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CED magazine is recognized by the Society of Cable Television Engineers.

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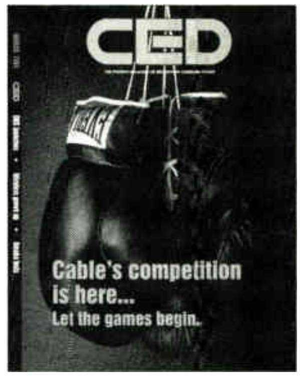

About the Cover

Taking the gloves off.
Photo by The Image Bank

Departments

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PacBell plans broadband upgrade; interactive TV tests next on agenda

The newest focal point of the information superhighway trials has expanded to include the high-tech Silicon Valley of California with announcements from Pacific Telesis Video Services that it is: 1) planning to spend $16 billion to upgrade its narrowband telephony network into a hybrid fiber/coax broadband network; 2) testing interactive television in conjunction with AT&T; and 3) building an interactive video system that will deliver programming on-demand via Hewlett-Packard video servers in four California communities.

The Silicon Valley joins northern Virginia and the Orlando, Fla. area as key test sites of true video on demand. In Virginia, Bell Atlantic will go head-to-head with Jones in Alexandria and GTE plans to offer multimedia services with AT&T in Manassas; Time Warner, meanwhile, plans to offer a full array of interactive services in Orlando. The Silicon Valley now will have both Viacom Cable in Castro Valley and PacTel in Milpitas offering movies on demand and other, more advanced services.

The key to understanding what is happening in the PacTel trials is to think of them as two different approaches: one that explores the full possibilities of the electronic superhighway (Milpitas) and another that intends to capitalize on offering movies on demand. This latter approach involves placing an HP video server in San Diego, Orange County, Los Angeles and Silicon Valley by early 1995. They are both components to the larger "California First" initiative that calls for the RBOC to bring broadband capability to more than half of the 9 million homes it services in California.

Placement of the HP servers in the four population centers reflects PTVS' belief that video on demand is a real business opportunity. "This is not a technology test or a market experiment; it is the actual introduction of interactive video services for the California mass market," said Lee Camp, president and CEO of PTVS.

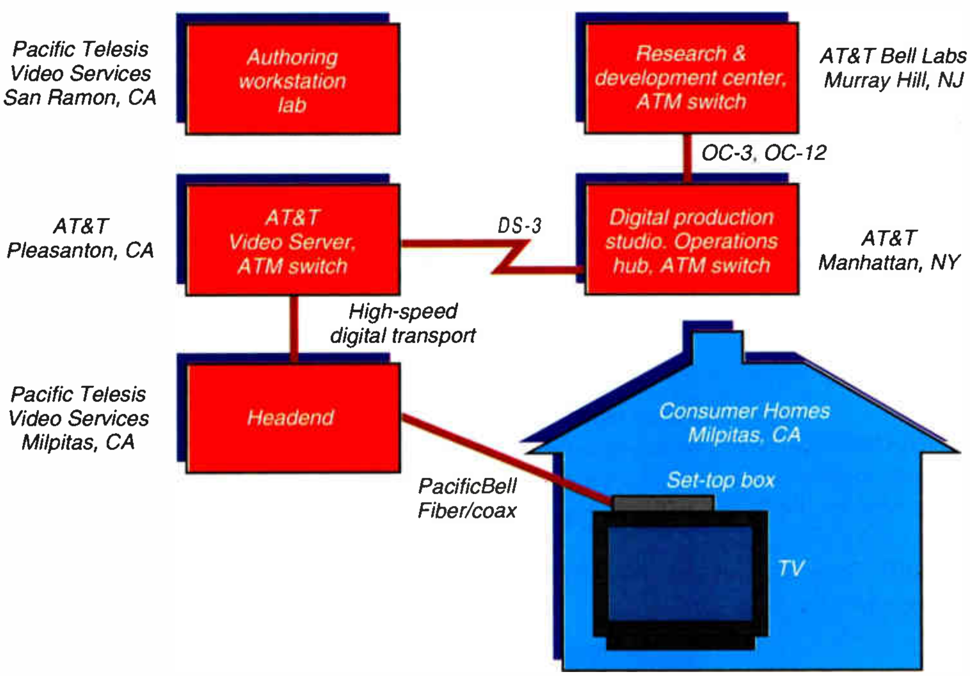
The Milpitas trial, however, intends to discern which other futuristic, interactive services will be embraced by consumers. "This trial will test what is possible with the new communications superhighway," said Camp. "We will learn consumer preferences fir services and the look and feel of interactive TV."

The Milpitas trial will rely on AT&T Network Systems's ATM switch, prototype set-top boxes and software. AT&T's digital production facility, digitization technology and content authoring tools will be used to adapt content.

Meanwhile, in Manassas, Va., GTE will utilize the same AT&T switch as well as AT&T servers to test interactive video services, starting at the end of this year (pending government approval). By mid-1995, the company hopes to have more than 1,000 subscribers.

GTE will test the system over its hybrid fiber/coax network. The two companies plan to upgrade the network over time to the new SONET-based technology developed by AT&T.

