiber tails	$534	$4.27
Optical couplers	$423	$3.38
Optic labor (aerial)	$1,171	$9.37
Optic labor (underground)	$805	$6.44
Optic total (aerial)	$18,397	$147.18
Optic total (underground)	$18,031	$144.25
Coaxial		
Taps, passives, connectors, power supplies, etc.	$1,513	$12.10
Cable (aerial)	$2,858	$22.86
Cable (underground)	$3,425	$27.40
Coax labor (aerial)	$4,965	$39.72
Coax labor (underground)	$11,684	$93.47
Coax total (aerial)	$9,336	$74.69
Coax total (underground)	$16,622	$132.98
Total plant cost (aerial)	**$27,733**	**$221.86**
Total plant cost (underground)	**$34,653**	**$277.22**
Cost premium		
Aerial		**65.75%**
Underground		**47.50%**
Specifications	At node	End-of-line (#)
CNR	48.1 dB	48 dB
CTB	-66 dB	-53 dB

Notes: *The economic analysis does not include the following costs: Make ready, permits, U.G. restoration, warehousing and overhead. Powering costs are for line electronics only.*

(*) Assumes up to three RF amplifiers in cascade including the integrated amplifier in the optical node.
(#) Assumes only the integrated high output amplifier co-located with the optical node.

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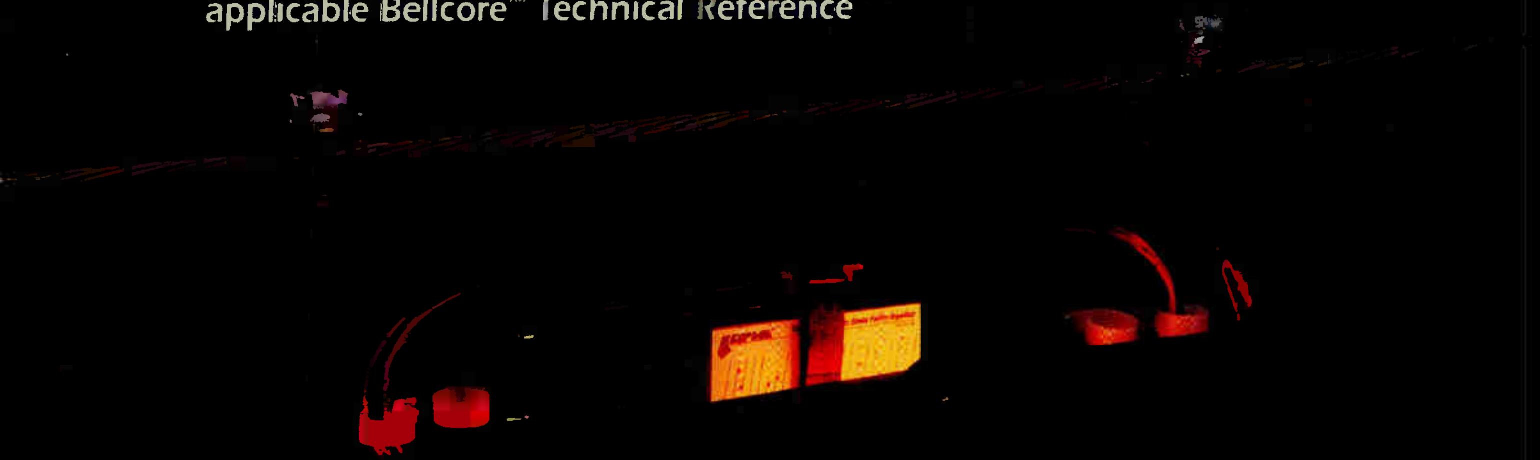

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Cost considerations for cable TV splicing

Understanding three major variables

By Douglas E. Wolfe, Corning Inc., and J. Douglas Coleman, Siecor Corp.

Optical fiber is traveling further into cable TV systems, serving nodes of fewer and fewer subscribers. With this deployment comes increased splicing and, with it, new considerations: splice loss, splice yield and splicing installation and maintenance expense. How can cable TV operators continue to keep costs under control without compromising system performance?

One answer is consistent fiber geometry characteristics (the physical attributes of the fiber), and more efficient splicing technologies. Together, tight and consistent geometry tolerances and more efficient splicing techniques may provide better results at lower costs.

This paper will examine how fiber geometry, splicing technology and the splice loss requirement can impact cable TV splicing costs.

In some fiber-rich cable TV architectures, fiber splicing and testing can account for up to 30 percent of the total labor costs associated with system installation. As cable TV operators continue to deploy more and more fiber nodes (requiring more splices) and with capital spending budgets tightening, the cost of splicing can no longer be ignored.

Figure 1

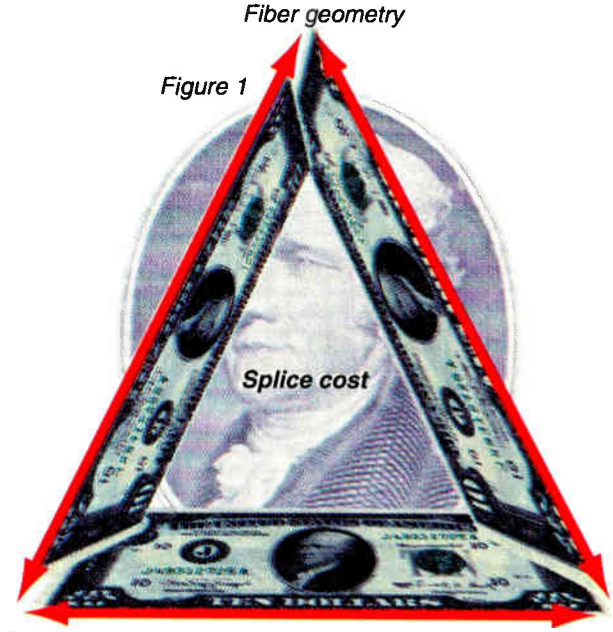
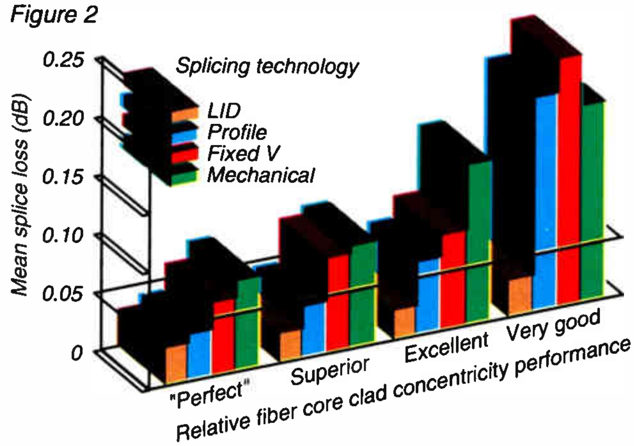


Figure 2



However, cable TV operators can control their splicing costs by understanding and influencing the major variables that impact splice costs. Although external variables like fiber handling and splicing-area cleanliness play a significant role in splicing, we have focused on, for the purpose of this paper, the three major variables that impact splice costs: 1) the desired maximum splice loss objective; 2) the type of splicing technology chosen; and 3) the quality (geometry) of fiber installed.

Figure 1 graphically illustrates the triangular trade-off between the desired splice loss requirement splicing technology chosen and fiber geometry on cable TV splicing costs.

Manufacturing fiber with consistent, tightly controlled glass fiber geometry is one way fiber makers can help cable TV engineers reduce their splicing costs.

Offering a complete line of innovative splicing technologies is one way that splice equipment manufacturers can help cable TV engineers reduce their splicing costs.

However, the cable operator's decision on the desired maximum splice loss required also can impact splicing costs, regardless of the fiber or splicing technology used.

An experiment

A fiber splicing experiment was conducted to determine the relative impact of fiber geometry, splicing technology and splice loss requirement on cable TV splicing costs. The experiment generated fiber splice data using standard singlemode fiber with four different levels of core/clad concentricity performance ("perfect," superior, excellent and very good) relative to today's industry specification of 0.8 microns. Four different commercially available splicing technologies, local injection and detection, profile alignment, fixed V-groove fusion and mechanical, were used to splice each set of fibers. Although other geometry parameters can impact splice loss and yield, core/clad concentricity has been proven to have the most significant effect on splice loss and yield. As a result, the fibers were chosen to have nominal values of cladding diameter, fiber curl and mode-field diameter.

Core/clad concentricity (also called core-to-cladding offset), refers to how well the fiber core is centered in the cladding glass region. This reduces the chance of core misalignment (or offset) when splicing two fibers together, and thereby yields a better, low-loss splice. Core/clad concentricity is important when using splicing technologies and equipment that don't actively align the fiber cores before or during splicing–such as mechanical splicers and fixed v-groove alignment fusion splicers.

A commercially available fiber cleaver was used for all splices in this experiment, and the cleave angle was monitored and kept below two degrees. This minimized the impact of a "bad" cleave on any of the fiber splices.