*Figure 1: **AT&T / Pacific Telesis Video Services trial network***



GTE selects ADC; ADC adopts VSB

In addition to working with AT&T in Virginia to test interactive video, GTE Telephone Operations has selected ADC Telecommunications to integrate voice, data and video over a single network to support a new tariffed service, called Multimedia Data Service, which is designed to provide ATM-like services that use well-known protocols like Ethernet and Token Ring.

GTE plans to kick off the new service in four southeastern regions, ultimately expanding it to its 12 largest markets. Potential customers identified by GTE include hospitals (X-ray and file transfer), businesses (videoconferencing), schools (Internet) and courts (remote arraignments).

ADC created a Multimedia Systems Configuration Group to help companies like GTE enter these businesses. The group will develop custom systems based on its fiber optic multiplexer, a DS-3 fiber loop converter and an FM multichannel video transmission system.

The system supports and environment that resembles a broadband ISDN world while providing a method for upgrading to ATM and SONET based networks of the future, according to ADC officials.

Additionally, ADC announced that it plans to integrate Zenith Electronic Corp.'s 16-VSB video compression technology into its "Homeworx" loop access platform, to provide an integrated solution for delivering video dial tone and other digital services.

ADC plans to use the 16-VSB technology to modulate digital signals for transport between video servers and the Zenith digital set-top. The two companies have also discussed possibly joint marketing and develop-

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ing an end-to-end network solution for service providers.

Bell Atlantic chooses set-top box vendors

Bell Atlantic has chosen the vendors that will develop set-top terminals to deliver interactive video services to subscribers. The vendors chosen include IBM, a partnership between Philips Digital Videocommunications and Compression Labs, and a consortium of DiviCom, MicroWare and EURODEC.

The set-tops will be used initially in Bell Atlantic's market test of Stargazer on-demand service, which is scheduled to begin within the next six months. They will also be used in the Washington, D.C. area in the latter half of the year, where Stargazer will be commercially rolled out.

The set-tops will include a microprocessor based on the Motorola 68000 series (with future migration to PowerPC planned) and will contain about 2 megabytes of memory, MPEG decompression capability, on-screen graphics capability and air-mouse type remote control.

One day prior to that announcement, Bell Atlantic said it formed an alliance with Oracle Corp. to jointly develop and market interactive multimedia software and services. Bell Atlantic said it intends to deploy Oracle's software, systems and services as the platform for its Stargazer on-demand programming roll-out. In addition, the companies intend to license the software to other telecommunications and cable-TV companies.

Bell Atlantic's stated goal is to develop and deploy a commercially viable system for delivering interactive multimedia services. It intends to work with video dial tone providers to deliver the service to viewers and couple it with the Stargazer navigational system and a combination of symmetrical microprocessor and massively parallel computers, which will be provided as part of the Oracle agreement.

The Oracle software has been designed to operate on a variety of computers and operating systems. Massively parallel computers string together thousands of microprocessors, each of which has its own communications pathway out of the string. The result is a powerful system that avoid congested pathways that plague traditional computers and limit their use in providing services like video on demand.

FiberVision gets nod on Hartford overbuild

FiberVision Corp. last month won preliminary franchise approval to build a $30 million, 750 MHz cable television network in the six Connecticut towns of Bloomfield, East Hartford, Hartford, Simsbury, West Hartford and Windsor. The overbuild will pass 135,000 homes in that region.

The Connecticut State Department of Public Utility Control granted the preliminary approval, and promised to issue a final decision by mid-February. Three other FiberVision franchises, representing 315,000 more households in Bridgeport, New Britain and New Haven, Conn., are pending. In total, the metro Hartford, Bridgeport, New Britain and New Haven projects represent a capital outlay of $94 million, said Karen Jarmon, VP of marketing and public affairs for FiberVision.

DPUC officials said the Hartford approval enables residents in that area to "have an opportunity to select a cable operator to provide service to their homes." FiberVision will begin construction of its fiber-to-the-feeder, 500-home node architecture in the Hartford franchise by mid-year. Bandwidth expansion to 500 or more channels via digital video compression technology will be added as it becomes available.

FiberVision will link schools within each franchise with fiber optic cable, providing interactive networking capabilities within the regions.

"Competing against the established cable TV operator will be a challenge," said Jarmon. "But by delivering excellence in picture quality, customer service and programming and by offering customers a choice in their cable service, we think we can attract and keep them."

Jottings

Cable Television Laboratories has issued a request for information on equipment and systems that can be used to provide telecommunications services over a cable TV network. The **RFI** seeks info on providing three services over cable plant: video telephony at rates up to 1.5 Mbps; POTS; and high-speed data services. Responses must be received at the CableLabs offices by 5 p.m. March 10 . . . Many cable system upgrades now underway are being spaced for 750 MHz gear, but few are actually installing the electronics. However, **Simmons Cable TV** in Madison, Ind. is the first Jerrold customer to install 750 MHz amps in its 130-mile rebuild. Simmons officials say they opted to go with 750 MHz equipment now because it will allow them to open a return path and prepare for digital/interactive TV . . . Several former employees of **Sumitomo Electric Fiber Optics Corp.** bought out that company's construction engineering division and created a new company called Network Construction Services that installs voice, data and video networks. Fred Strohmeyer at (910) 855-3950 was named president of the new company, which is based in Greensboro, N.C. . . . **Scientific-Atlanta's** portable, briefcase-sized satellite earth station has been approved by Inmarsat to offer voice and fax services, the only such device to gain approval for both services . . . **Ericsson Network Systems** and **Reliance Comm/Tec** have formed a team to define, develop and implement video-on-demand field trials in the U.S. The deal brings together Ericsson's ATM switching expertise with Reliance's digital loop carrier and fiber optics experience. The team will be based in the Dallas-Ft. Worth area . . . A new interactive entertainment information system for broadband TV is being developed by **MNI Interactive** (formerly MusicNet Inc.) to make it easier for consumers to select and purchase entertainment products. Although details are few, MNI says it will "guide consumers through the maze of entertainment product choices by developing an interactive cable service that combines a sophisticated interface, personalized guidance and recommendations, product sampling and promotions" . . . **AT&T Network Systems** is taking orders for a new low cost ATM system that operates at 2.48 Gbps that can be used by smaller service providers to enter the ATM game or as an "edge vehicle" in larger ATM networks. The scalable system will be ready for shipment in June. AT&T also consolidated all its ATM products under a single umbrella term: Globeview-2000 Broadband System . . . Remember those expensive Sprucer set-tops that **Garden State Cable** in Cherry Hill, N.J. bought about 10 years ago? About 90,000 of them are still in use–and will be for some time. A computer software company called **Intermetrics** upgraded the controllers to allow Garden State to add fiber to its cable plant and to speed up PPV ordering. . . The **Fibre Channel Association** has doubled its membership since forming last autumn. The association is developing technology for high-speed data applications such as mass storage interconnection and workstation clustering that will complement ATM and other data transfer technologies. The group now has 40 members, most of which are computer firms . . .**The Sega Channel** (a joint venture between TCI and Time Warner Cable) will use the interactive technology developed by **Interactive Network Inc.** to test interactive game delivery to several U.S. markets later this year . . . CED

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A WHOLE NEW UNIVERSE OF CABLE NETWORKING.

Johnson: Cable TV's RF wizard

By Leslie Ellis

Once upon a Tulsa time, on a December morning many years ago, the Johnson family gathered next to the Christmas tree to open their gifts. Young Steve Johnson, a fourth-grader at the time, spied a package with his name and eagerly ripped off the colored paper. Inside was a brand new crystal radio set. Steve was ecstatic, and immediately started to assemble it. (Steve's parents, while pleased at his obvious delight, were a little dismayed when he was reluctant to leave the radio and open the rest of his gifts.)

So began a lifetime love of communications for Johnson, now a senior project engineer for Time Warner Cable. He's the kind of guy who occasionally goes on "hidden transmitter hunts" with local amateur radio friends to track down a propagating signal emanating from a hidden, battery-operated VHF transmitter.

An avid ham radio operator–he tested for his FCC license while in high school–Johnson is the unofficial keeper of the nearly 600 known ham operators within the cable industry. It's not at all unusual to find him carving tracks down a Colorado ski slope while talking to friends on a portable ham radio; even his business card sports his ham license number.

Definitely not a geek

On the other hand, though, there's no pocket protector or duct-taped glasses on this guy. An avid bicyclist and athlete, Johnson pedals away some 3,500 miles per year on a mountain bike that is often perched atop his car, awaiting a lunchtime ride.

An active industry participant, Johnson is Time Warner's representative on the NCTA Engineering Committee. Within the SCTE, Johnson currently co-chairs the group's EBS subcommittee and is a former officer of the Rocky Mountain chapter. In January, Johnson was again elected treasurer of the chapter. "I guess I didn't learn the first time," Johnson laughs.

Johnson says his interest in cable started in 1967, when he read an article about the industry in an electronics magazine. "I thought it'd be neat to get into, but never realized at the time I'd really end up here," Johnson recalls.

Actually, the cable industry sort of "discovered" Johnson. While studying for his B.S. degree in electrical engineering technology at Oklahoma State University, he turned in an application to a local office supplies store. He was rejected for that job, but an insightful personnel manager told him to return after he graduated. "It was ironic–he told me that they had a cable company called LVO Cable in Tulsa, and that I should come back after I finished school. I did, and they hired me as a corporate project engineer."

Johnson started with LVO in 1974 and stayed there for a year during a somewhat tumultuous transition to new owner United Cable. In 1975 he left, foreseeing a layoff, and dabbled in the oil field for a couple years. All the while, though, he kept in close contact with his former colleagues at United. In 1977, Johnson rejoined the firm in its new Denver headquarters.

While at United, Johnson undertook what he describes as his largest engineering undertaking: the addition of mid-band and superband channels to 20 headends sprinkled between Illinois and Texas, all within a four-month timeframe. (The logistics of the project, Johnson says, are second only to the recent planning of his wife's surprise 40th birthday party.)