Fifteen typical splices were completed for each of the combinations of fiber geometry

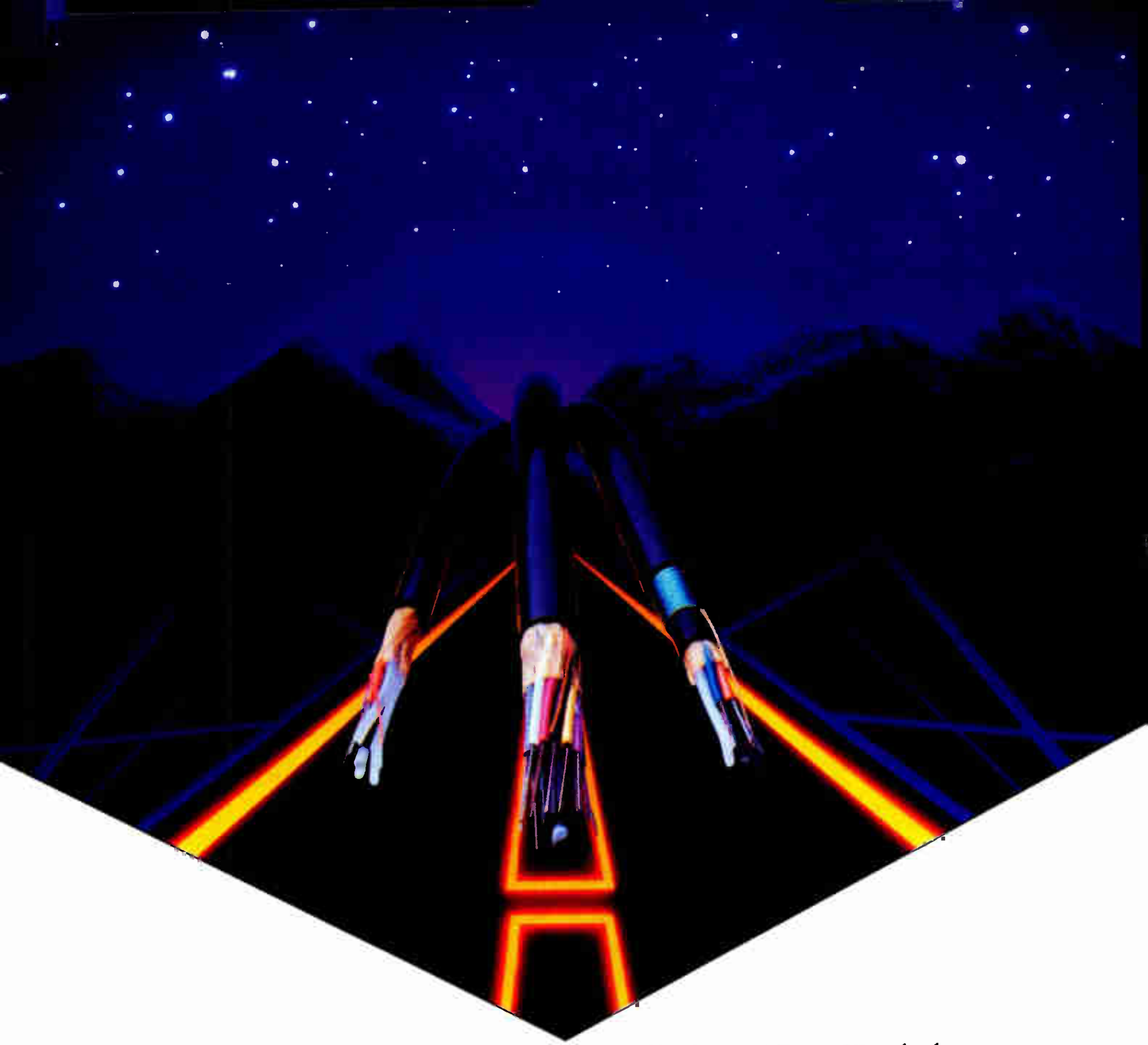


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Figure 3: ***Typical percent of splices completed on first attempt that met desired maximum splice loss requirement***

Maximum splice loss objective	Avg. CCC	LID	Profile	Fixed V	Mechanical
0.05 dB	Perfect	100%	93%	73%	47%
	Superior	100%	73%	67%	33%
	Excellent	100%	47%	33%	0%
	Very good	87%	27%	20%	0%
0.10 dB	Perfect	100%	100%	87%	73%
	Superior	100%	100%	87%	73%
	Excellent	100%	87%	60%	40%
	Very good	100%	27%	20%	40%
0.15 dB	Perfect	100%	100%	87%	87%
	Superior	100%	100%	87%	80%
	Excellent	100%	100%	93%	67%
	Very good	100%	47%	33%	47%
0.20 dB	Perfect	100%	100%	100%	100%
	Superior	100%	100%	87%	100%
	Excellent	100%	100%	93%	93%
	Very good	100%	67%	53%	67%

Figure 4: ***Cost per splice assumptions***

Splice cost assumptions	LID-system	Profile alignment	Fixed V-groove	Mechanical
Equipment fixed costs (Including splicing equipment, cleaver and maintenance)	$32,500	$32,500	$15,700	$1,263
Variable costs per splice				
Labor	$11.10	$10.80	$11.10	$11.40
Consumables	$1.00	$1.00	$1.00	$15.00
Persons per splicing crew	1	1	1	1
Average cost/splice (1,000 splices)	$44.60	$44.30	$27.80	$27.66
Average cost/splice (5,000 splices)	$18.60	$18.30	$15.24	$26.65

and splicing technology, for a total of 240 splices (16 sets of data). The average loss for each of the splices was calculated by averaging the bi-directionally measured OTDR splice loss at 1310 nm.

Splice loss distributions for each of the 16 combinations of splicing technology and fiber core/clad concentricity were generated, and the average (mean) splice loss values for these distributions are shown in Figure 2. The data indicates that fiber core/clad concentricity does influence the average splice loss depending upon the type of splicing technology chosen.

Interestingly, the profile alignment technology, which is designed to actively align the fibers based on their core profiles, also appeared to be sensitive to increased fiber core/clad concentricity, resulting in higher losses. Normally, we would expect the profile alignment system to optimize the fiber cores regardless of core off-set. However, we attributed the core off-set sensitivity to cladding

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surface tension effects during the fusion process. Cladding surface tension effects create a tendency for the fibers to align with one another by their outside diameters during the fusion process. As a result, most profile alignment splicers have special built-in software algorithms that try to pre-compensate for cladding surface tension effects by altering the alignment of the fibers. However, it's difficult to fully compensate for all possible values of core/clad concentricity. Therefore, high values of core/clad concentricity can often lead to excessive splice loss even when using typical profile alignment splicers.

The local injection and detection splicing technology (LID-system) performed the best for all levels of fiber core/clad concentricity performance. This technology actively aligns the fibers during the fusion process by monitoring a light signal through the splice. The signal is injected into the fiber on one side of the splice and detected on the other. This continuous splice loss monitoring during the fusion process appears to help overcome some of the cladding surface tension effects normally seen during fusion splicing. The result is low splice loss, independent of the fiber core/clad concentricity value.

Interpretation

Fiber core/clad concentricity and splicing technology play major roles in producing a low loss splice. In general, splicing fibers with improved core clad/concentricity produces better, lower loss splices.

The average splice loss data was then analyzed against four different maximum splice loss requirements: 0.05 dB, 0.10 dB, 0.15 dB and 0.20 dB. Figure 3 illustrates the typical percentage of splices completed on the first attempt that met the desired maximum splice loss requirement stated. Three observations can be made from Figure 3: 1) higher values of fiber core/clad concentricity lead to a lower percentage of splices completed that meet a specific splice loss requirement; 2) LID-system splicing technology out-performed profile alignment technology, which out-performed fixed V-groove technology, which out-performed conventional mechanical splicing

Figure 5: ***Incremental cost per splice relative to LID splicing technology***

	CCC Performance	Profile alignment 1,000 Splices	Profile alignment 5,000 Splices	Fixed V-groove 1,000 Splices	Fixed V-groove 5,000 Splices	Mechanical 1,000 Splices	Mechanical 5,000 Splices
Maximum splice loss objective: 0.05 dB	Perfect	0%	0%	-28%	5%	-13%	103%
	Superior	8%	20%	-24%	15%	0%	133%
	Excellent	27%	66%	90%	94%	40%	229%
	Very good	50%	118%	103%	136%	125%	229%
Maximum splice loss objective: 0.10 dB	Perfect	0%	0%	-34%	-10%	-30%	63%
	Superior	0%	0%	-34%	-10%	-30%	63%
	Excellent	3%	5%	30%	27%	50%	117%
	Very good	50%	118%	103%	116%	50%	117%
Maximum splice loss objective: 0.15 dB	Perfect	0%	0%	-34%	-10%	-35%	50%
	Superior	0%	0%	-34%	-10%	-33%	55%
	Excellent	0%	0%	-36%	-15%	-27%	70%
	Very good	28%	66%	103%	94%	40%	103%
Maximum splice loss objective: 0.20 dB	Perfect	0%	0%	-38%	-18%	-38%	43%
	Superior	0%	0%	-34%	-10%	-38%	43%
	Excellent	0%	0%	-36%	-15%	-37%	46%
	Very good	13%	28%	40%	42%	18%	70%

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technology; 3) the higher the allowable maximum splice loss requirement, the more likely all of the technologies would be able to meet it.

Figure 4 lists the basic assumptions used to develop an estimated cost per splice value for each of the technologies, assuming average usages of 1,000 and 5,000 splices over the splicing equipment's lifetime. Actual cost per splice values may vary, depending upon specific equipment type and lifetime assumptions.

Based on the yields generated in Figure 3 and the splice cost assumptions in Figure 4, a cost model was developed to estimate the relative impact of fiber core/clad concentricity, splicing technology and splice loss requirement on total splicing costs. The total cost per splice used in the cost model was calculated by assuming a maximum of three splice remake attempts. The splice loss distributions from Figure 3 were then applied to the percentage of splices not meeting the splice loss objective in each remake attempt. In other words, splice remakes would only be attempted on the percentage of splices not meeting the original requirement using the same yield percentages as Figure 3. It seemed realistic to assume that remake attempts would yield similar splice loss distributions to those of the first attempt distributions.

Because the LID-system splicing technology outperformed the other splicing technologies, it was chosen as the baseline for comparing the relative cost per splice estimates of other technologies. Figure 5 illustrates the incremental cost per splice for the profile alignment, fixed V-groove and mechanical splicing technology relative to the cost per splice of the LID-system splicing technology. Relative cost per splice estimates are provided for the four different levels of core/clad concentricity performance and, correspondingly, for the four maximum splice loss requirements. A positive percentage represents a higher cost per splice than the local injection and detection equipment, while a negative percentage represents a lower cost per splice. Cost per splice estimates were determined using both 1,000 and 5,000 splices completed.

It is clear from the data that fiber geometry, specifically core/clad concentricity, has a major impact on splice loss and splice costs. The higher the core/clad concentricity (core-to-cladding offset), the greater the splice loss. Greater splice loss leads to higher splice costs as the maximum splice loss requirement is tightened. For cable TV systems with typical maximum splice loss requirements of 0.05 dB or 0.10 dB, splice costs can be significant, depending upon the splicing technology and fiber geometry used.