In the mid-'80s, Johnson got the itch to do his own thing, and so started his own company–Johnson Consulting. "How's that for an original name?" Johnson laughs. During that period, he moved to West Palm Beach to follow business opportunities there. "Ultimately, I decided that while consulting had been fun, it was time to get a real job again," Johnson recalls. He soon after hired on with ATC (now Time Warner Cable).

He says his biggest projects there have been signal leakage control and, more recently, his work with Time Warner's Telecommunications Division to develop spread-spectrum PCN technology for the company's Full Service Network project in Orlando, Fla. His role in the upcoming PCN tests is to ensure that the custom-made spread spectrum system, developed by San Diego-based Qualcomm, is compatible with the advanced network.

"We'll be testing different power levels, different antenna heights, ranges and the hand-offs between cells," Johnson says of the tests. In the trial, 20 of Qualcomm's 1.9 GHz telephone handsets will be dispersed to Time Warner staffers. The handsets transmit the telephone traffic to a microcell, where it is converted into the 850 MHz to 1 GHz return band. After being converted, the traffic travels to Time Warner's headend, where it ties into the telephone network.

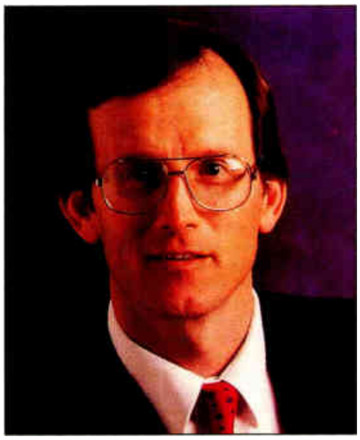
Germany-bound

The PCN tests in Orlando will take place in April and May–which is a good thing, because the Johnsons are scheduled to bike 400 miles from Munich to Vienna in July. The German trip will be the Johnsons' third such vacation; in preparation, he and his wife, Dona (who also is a member of the cable industry as an executive with Cable Audit Associates), are taking German lessons at a local community college. He and Dona each own a road bike, a mountain bike and share a tandem bike.

No tropical beaches for these two. Two years ago, they biked for two weeks through New Zealand; last year they pedaled through Alaska. Next year?

"China," Johnson says, smiling. CED

Internet protocol and standards



By Chris Bowick, Group Vice President/ Technology, Jones Intercable

Last month, we examined the International Standards Organization's (ISO) model for computer-to-computer communication, called the Open Systems Interconnection (OSI) model. Even though the Transmission Control Protocol/Internet Protocol (TCP/IP) is such an open standard and has become the de-facto communications protocol for the Internet today, it is not actually based on the OSI model. This month we'll examine some of the characteristics and history of TCP/IP.

A little history

The OSI model is a relatively recent development. While work on the model was actually begun in 1977 under the guidance of ISO Technical Committee 97, Subcommittee 16, it wasn't until 1984 that the OSI Basic Reference Model was to become an international standard.[1] In the meantime, in the early and mid 1970s, the U.S. Defense Advanced Research Projects Agency funded work to develop network standards detailing how dissimilar computers should communicate, as well as a set of standards for interconnecting dissimilar networks and also for routing information.[2] This was accomplished separately, during the early stages of development of the OSI model.

The resulting protocols were known as TCP and IP, and acquired their current form in the late 1970s, prior to the standardization of the OSI reference model. It was during this time-frame that TCP/IP became such a huge commercial success and became the de-facto standard for internetworking. TCP/IP's commercial success is sometimes attributed to three primary factors: 1. Low cost microprocessor and memory technology that enabled such a set of protocols to be cost effectively embedded in just about any type of computer product; 2. The fact that DARPA funded the integration of TCP/IP into the University of California at Berkeley's UNIX operating system, thereby ensuring wide distribution; and 3. That it was an "open system," free of license charges and available to any applications programmer on request.

Since TCP/IP was completed during the early stages of development of the OSI model (the ARPANET completed its transition to TCP/IP in 1983), it does not include protocols at all of the various layers of the model. Even so, a large portion of the functionality of the OSI model is included in the TCP/IP set of protocols,[3] and TCP/IP has therefore become the glue that holds the Internet together. In essence, TCP is a layer 4 (transport layer) protocol which ensures the integrity of the data, while IP is a layer 3 (network) protocol which actually routes and delivers the data.

What each one does

TCP is responsible for error checking, detecting lost or out-of-sequence information or duplicate information, and flow control to prevent a fast or powerful user from "swamping" another less powerful user. It is also responsible for status and synchronization control, which includes the ability to make and break connections, and the ability to signal an unusual event such as an interrupt.[4]

IP is responsible for the creation and launching/recovery within the network of an individually addressed data packet, known as a "datagram." With a datagram, each individual information element is addressed to its destination and then launched into the network and routed by the best available path to the destination. This is accomplished without any fixed route specified by the originating computer.