For very low splice loss requirements, LID-system splicing technology could reduce splicing costs by more than 20 percent over traditional profile alignment splicers due to their greater tolerance of larger core-to-clad offsets. However, as cable TV splice loss requirements are relaxed, less expensive fixed V-groove alignment splicing technologies could emerge as the most cost-effective solution. Fixed V-groove alignment splicers offer savings in capital investment and could make an attractive choice for system restoration and maintenance.

As fiber moves deeper into cable TV systems, the demand for quick and cost-effective splicing techniques will increase. The exacting geometry tolerances of optical fiber and the host of available splicing technologies will help provide cable TV engineers and technicians with cost-effective solutions for fiber splicing. CED

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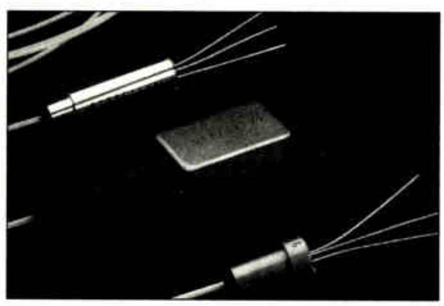

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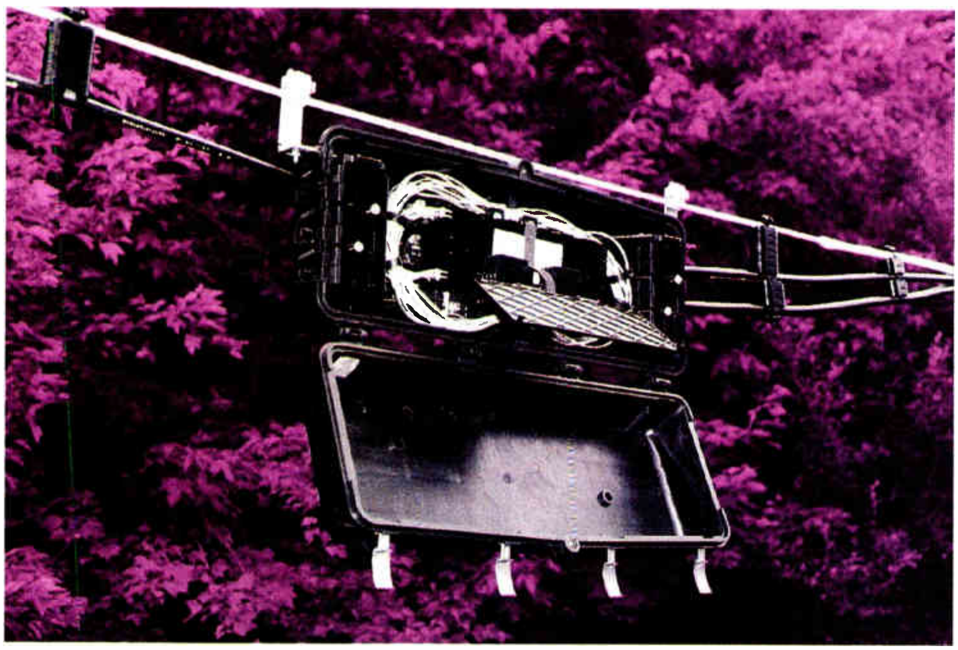


By George Steenton and David Stehlin, Keptel Inc.

Over the past decade, fiber optic cable has become the transmission medium of choice in almost all high-capacity telephony, data and video applications. Fiber's advantages are many and well-documented, and almost all the components that make up a fiber network have been refined to the point that each is very reliable and relatively easy to use.

As the convergence of the telecom and CATV industries speeds up the deployment of fiber in the feeder and possibly the distribution plant, factors that a few years ago were not very important become paramount. Craft-friendliness is now a key concern because speed of installation and the ability to effectively and quickly rearrange signal distribution will greatly influence the service provider's ability to compete. Because the service provider will be installing more systems in a compressed period of time, more craft will be needed. Additionally, their overall level of experience with fiber may decrease, all without an increase in supervision. Finally, the cost of the entire system must come way down if fiber is to continue to push its way toward the video or telephone subscriber. Overall system cost is, in a large part, a function of the cost of its components–so the cost of each high volume or expensive item, such as closures, must be closely reviewed.

Of course, the quality of the components and the system as a whole will have to be better than ever. Not only do subscribers expect higher quality, but lower maintenance expense is a key to a service provider's long-term competitiveness and viability. Quality of the signal, whether voice, video or data, is clearly a major selling point and service providers cannot afford to be at a disadvantage in this regard.

One area that can have a major effect on the cost of a fiber network is splicing. The components of a splice point, namely the splice closure and organizers, fusion or mechanical splicing equipment, the installation techniques and the labor to install the splice, together form a major portion of the total system expense. Typically a splice point takes a large number of man-hours to complete because of cable preparation, closure assembly, actual splicing, closure close-up and mounting.

An area often overlooked, but one that actually causes major dismay among splicers and network engineers alike, is splice point re-entry. Because of a customer's demand for additional services or the need for system rearrangement, splice points are often opened to add a cable, splice dark fiber or reconfigure working fibers. Some closures in busy areas are opened frequently.

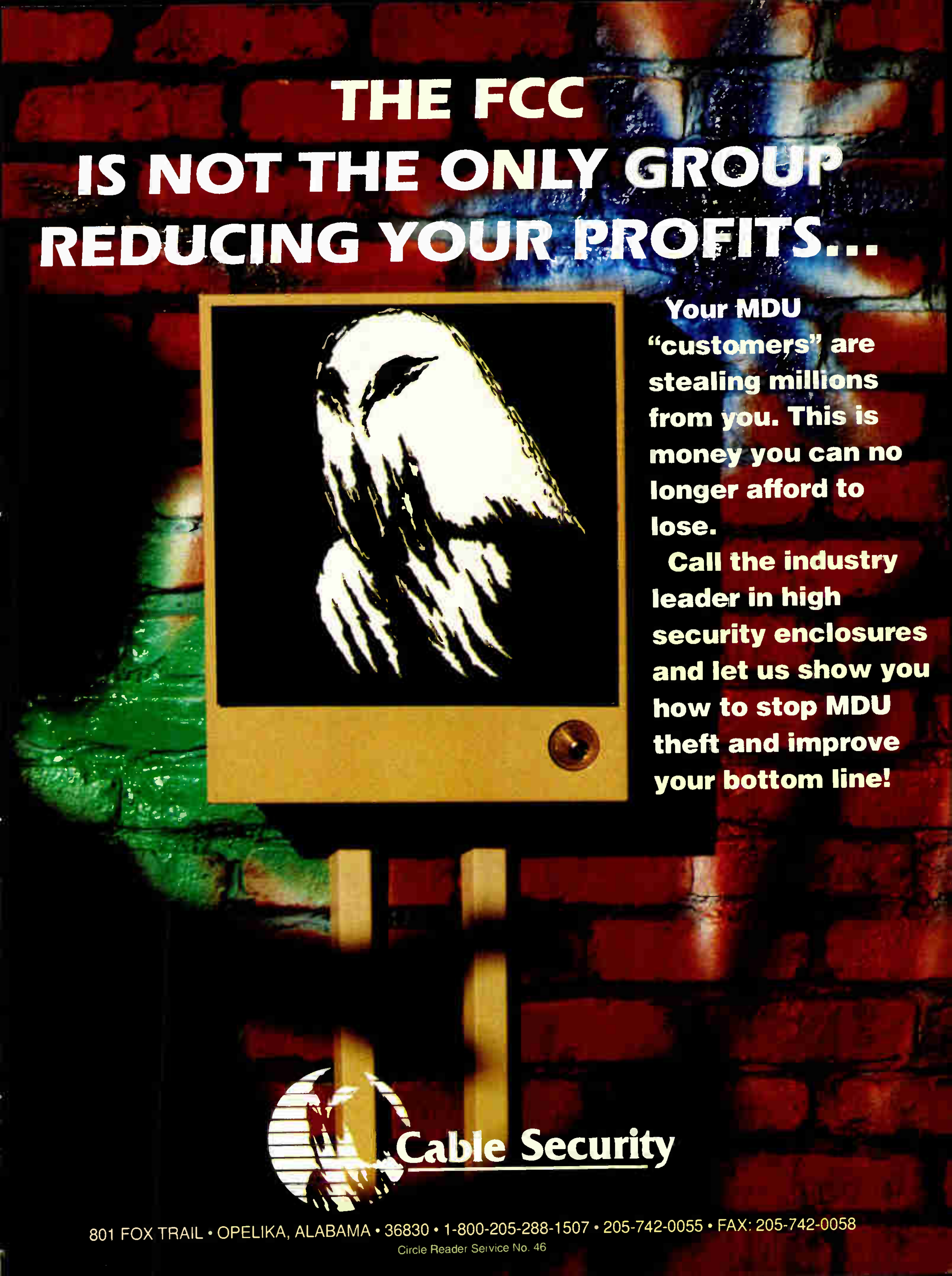
These re-entries often cannot be planned, but they can be made less painful. As fiber moves out into the feeder and distribution portions of the network one can expect more splice points than in the trunk, because there is a greater need for cable drops, additions and rearrangements. Also, the cable lengths designed for the loop are shorter.

All this adds up to a substantial investment in time and equipment. While it is clear that splicing in general is an area where significant improvements and cost reductions are possible, the focus of this article is the use and viability of a relatively new product: breathable fiber optic closures in above-ground splicing applications.

A more apt description of this closure would be an aerial weather-tight fiber closure, because the only free-breathing points are two small screened areas on the bottom which allow the free exchange of air, but prevent insect, dust, rodent and driving rain penetration. The two free breathing ports allow equalization of air temperature inside the closure vs. outside the closure and a flow route for air, thus reducing or eliminating condensation buildup caused by humidity.

All closures, regardless of design, will suffer from interior moisture build-up. Because of exposure to sunlight or other generated heat sources, closures, pedestals and enclosures all build up heat greater than the outside ambient temperature. This greenhouse effect, when coupled with moisture or humidity in the air, causes condensation to form inside the closure. Even in a totally sealed closure, moisture from the air inside the closure, moisture that comes in through the cable, or moisture that leeches through the plastic cover of the closure will cause condensation to form inside the closure.