This can either be accomplished through the use of "routing tables" at each node, where a comparison is made of the individually addressed packet to a set of tables to determine the optimum route that it should send the packet as it winds its way to its destination, or by having every node that receives a datagram relaunch that datagram on all of its available output lines regardless of the destination.

Note that, depending upon the instantaneous status of the entire network, various datagrams intended for the same destination might take a multitude of different paths through the network and could therefore arrive (depending upon the distance traveled by each packet) at the destination out of sequence. The IP protocol is also required to correct such a situation.

The TCP/IP header is usually 20 to 24 bytes in length, which is somewhat inefficient as protocol standards go, with the IP header preceding the TCP header in the protocol stack. Because of its perceived inefficiency, and because of the industry's apparent movement toward a more "perfect" OSI implementation, there are some who say TCP/IP's days are numbered. If true, the widespread proliferation of this "standard" will certainly mean a very slow death.

TCP/IP is the de-facto protocol standard for communications on the Internet and has been implemented on just about every type of computer known. It has been recognized by the industry as a robust, reliable set of protocols that has withstood the test of time. As of the beginning of 1990, TCP/IP was the most widely used, vendor independent set of communications protocols in commercial use.[5] As we continue to investigate the network and equipment requirements for access to the Internet via the CATV plant, TCP/IP will always operate in the background, (usually resident on hardware/firmware/software on our PC) to ensure the integrity of the data, and to route and deliver datagrams through the network. It operates independently of the host computer's architecture or its performance with both higher-level (applications level) and lower-level (data-link and physical) protocols. CED

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Circle Reader Service No. 10

Are MSOs that use fiber violating someone's patent?

Check your mail

By Roger Brown

Some cable system operators have received letters from a Miami, Fla. law firm offering to discuss a fiber optic patent it says may have been violated by several cable companies.

Cable television system operators who have upgraded their networks with fiber optics in a backbone or fiber-to-the-feeder architecture have capitalized on a technology that offers improved pictures, less degradation, more bandwidth and reduced maintenance costs while simultaneously splitting their networks into "pockets" of subscribers, making the network perfect for emerging interactive services.

But they may have also violated a patent.

At least that's the contention of Intellectual Property Development, a Miami, Fla.-based company that is seeking licenses from cable companies that have installed such fiber technology in systems located around the country.

Intellectual Property Development says cable companies have been in violation of U.S. patent number 4,135,202, which was filed on March 12, 1976 and granted on Jan. 16, 1979. In the patent, inventor Albert E. Cutler, who at that time was employed by Rediffusion Inc., a British technology company, outlined specific methods in which fiber optics could be used to distribute cable television signals to clusters of subscribers. Although the experimental work that took place at that time didn't pan out, the cable industry was able to deploy such systems over the past few years as advances in optoelectronics made it possible.

"Clearly, cable operators should have known about this (patent), due to the fact that it's on file in the patent office," notes Howard Krass of the Nortman & Bloom law firm of Miami, who represents Intellectual Property Development. "I'd be astonished if they didn't know this technology was patented."

It is unclear just how many cable MSOs have been contacted to discuss a licensing arrangement, but at least three of the biggest companies in the U.S. have been approached, including Tele-Communications Inc., Time Warner and Continental Cablevision. Predictably, the three companies have little to say about the subject, other than they take it seriously and that they are evaluating the license claim.

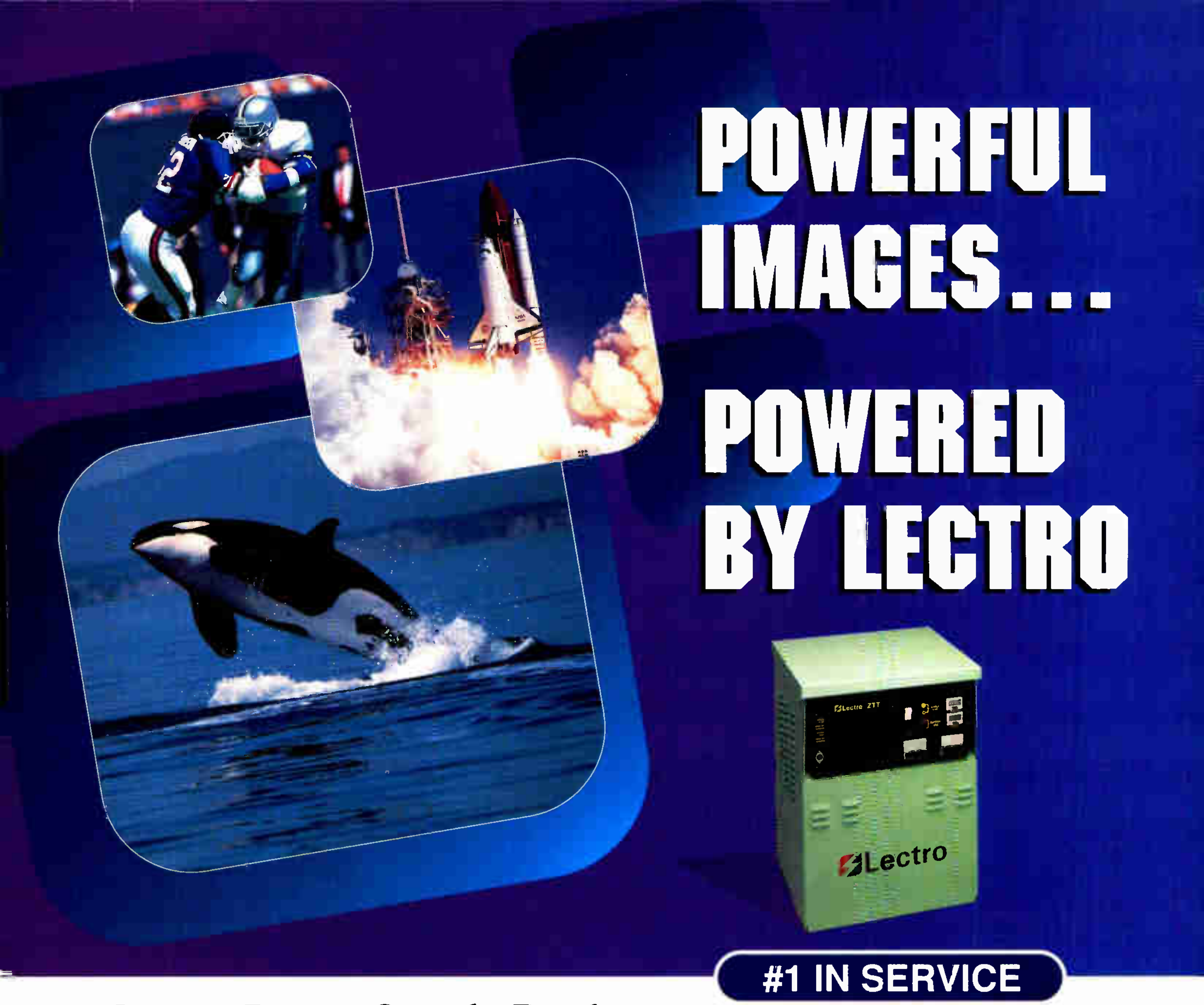
According to a news story from The Miami Herald that ran last fall, Intellectual Property is asking each company for 2.5 percent of its gross annual revenues in exchange for a license. If that is true, license fees for the Top 10 MSOs would be about $275 million.

However, that figure is hotly contested by Krass. "That number is incomprehensible," says Krass. "I don't know who arrived at that number. We clearly will settle for a lot less than that. We're trying to license this technology without resorting to litigation." Krass says a dollar figure that high would have provoked immediate litigation from the MSOs. "If we wanted that, we might as well have sued from day one," he adds. However, if litigation comes about, Krass says his firm is "prepared and equipped to do that."

Where the patent's been

The patent rights were purchased by Intellectual Property for an unspecified sum from Arthur Andersen Co., which gained possession of the patent following the death of British publishing mogul Robert Maxwell, who drowned amid mysterious circumstances while sailing off the Canary Islands in 1991. Andersen is one of several companies that has been contracted to liquidate Maxwell's multi-billion-dollar estate.

Maxwell reportedly purchased the patent from Rediffusion in 1985. Although much speculation surrounds the reason why Maxwell never brought the patent to public attention, Krass believes he held onto it because he anticipated using it himself, knowing that such technology would be invaluable during the development of future communications infrastructures. Others speculate that Maxwell recognized the potential for an economic windfall and was simply waiting until



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such networks were built before bringing about patent infringement lawsuits.

Several inquiries

The National Cable Television Association reports receiving several inquiries related to the licensing requests from its member companies but, as of press time, had yet to get a legal opinion on the matter. The subject has been the focal point of several discussions between engineers, however.

Naturally, people are looking for ways to invalidate the rights claim. Industry veterans are scrambling to find technical articles that were published before Dec. 3, 1973, which would allow them to claim the information in the patent was already publicly available.

(Although the patent was filed with the U.S. patent office on March 12, 1976, the patent was first filed in the U.K. on Dec. 3, 1973. Because the U.S. apparently recognizes filings with the U.K. patent office, this earlier date becomes the benchmark.)

Prior work

Many point to a June 1973 NCTA Technical Paper as evidence this information was already publicly known. The article, "Optical Waveguides–Future Cable for CATV," was published in the convention transcripts by W. Bart Bielawski of Corning Glass Works, which had developed a way to manufacture fiber cable and was attempting to develop markets for the product. The three-page article broadly outlines how fiber waveguides can be used to transfer information over cable TV networks via LED or laser transmitters and photo diode receivers.

The article points out fiber's benefits (increased bandwidth, low attenation, small size and weight), its state of development and limitations caused by a lack of adequate input and output devices. The article also shows a schematic of a video link used to transmit video over a 1,000-foot waveguide.