Without a means of releasing the moisture there is the possibility that if it gathers on bare fiber and the temperature drops to freezing, microbends could occur. Leading fiber manufacturers have stated in various technical doc-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uments that the coatings extruded over bare fiber stops water penetration in extreme heat and cold. Bellcore's Technical Reference TR-20, the industry standard for fiber quality, is met by a number of fiber manufacturers including AT&T and Corning. Engineers at Bellcore have stated that fiber meeting TR-20 can be effectively and safely placed above ground.

While this requirement is key to the use of any breathable closure, the successful implementation of the closure in the field rests with its ability to be craft friendly and physically capable of withstanding the harsh realities of the aerial plant. Previous aerial closures for both copper and fiber have failed because of substandard designs, susceptibility to rodent infestation and poor material selection.

The purpose of an aerial fiber splice closure is to provide environmental protection for the fiber cable and splices, maintain the mechanical integrity of the cable by duplicating or anchoring the cable strength member, and provide a workable area to allow easy access for maintenance or expansion.

Until recently fiber closures have been generically deployed into the field and have been totally sealed, pressurized units, used in buried, underground (manhole or handhole), pedestal, or aerial applications. Free breathing fiber closures are solely for above ground/aerial deployment.

The closures, as well as the fiber, should be designed to last a full 20-plus years. The sophisticated customer base should not have to worry about the cable plant once it is installed, and the inevitable closure re-entries and rearrangements should be accomplished with ease, not pain.

Finally, breathable closures, because of the elimination of hermetic seals, should be significantly lower in cost. Recent studies show a per piece savings of 35 percent to 50 percent in the closure price alone when compared to fully sealed closures. This savings does not include the grommet drilling kits, heat shrink sealing devices and re-entry kits often found in older sealed closures.

After talking with hundreds of seasoned craftsmen, a list of features that would make their installation job significantly easier and shorter was created. The list includes:

✔ Come complete with all the necessary parts for completing a splice, without complicated re-entry kits or myriad parts or special tools.

✔ Pass the stringent rodent resistance tests conducted at the Denver Wildlife Center.

✔ Provide self-sizing cable seal grommets to eliminate errors that occur when sealing grommets are cut or drilled.

✔ Offer independently sealed cable ports, strength member tiedowns and cable sheath tiedowns so as not to disturb already installed cables when adding cables.

✔ All hardware should be corrosion resistant, preferably stainless steel.

✔ The closure housing should be of a hard plastic design, resistant to U.V., chemicals, drop, impact, cold and heat stresses, and rodents.

✔ Require no mastics or tapes for sealing cables or covers.

✔ Channel condensation out of the closure and equalize temperature inside the closure via vent ports.

✔ Allow for in-line express or butt splicing capability.

✔ Accommodate either single-fusion or mass fusion fiber splicing trays.

✔ Route and store excess fiber bundles while allowing easy access to each one after storage.

Reliability and Testing

Fiber optic closures should withstand a battery of environmental tests to ensure their reliability in the field. Testing by the manufacturer, in conjunction with an independent lab source to established industry standard specifications such as Bellcore TR-771, TR-950 and TR-1368, is the minimum necessary requirement to provide long-term reliability in the field.

Environmental and mechanical tests from these TR- specifications cover a broad range, including thermal aging, cable pull out, impact for cold and warm temperatures, weathertightness (dust), simulated driving rain, chemical resistance, temperature and humidity, ultraviolet resistance, salt fog, and rodent resistance.

Fiber offers extremely high reliability and lowers overall system maintenance costs, so it is imperative that the splice closure offer the same reliability to ensure overall system integrity.

Conclusions

As fiber continues to move deeper into the network, old methods for installation and antiquated opinions on protection must be revisited. The convergence of the telecom and CATV industries will encourage service providers to speed up installations and lower costs. CED

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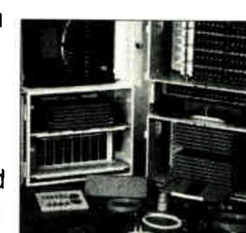

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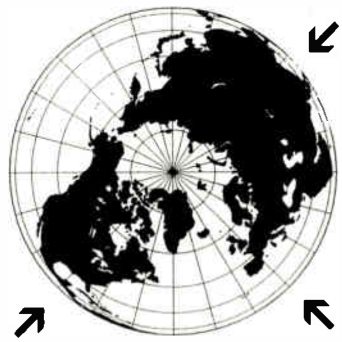

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1550 gear quietly comes on line

Cable cagey about use

By Fred Dawson

Lightwave technology operating in the 1550 nanometer (nm) transmission "window" has suddenly emerged as a significant factor in the fast-paced network expansion arena, challenging long-standing engineering doubts about the viability of optical amplification as a cornerstone of system design.

Is 1550 nm gear cable's hidden ace?

During the past few months, a growing number of system engineers have turned to high-power transmitters and optical amplifiers operating in the 1550 region, where optical loss is minimal, to support long-distance AM cable transmission across large, regionally integrated franchise territories. Cable systems using such links can now be found in Rochester, N.Y., San Diego, Toronto, Montreal, Indianapolis, Detroit, Long Island, N.Y. and many other localities.

At the same time, many cable and telephone companies have begun looking at using 1550 nm equipment to help achieve the most cost-effective design balance for "multicasting" AM and digital fare while "pointcasting" digitally to the local distribution fiber node.

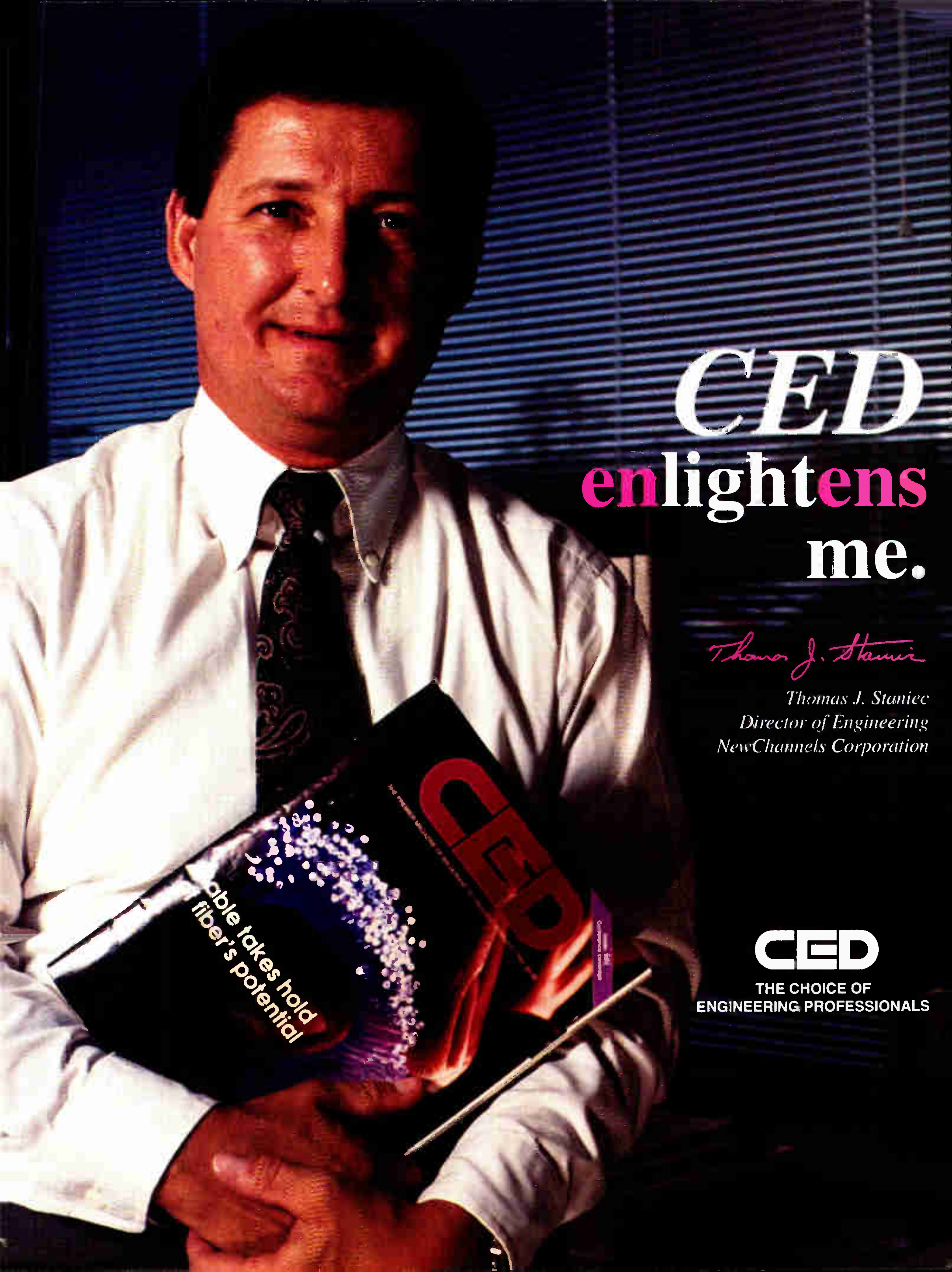
Rising interest in 1550 nm as a transmission path in the distribution plant is fueled in part by the possibilities surrounding wavelength division multiplexing (WDM), which is moving beyond the ability to combine 1310 nm and 1550 nm signals over a single fiber to "high-density" WDM involving four or more wavelengths in the 1550 nm region. By far, the biggest application in cable to date has been in long-haul supertrunking, where the list of MSOs making use of 1550 nm gear, with varying degrees of intensity, now includes Tele-Communications Inc., Time Warner Cable, Cox, Comcast, Rogers Cablesystems, C-TEC Cable, Videotron and Cablevision Systems Corp.

But the technology is beginning to make its way into distribution plant as well, starting with Cablevision Systems, which for a long time stood as the lone 1550 nm proponent in cable, and followed recently by Comcast, whose officials refuse to discuss their applications. George Fletcher, senior marketing vice president at Texscan, says his firm's 1550 nm product line is now finding as many, if not more uses in distribution plant than in long-haul applications.