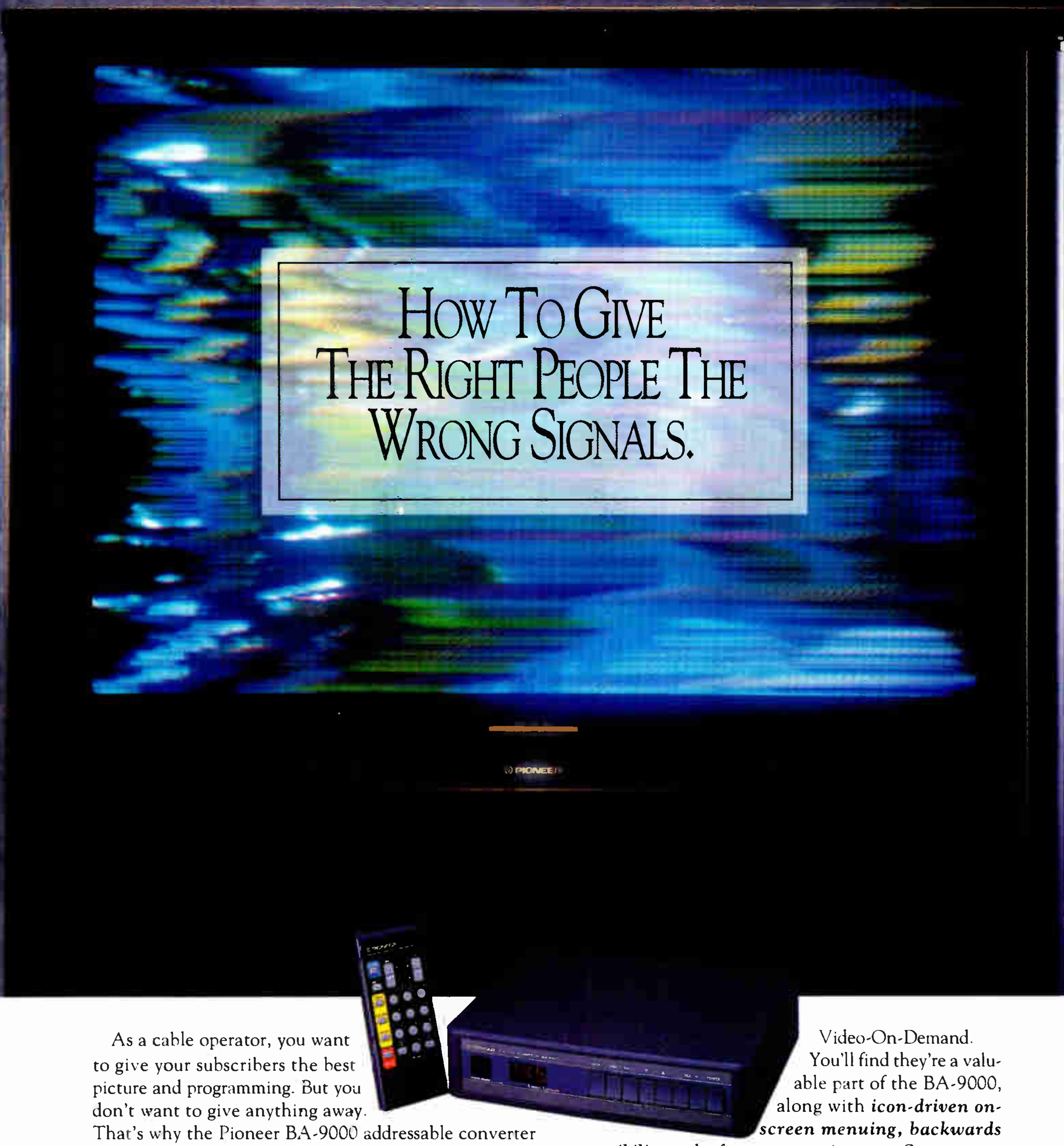
Krass, however, discounts the article, saying it shows a fiber-to-the-home application. "We looked at that (paper)," says Krass, who contends the patent covers alternative delivery methods, similar to the ones in widespread use today.

Clearly, other research related to the transmission of video over lightguide was performed prior to the 1973 date. For example, Archer Taylor or Malarkey-Taylor Associates was hired by Corning to determine the feasibility of such a network. However, the work and the reports that were generated were proprietary and not germain to the patent claim. Taylor says a Washington, D.C. law firm is already examining the patent and its claims.

Krass, however, says he wants to avoid litigation. "We're not shooting first and asking questions later," Krass notes. "But it's our position that an MSO utilizing a fiber optic backbone with distribution stations (is) infringing on our patent."

Given the dollar amount Intellectual Property is seeking for a license, most observers anticipate litigation will be the end result of this situation. If that occurs, nearly anything can happen, says Taylor "The courts are not always consistent" in its patent rulings, he says. "It's a very tricky situation."

Others say squabbles like this point out the shortcoming of the U.S. patent process, noting that the patent office often grants patents to inventors for devices or concepts that are already relatively well known, leaving it up to the court system to settle such conundrums. CED



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programming and equipment in rural areas, company officials say. Also targeted: TVRO distributors Echosphere Corp., CSS Distributing, DSI Distributing, Earth Terminal TV, Ltd. and Warren Companies. Through the latter agreement, satellite dealers nationwide will have access to marketing support, advertising, display materials and training from the five distributors.