"We have a lot of long-haul point-to-point links going in," he says, "but, if you start looking at the costs of transmitting 750 MHz to one to three nodes using 1310 nm DFBs (distributed feedback lasers) versus 30 to 40 nodes using a high-power 1550 nm transmitter and optical amplifiers, 1550 nm becomes very attractive."

Texscan is now taking orders on 80 milliwatt (mW) as well as 40 mW transmitters, Fletcher says. In both cases, he notes, with a load of 80 AM TV channels per link, specifications for 0 dBm received optical power at the node include a carrier-to-noise figure of 52 dB and distortion figures of -65 dB or below. For example, at the 40 mW level, the transmitter would be able to deliver 80 channels of AM TV through four separate 40 kilometer links, each of which delivers these node specs.

The transmitters, combining unmodulated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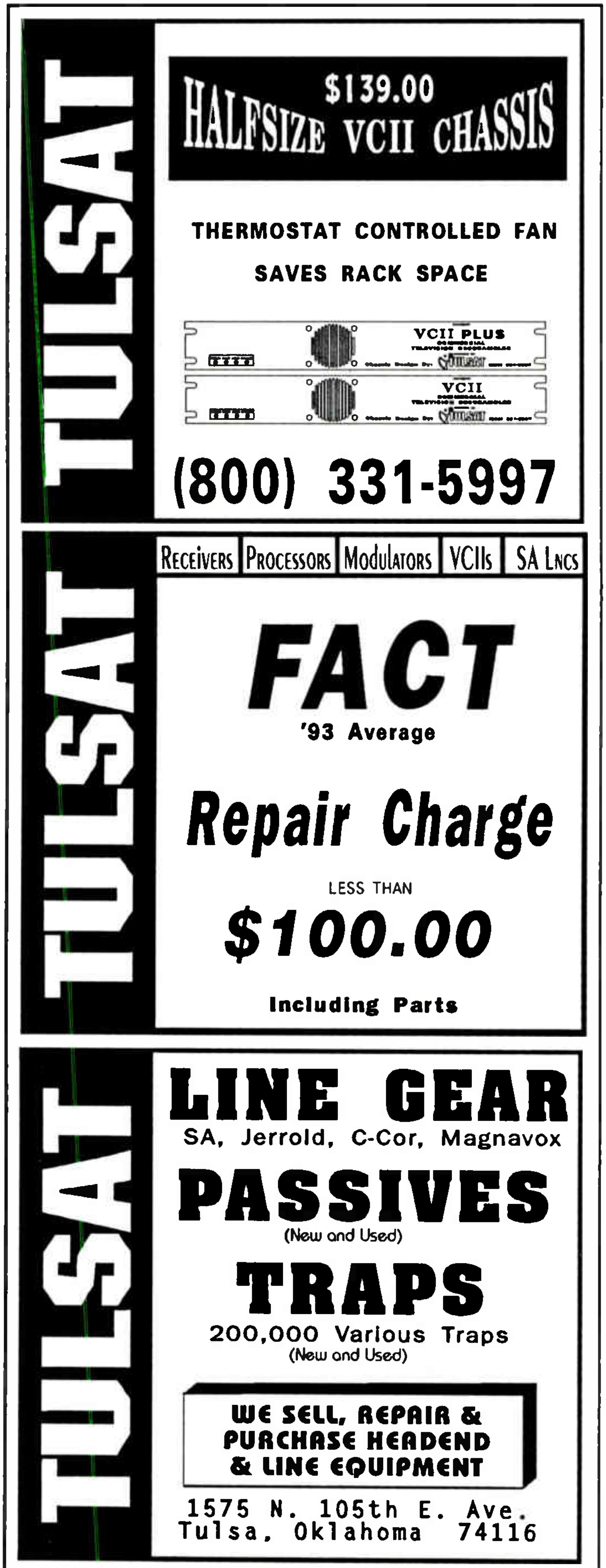

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"chirpless" output from 1550 DFBs with optically linearized Mach Zehnder modulators and optical amplifiers, are supplied to Texscan by Synchronous Communications, which also markets the equipment under its own name. So far, virtually all the 1550 CATV systems now in operation in the United States, Canada and Europe were supplied through these two firms. But this is about to change, as Scientific-Atlanta, AT&T and other vendors prepare to put product on the market.

"We're seeing a need for high-power transmission systems in a variety of applications," says Greg Hardy, director of fiber and distribution product marketing at Scientific-Atlanta. "1550 is definitely a factor." S-A plans to introduce 1550 transmitters and other components in the near future, Hardy says. "This technology is becoming more refined. The economics are making more sense."

The use of 1550 technology in long-haul applications begins with the cost-efficiencies of AM versus digital transport for multicast CATV services. Fletcher tells of an instance involving a South American telephone company where his company bid on an RFP calling for digital links to interconnect CATV territories over large regions. "We also threw in a bid based on 1550 nm technology," he says. "They needed some long-distance links, some as much as 120 km, with 10 different hub sites delivering 32 channels for RF distribution. The 1550 solution was one-half the cost in the forward direction, delivering 80 AM channels instead of 32 digital. They bought it, and we're using digital in the return direction."

"This technology is becoming more refined. The economics are making more sense."

Time Warner's cable operation in Rochester, N.Y. recently chose 1550 nm equipment from Synchronous to help meet system consolidation requirements, linking three hubs at distances up to 26 miles for delivery of a 550 MHz AM payload. "The system is performing very well," says Tom Foster, vice president of engineering at Greater Rochester Cablevision. "It definitely solves a big problem."

"We see a good opportunity for our products in this area," says Mike Powell, managing director of Integrated Optical Components, a British firm. "The (U.S.) telephone and cable companies are very clear about their needs along these lines." IOC and its competitors, which, in the United States, include Corning, United Technologies and Crystal Technologies, are specialists in the glass components, as well as all types of fiber, that make lightwave multiplexing possible.

An executive at one of these firms, asking not to be named, says the market push is especially strong from US West and Pacific Telesis, which have aggressive video expansion programs. "When you start shunting AM video around big territories like the L.A. Basin, you need a lot of power and plenty of bandwidth," he says. Developers say the value of 1550 nm systems resides in several factors, starting with the fact that light signals at that wavelength travel farther than light at other wavelengths, registering about 0.25 dB per km optical loss over fiber designed for 1310 nm transmissions, versus 0.40 dB per km for 1310 transmissions over the same fiber. In addition, optical amplification, while possible at 1310 nm, is much more efficient at 1550 nm.

One of the key optical component breakthroughs supporting ever improving performance levels are the "optically linearized" Mach Zehnder modulators, which reduce electronic circuitry requirements in the transmitter, vastly improving reliability over earlier types of high-power externally modulated transmitters. Reliable Mach Zehnders are vital to the economics of 1550 nm because a key drawback for 1550 nm was the signal dispersion effects when light at this wavelength is sent through fiber that was "dispersion nulled" for 1310 nm.

Developers say the external modulation devices avoid the "chirp" of directly modulated lasers, overcoming the dispersion problem. "Our devices for analog applications are extremely well-suited to high-power 1550 nm output," Powell says. "Dispersion is not a problem."

Powell and others say the pressure on component manufacturers is especially strong from systems suppliers who are competing for the business of local exchange carriers. "Scientific-Atlanta (system supplier to US West for its video dialtone trial in Omaha) is a big factor in our efforts right now," notes an engineer at GEC-Marconi Materials Technology Ltd., asking not to be named.

At Rogers Cablesystems, Senior Vice President of Engineering Nick Hamilton-Piercy notes the company plans to deploy a 1550 nm link over a 50-km inter-city route. The technology is a lower cost alternative to digital, which Rogers is also using in some areas, Hamilton-Piercy says, "but it's still more expensive than we'd like." Whether costs come down depends in part on how many vendors succeed in providing 1550 nm systems that meet network operation requirements. The suppliers of the optical components will have much to say about whether those requirements can be met.

Some developers are looking at moving to fiber lasers as a low-cost way to supply narrow wavelength transmitters.

The next breakthrough for 1550 nm is high-density WDM, which will open the way for combining 30- to 40-node scale delivery of standard AM cable with narrowcast, high-capacity transmitters that can serve multiple nodes on a dedicated "virtual channel" basis. Fletcher says the question isn't so much a technical one for getting to a commercial four-wavelength WDM tier as it is a matter of demand.

"It's analogous to the need for AM-specified DFBs," he explains. "Everything has to be spec'd at narrow wavelengths." The four windows under development at Synchronous and Texscan would be in the 1530 nm to 1560 nm range. "Customers are interested, so we're starting to toy with it," Fletcher says. "It's probably six or eight months down the road."

Some developers are looking at moving to fiber lasers, a new technology, as a low-cost way to supply narrow wavelength transmitters. Fiber lasers, employing the stimulated emission properties of erbium doped fiber amplification, can be easily fabricated to produce very narrow, highly predictable wavelengths within the 1550 nm window, says Greg Ball, a researcher at United Technologies Corp. Developers at United's Research Center in East Hartford, Conn. report they have made low-noise fiber lasers with output linewidths so narrow that eight separate wavelengths can be multiplexed together in the range between 1530 nm and 1560 nm.

While narrow linewidths along these lines have been achieved with other, more expensive laser designs, the use of fiber lasers points to the likelihood that narrow-linewidth devices will become available in the not-too-distant future at prices competitive with today's workhorse, the distributed feedback laser. "We're at a point where high density wavelength multiplexing is becoming feasible," says Vince Borelli, chairman

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and founder of Synchronous. "It could change the design equation for last-mile distribution as well as the longer-haul applications."

Despite growing enthusiasm, 1550 nm technology hasn't reached mainstream status, with the exception of the very long-haul AM transport market. Lack of publicity, fueled in part by cable operator reticence about technical strategies, is part of the reason. Not long ago, the regional engineering strategist for a top MSO responded to queries about the viability of 1550 nm technology for his long-haul needs with, "Last I heard, this was...a good two years off from being available commercially." Now, several months later, his group is installing 1550 nm links to serve interconnection needs in its largest system.

But cable companies remain reluctant to discuss such plans these days. "We're in an all-out war, and we need to be careful," says one engineering executive, declining to discuss his firm's largescale deployment of 1550 nm links. Cable industry reluctance to discuss 1550 nm strategies may be of little use, however, given the pursuit of 1550 nm solutions within the telephone community.

There, starting with now-commonplace long-distance applications, 1550 nm has often figured in long-term planning, but has yet to win any known commitments at the local distribution level. This could quickly change given the immediate needs of aggressive network developers like Pacific Bell and US West. "Bellcore is all over this," says a leading vendor executive, asking not to be named. "It's silly for cable people to think they can have the technology for themselves."

"It's silly for cable people to think they can have the technology for themselves."

It's safe to say that there will be significant use of 1550 nm technology in the distribution plant as well as interconnection links of cable and telephone networks. But the ever declining price per milliwatt of 1310 nm DFB lasers ensures that each project will require careful weighing of options at both wavelength regions.

Lawrence Stark, senior vice president of marketing at Ortel Corp., a supplier of 1310 nm DFBs, says costs are dropping at a rate of 20 percent per year. He reports his company's calculations show that it is now as cheap to build an all-passive hybrid fiber/coax network in the "fiber deep" mode as it is to build a fiber overlay to 2,000-home nodes.

"In three years it will be a no-brainer to go to all-passive in new construction," Stark says, though he acknowledges the cost benefits for upgrades are not as clear. As S-A's Hardy notes, the key point in recognizing the arrival of the 1550 nm option is that it allows network designers to be creative, mapping topology to immediate requirements, no matter which parameters for future needs they choose to bet on.

"We're seeing different schools of thought," he notes. "You can WDM or you can go in with digital on a second fiber or you can use a single laser for each node, combining digital and analog over the same wavelength. There's a lot to look at." CED

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Engineering Consortium expands training focus

More broadband issues

By Patrick J. Etchart

The information technology industry is at the threshold of a new age. New engineering and scientific advances promise untold services for consumers and nearly unlimited opportunities for those companies that can mold innovative solutions to meet the increasingly complex challenges that lie ahead.

The convergence of new technologies and industries, increasingly competitive national and international global markets, and growing consumer expectations represent just a few of the challenges facing professionals today in the information technology industry. To meet those challenges, industry must be prepared to embrace new developments and strategies in the marketplace and be willing to adapt to rapidly changing conditions.

One organization that has been evolving to meet the new challenges of changing technologies is the International Engineering Consortium (IEC), a non-profit cooperative dedicated to educating professionals in the information industry. The Consortium celebrated its 50th anniversary this year and marked the occasion by announcing a name change to better reflect the realities of a global economy.

Previously called the National Engineering Consortium, IEC Director of Media Relations Jim Cullen says the name change "better reflects the IEC's and industry's expansion into the global marketplace." The original National Engineering Consortium was founded near the end of World War II in 1944 by several industry leaders, as well as professors from Northwestern University, the Illinois Institute of Technology, and other universities, with the objective of developing techniques "for professionals to continue making new discoveries." Robert Janowiak, one of the original founders, remains as executive director of the Consortium. Since its formation, the Consortium has continued to evolve into one of the better-known organizations in the nation providing education for industry.

Headquartered in Chicago, the IEC is a cooperative association of industry and academic institutions that examines where the information industry has been, where it is going, and what future issues need to be addressed. The Consortium, says Cullen, "looks to stimulate communications between industry and educators...to make one aware of the other, which is beneficial to both."

The centerpiece of the IEC's efforts are a series of educational forums held throughout the year and culminating this year with the 1994 National Communications Forum scheduled September 19-21 in Chicago. An estimated 3,000 people are expected to attend NCF94, described by the IEC as the ultimate innovative educational experience for both established companies and new entrants worldwide. It boasts approximately 150 class offerings covering a range of core subject areas, referred to as "tracks."

The IEC also organizes an annual Eastern Communications Forum, a Western Communications Forum, and special technology-specific sessions as part of its TecForum Series. A Multimedia ComForum and a Broadband ComForum are scheduled in Denver this year from October 17-19 and October 19-21, respectively. The Denver sessions, according to IEC Program Coordinator Dan Hutton, will focus on all aspects of multimedia and broadband, "looking at every aspect of transporting information into the home through the cable box." Colorado Springs will be the site of next year's Western Communications Forum, scheduled March 7-8, 1995.

Hutton described the IEC forums as "all-

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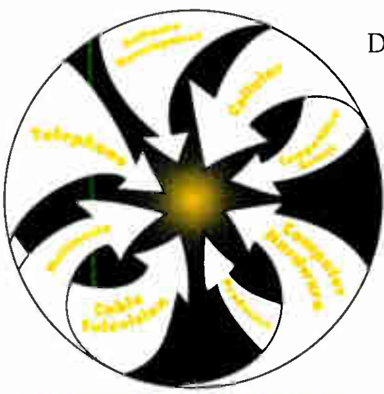

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encompassing with something for everyone." The forums will generally focus on approximately 15 tracks with associated class offerings. What is offered in the form of classroom topics is generally decided a year in advance through a process initiated by the IEC's Executive Council. That council consists of more than 325 representatives from 21 major information industries as well as representatives from university affiliates. The IEC is affiliated with 57 major engineering universities, including recent additions from Canada and Mexico. The global focus of the IEC is further illustrated by recent invitations to European universities, with new affiliations expected in the near future from England, France and Ireland.

The industry and academic leaders who participate in the Executive Council meet periodically to review new technologies and issues, offer insight into emerging technologies and direct IEC programs. Based on what the Executive Council may see as "hot topics" in the information industry, forums covering specific themes will be organized. The topics will be researched, instructional material prepared and courses presented by industry representatives or university professors who are experts in a particular field.

Among the 54 tracks offered at NCF94 are sessions on Fiber-in-the-Loop, Content Creation and Distribution, Broadband and ATM (Asynchronous Transfer Mode), the Business of Cable TV and its Services, National Information Infrastructure, Global AIN (Advanced Intelligent Network), Network Reliability and Survivability, Wireless Applications, Competition in the Local Loop, Marketing Tactics for a New Competitive Environment, Digital Switching, the Infrastructure of Cable Television, Advanced Network Technologies and Applications, and Regulatory and Public Policy Issues.

Cullen stresses the importance of interaction between industry and the academic community, and notes that the IEC's University Program fosters that interaction. Through the University Program, sponsoring organizations provide grants that enable some 200 professors and 100 students the opportunity to participate in NCF94. These participants work closely with attendees from all sectors of the information industry to help identify current trends and challenges. The IEC believes this interaction provides professors with new ideas and materials to expand their educational capabilities, which ultimately leads to improved classroom presentations.

Cullen sees an expanding role for the IEC in the years ahead.

Cullen says the disciplines of the professors cover a broad spectrum that mirror the convergence of the industry, ranging from electrical engineering, business administration, and computer science to public policy, information technology and communications. The new university Student Program initiated this year represents an expanded commitment to education by the IEC.

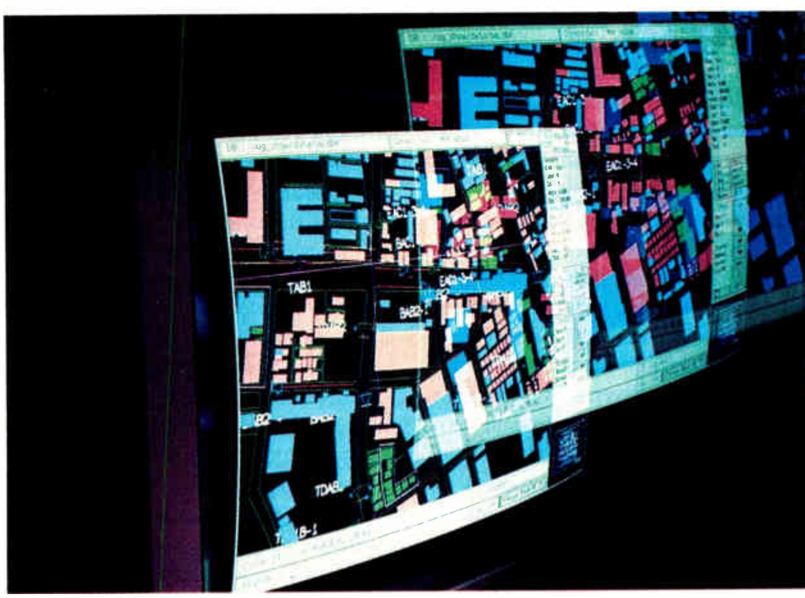
What does NCF94 offer cable professionals? Quite a lot, according to Cullen. In addition to providing the opportunity to interact with the university segment in a noncommercial atmosphere, it allows cable professionals the opportunity to learn about and see new information technologies, witness how new processes can be applied and learn about emerging trends and business strategies.

Jim Bauer, vice president of marketing for ANTEC, a leading supplier of technology integrator and broadband products, agrees. "The NCF is not a trade show," says Bauer. "It is an educational and technology exchange forum where engineers, architects and the leadership in engineering information fields exchange ideas and discuss future trends, both domestically and internationally."

NCF94 also offers what are called TecPreviews as a complement to classroom education. Participants can view and assess current and near-term future technologies with demonstrations hosted by engineers and technology concept experts.

Cullen sees an expanding role for the IEC in the years ahead as the information technology industry continues to make new discoveries and explores new arenas for customer service as part of the burgeoning information superhighway. "Information technology," says Cullen, "is making it all possible." But he wonders if industry is fully considering all the practical applications. "It's one thing to have it, it's another to have practical uses that can help make life easier and better for the consumer." CED

Mr. Etchart is a Denver-based freelance journalist.



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- ☐ 6b. Local Telephone Co.
- ☐ 6c. Regional Bell Operating Co.
- ☐ 6d. Long Distance Telephone Co.
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- ☐ 13. Advertising agency
- ☐ 14. Educational TV Station, School or Library
- ☐ 15. Telecommunications Consulting Firm
- ☐ 16. Local Area Network End-User
- ☐ 17. Local Area Network Equipment/ Services Supplier
- ☐ 20. Satellite Communications Services/ Common Carrier Firm
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- ☐ 18. Others Allied to the field ______ (please specify)

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- ☐ e. Headend Equipment
- ☐ f. Contract Services
- ☐ g. Other ______ (please specify)

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11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120

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121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
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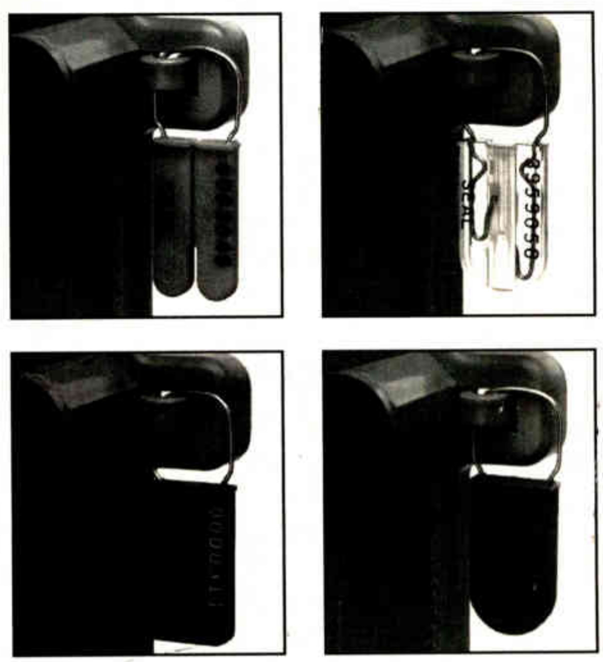

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ACCESSORIES

Metrotek's new fiber test set

ELMSFORD, N.Y.–Metrotek Industries Inc. is offering a fiber optic test set, Model D410, a simple alternative for checking fiber optic cables and connectors. It's easy to use and small enough to fit into a shirt pocket, according to the company.

The bargraph indicator measures absolute optical power in 2 dBm steps. Available with ST or SMA connectors, the D410 frees up more costly test equipment when all that is required is a quick operational test. Because it contains both a source and a receiver, the D410 can be used to test a jumper or a spool of cable. A pair of testers can be used to test long fiber runs between equipment bays or buildings.

The D410 is intended primarily for general field maintenance and installation work.

Circle Reader Service number 60

Multi-test platform

VANIER, Quebec–EXFO has launched the OTDR Kit universal test platform, a toolbox of fiber optic test equipment. The versatile kit can be configured to fit almost any fiber testing needed.

The user can combine any three of the following test cards: singlemode OTDR, multimode OTDR, automatic attenuation meter and fiber optic talk set. A CW light source or visual fault locator plus a power meter can also be added. The entire platform is run by a compact, notebook computer that can run other computer applications as well.

OTDR kit

This card-based OTDR has all of the features of a conventional OTDR: full fiber analysis, real-time averaging, event zooming, signature overlay, 2-point analysis and splice loss measurement.

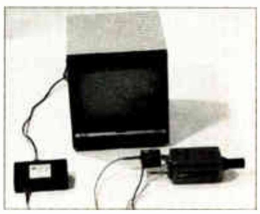
Other features of the kit include: trace management software (DocuNet); mass storage capability; large, easy-to-read display; easy mouse or keyboard operation; file and batch printing; and complimentary software upgrades.

Circle Reader Service number 61

Video link system

ORISKANY, N.Y.–Fiber Instrument Sales has added the Fiber Optic Video Link System to its line of equipment. The system is designed for transmitting high quality video in any standard format over much longer distances than are possible with coaxial cable. In addition, the system provides additional security and distance capabilities up to four kilometers.

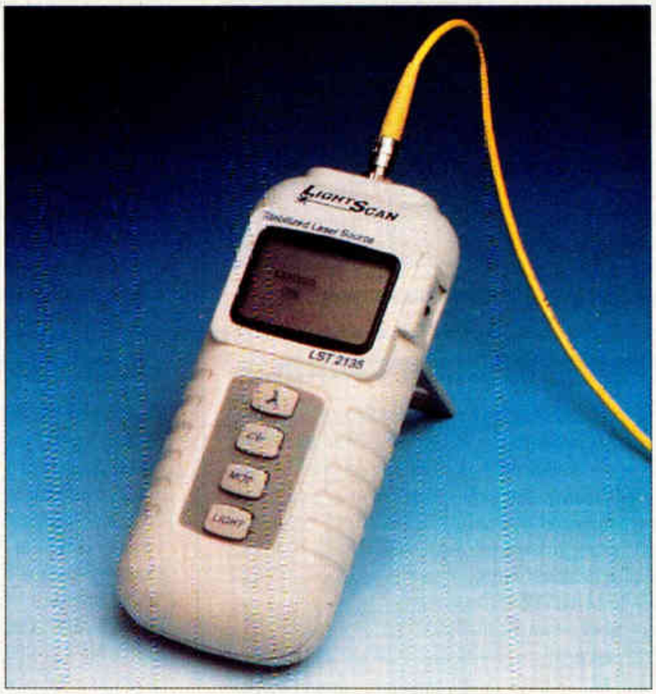
The system features a built-in automatic gain control which adjusts automatically for varying cable lengths. Video Link accepts ST style fiber optic connectors using 50/125 or 62.5/125 core/clad μm fibers. Having a 10 MHz bandwidth capability with a link budget of 16 dB, the system is equipped with a status bi-color LED. The LED indicates the presence of video signals and a properly operating system. Operating temperature is from 0 to 50 degrees Centigrade.



Fiber optic video link system

This ruggedized system is immune to the effects of radiated interference, high voltage differentials, water, ground loops and the effects of hazardous environments, says the company.

Circle Reader Service number 62



Stabilized laser source

PENACOOK, N.H.-LightScan Advanced Technologies is offering the LightScan Stabilized Laser Source model LST 2135, featuring a single port design for testing at both 1310 nm and 1550 nm without the need to change connections. Output power

Optical test converter

AUSTIN, Texas-3M Telecom Systems Division has announced the Photodyne 5350 modular optical test instrument, a modular tray attachment with optical modules that converts a notebook computer into a full-featured optical time domain reflectometer (OTDR).

The Photodyne 5350 enables the operator to develop a detailed automatic analysis of the fiber optic line being tested by pressing a single button. In addition, the 5350 has all of the features of an OTDR, including measurement, historical analysis and tracking.

Photodyne™ 5350 modular optical test instrument

The 5350 is targeted at installation contractors, telcos, or telecommunications site managers requiring fiber optic test equipment that has all the features of an OTDR, but at

Stabilized laser source model LST 2135

is stabilized to provide accurate, repeatable performance for all applications. Power options include an AC wall cube, rechargeable nickel-cadmium or alkaline batteries.

Users can choose to transmit a continuous wave; a modulated wave at 270 Hz, 1 kHz, or 2 kHz; or they can automatically scan the modulated frequencies. A built-in stand allows hands-free operation and continuous self testing assures accuracy. In addition, the unit has a 24-month warranty.

Circle Reader Service number 68

a more economical price.

Additionally, the 5350 modular tray holds up to three optical modules, or two optical modules and a battery module, depending on the application. Multiple 5350s may be added to a single computer, offering limitless expansion to cover all types of testing of multimode or singlemode fiber optic cable.

Six optical modules can be used in the Photodyne 5350: multimode modules at 850 nm, plus a dual-wavelength module running 850 nm/1300 nm; singlemode modules at 1300 nm and 1550 nm, plus a dual-wavelength 1310 nm/1550 nm. Optional battery modules enable the optical modules to be operated without an external power source.

Circle Reader Service number 63

Fiber talk set

HICKORY, N.C.-Siecor Corp. has introduced a full-featured fiber optic talk set, the FTS-110. The FTS-110 high-powered LED based set operates on both singlemode and multimode fibers up to 60 km or more; or 30 dB range. The full duplex operation permits simultaneous talk/listen capability like standard telephone conversation over one fiber. It incorporates a call feature, similar to a telephone "ring," to indicate conversation. Each set is rechargeable and includes a low-battery indicator.

The talk set offers noise-canceling, hands-free headsets to simplify communication for field splicing and installations, emergency restorations, and routine testing and maintenance, when standard telephone service may not be available.

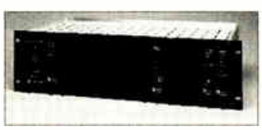
The use of fiber talk sets provides a number of advantages over other communications alternatives, according to Siecor. Conventional copper talk sets won't work on optical fiber cables, and cellular options can add costs to cover remote sites. Radio sets can be crowded and noisy and may lack range.

Siecor's line of talk sets also includes the FTS-100, a laser-based talk set with up to 80 km range, plus singlemode and multimode versions of the smallTALK® fiber communicators, which provide walkie-talkie style operation.

Circle Reader Service number 64

CD quality audio/video

BOHEMIA, N.Y.-Fiber Options Inc. has introduced its Series 1240B fiber optic links for transmitting video and stereo audio signals incorporating 18-bit digital audio signal processing technology.



Series 1240B fiber optic

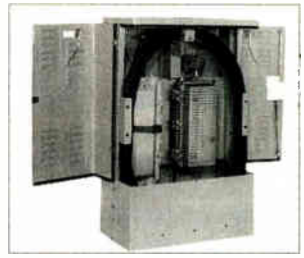
Systems in the series convert video and two channels of stereo audio to broadcast-quality digital signals that are transmitted over a single optical fiber. The signals are then reconstructed without degradation. Employing 18-bit delta-sigma analog-to-digital audio signal processing with a sampling rate of 48 kHz ensures that distortion is kept very low throughout the system. Systems also include two low-speed (50 baud) CMOS-level signals.

Links include optical AGC circuitry and require no field adjustment either at installation or periodically thereafter. The transmitter includes both a video-presence and a 10-segment audio-levels indicator. The receiver includes a Level/LossTM LED that indicates loss of received optical power, should it occur.

Circle Reader Service number 65

Conversion enclosure

FRANKLIN PARK, Ill.-Reliance Comm/Tec Corporation's Reliable Electric Division is announcing its OPFOTV11, an above-ground cabinet designed to house fiber optic and coaxial distribution equipment.



OPFOTV11, an above-ground cabinet

The upright OPFOTV11 cabinet houses an optical node (including the Jerrold SX and ANTEC Gateway systems), fiber splice enclosure and up to 200 feet of optical cable. Mounting accommodations are also provided for combining an optical node, fiber optic splice unit, amplifier, directional coupler, power inserter, tap and splitters.

Hinged removable front and rear doors, lower front cover and a removable cap permit 360-degree access for efficient installation of distribution equipment.

The internal components consist of a mounting plate, cable arrangement brackets and a grounding system. All components are manufactured from heavy gauge, mill-galvanized steel and are treated with a patented nine-step finishing process.

Circle Reader Service number 66

Digital transmitter tester

MORGAN HILL, Calif.-Anritsu Wiltron has introduced the MS8604A, a digital mobile transmitter tester designed to make high speed measurements. The integration of digital signal processing and an Anritsu algorithm combine to make fast and accurate measurements of NADC, PDC and PHP transmitters.

The MS8604A can measure burst modulation accuracy in less than one second and can measure occupied bandwidth, spurious emissions and leakage power of adjacent channels in two seconds or less. Typical spectrum analyzers take up to 10 seconds to perform similar measurements. A built-in power meter calibrates the analyzer to ±0.5 dB accuracy.

MS8604A, a digital mobile transmitter

The MS8604A combines a 100 Hz-8.5 GHz spectrum analyzer with a 400 kHz-2.1 GHz digital modulation analyzer.

Circle Reader Service number 67

Quality, price and reliability

By Archer S. Taylor, Director and Senior Engineering Consultant, Malarkey-Taylor Associates

Competition in the brave new world ahead will focus on price, quality, service and marketing. Prime concerns in the technical community will be the quality and reliability of the product, and the capital and operating expenses which are at the root of the price structure.

Cable TV could parrot the telephone company with fully redundant routes and equipment, fiber to the tap, costly central power with eight-hour battery standby and comprehensive round-the-clock status monitoring. Systems could be designed for the highest possible performance under the most unlikely adverse conditions. This could be done.

But, it is more likely that the telcos, without 99 percent subscriber penetration and guaranteed return on investment, will shift their emphasis toward reducing capital and operating expenditures while compromising quality and reliability. It is interesting to observe that, released from monopoly utility protections, telcos will be faced with the same laws of physics and economics as cable TV, albeit with deeper pockets.

Cable's technological leadership

There was a time when cable TV technology depended heavily on research at Bell Telephone Laboratories. Not so now. Thanks to ATC and Jim Chiddix, cable TV produced the successful amplitude modulation technology for fiber optic networks, once disdained by telcos. Thanks to GI (Jerrold), cable TV has turned television technology on its head with the DigiCipher and DigiCable AM/digital hybrids.

Telcos seem to be finding that AM fiber may serve useful purposes after all. And the digital compression and sophisticated AM techniques first exploited by GI (Jerrold) may have provided the inspiration for the development by telcos of the ADSL (asymmetric digital subscriber loop) as an interim technology for transmitting video on copper pairs until fiber to the home becomes justifiable.

The original video dialtone (VDT) architecture was conceived as a replication of the traditional public switched telephone network (PSTN) with expanded downstream bandwidth to accommodate a 6 MHz TV channel. By analogy to central office switching in the dial-up telephone system, separate VDT paths would be established from the headend for whatever program each subscriber dialed. ADSL would be well suited to this concept.

A reality check of the competitive marketplace, including the role of the independent and highly entrepreneurial consumer electronics industry, has transformed VDT into a common carrier vehicle with unspecified architecture.

ADSL and the centrally switched architecture are inherently incompatible with cable-ready TV sets. As a consequence, the telco networks tend to look more like cable TV networks, with fiber/coaxial hybrids, and AM fiber optics carrying both multichannel analog VSB/AM and amplitude modulated digital carriers.

Telco boasts about the reliability of plain old telephone service (POTS) and the high quality of digital transmission are at least arguable. After running through all the voice mail options without finding any way to communicate with flesh and blood, finding numerous errors in directory information, and experiencing misdirected calls, one wonders about the availability of telephone communication. The compromises required to squeeze digital video into copper pairs are bound to degrade some pictures, especially those involving rapid motion or scene changes.

Balancing reliability and price

The degree of reliability required for POTS is high, though perhaps not immune to compromise in the interest of cost reduction. Loss of entertainment video during the Super Bowl, World Series, or a climactic soap opera scene can be catastrophic. But generally, cable TV subscribers are reasonably tolerant of outages, providing recovery is prompt and effective. Reliability can be expensive. The proper balance between reliability and price will be determined in the marketplace.

Telephone companies, seemingly eager to leave the comfortable "cost plus" world, will soon come face-to-face with the harsh realities of competition. Prudent compromises with reliability and service quality in favor of cost reduction are to be expected. Cable TV is on the right track, improving performance with increasingly rich fiber penetration, shorter cascades, leakage monitoring and standby powering.

Telcos are prone to claim near perfection, but at a cost much too high to support competitive pricing without the subsidies provided by allocating most of the cost of integrated services to the POTS monopoly. The genius of cable TV throughout its history has been its unparalleled ability to produce marketable quality at exceptionally low cost. Cable TV technicians and engineers know how to deliver reliable, high quality product.

Regulatory help

Redundancy, robust construction, conservative design, fiber-rich upgrades, effective use of status monitors, computer assisted and competent maintenance can be implemented, perhaps one step at a time, to enhance the marketability of cable service at affordable incremental cost. With even-handed regulation, cable TV should be able to adapt available technology to produce a marketable product at lower prices than telcos can offer without cross-subsidies. CED

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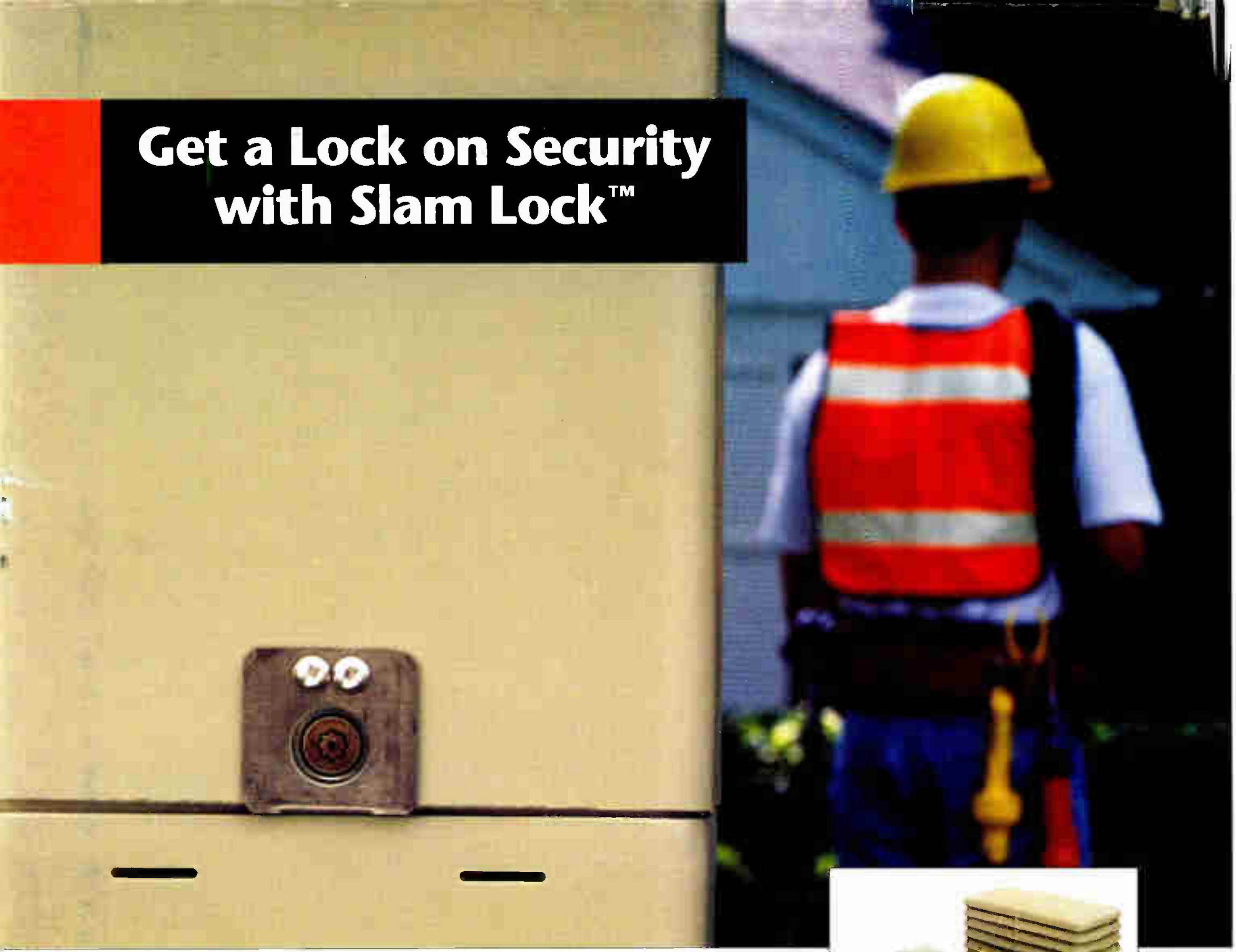

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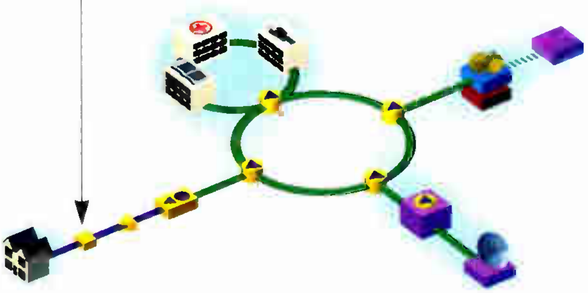
Our Cable Integrated Services Network (CISN) is a "blueprint" for building a broadband network that accommodates interactive services in a 1 GHz spectrum. The MONARCH family of products provide outside plant equipment for the broadband network.



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