Does DirecTV have all the bases covered? DirecTv thinks so. Cable operators think not. "The cable industry essentially has an office in every city," says Joe Van Loan, senior vice president of engineering for Cablevision Industries.

"If something breaks, you dial a number and somebody comes to fix it. With DBS, what happens if something goes wrong? Do you have to mail it in somewhere and wait for a loaner?"

Who's in the DirecTv game?

***Hughes Space and Communications Co.**–Building two high-power, HS 601 series DBS satellites which will ultimately sit in a co-located position around 101° WL.*

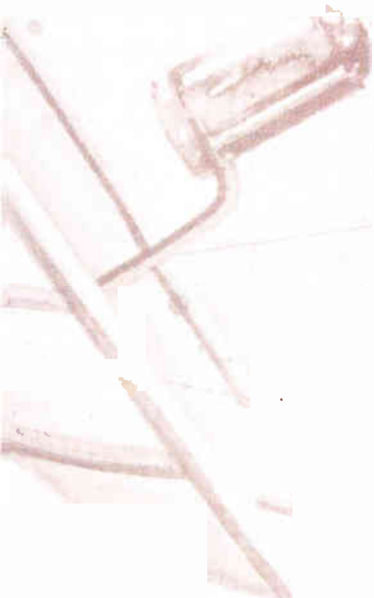
***DirecTv**–The kingpin of the high-stakes direct broadcast satellite venture, DirecTv is a subsidiary of Hughes Communications, which in turn is a subsidiary of GM Hughes Electronics. General Motors owns Hughes Electronics. Home plate for DirecTv: Castle Rock, Colo.*

***Thomson Consumer Electronics**–Designing and manufacturing the digital satellite system, which consists of an 18-inch dish, an IRD and a remote control.*

Van Loan, who himself lives in an area he says is "too rural" for economical cable delivery and receives entertainment services from a large-sized dish, foresees other problems, as well. "I wonder how the consumer public will react after laying out that kind of money, then realizing that every television in the house is forced to watch the same channels." And that will be the situation, unless the consumer has purchased more than one decoder.

Further, Van Loan submits, is the problem of local broadcast network delivery. "Of course, the clever retailer will put together an antenna package that solves that problem," he muses.

The phone connection for authorization and



News Datacom–Developing conditional access and encryption "smart card" system.
Digital Equipment Corp.–Operating DirecTv's national billing center.
DBS Systems Corp.–Developing and providing advanced billing software.
Matrixx Marketing–The customer service and telemarketing center providers.
Sony Corp.–Manufacturing broadcast TV equipment for the Castle Rock uplink facility, and providing digital satellite system technology after a DirecTv/Thomson exclusivity period.
NRTC–Providing rural sales distribution through some 300 franchise members and affiliates.

billing is another potential sore spot, Van Loan says. In his systems, customers often unhook the phone connection. "It causes us a lot of grief," Van Loan says. "In fact, in the systems where we have impulse boxes, we have staff people who do nothing else but to go around and re-hook the phone lines."

And what of the AC-powered, wireless phone connections DirecTv suggests for areas in the home which don't currently have a phone line? "That's another $100 or so," he says.

However, Van Loan doesn't think the $700 price tag is too much of a barrier. "If it does become a barrier, it won't be long before someone comes up with creative financing. After all, DirecTv is a subsidiary of General Motors, and everyone knows about GMAC financing. It's a non-issue, when you take that into consideration."

Should cable operators be worried? Maybe. DirecTv literature consistently boasts a 10 million subscriber count by the year 2000. If those 10 million people are current cable subscribers who jump ship, that's a 20 percent hit to cable.

Are cable operators worried? Somewhat.

"The threat of DBS is kind of like the threat cancer–yes, I'm worried about it, but thankfully I don't have it," says Pete Smith, VP of engineering for Rifkin and Associates.

But, Smith says, the deep pockets backing the DirecTv venture are an issue. Commenting on DirecTv's ultimate financial backbone, Smith says: "If there's any company that can lose money for an extended period of time and still keep it going, it's General Motors." CED

All eyes are on Omaha Innovative technology tests running side-by-side

By Roger Brown

Orlando and Castro Valley may have been receiving the lion's share of the media's attention as examples of cable TV's next-generation system architecture, but there's a real-world battle about to commence in Omaha, Neb. between a cable operator and a telco that may serve as a more realistic testbed of both technology and market acceptance of interactivity.

Cox Cable of Omaha and US West are both busily installing hybrid fiber/coax networks to pockets of about 400 homes that will feed each area with video-on-demand and other multimedia interactive services. But outside of that, the approaches taken by the two companies differ radically.

How Cox approaches Omaha

Cox, which already has about 90,000 subscribers out of about 150,000 passings in Omaha, has selected that system for its first 750 MHz build. The system presently has 400 MHz bandwidth capacity and utilizes the Cable Area Network redundant fiber architecture. The upgrade will use the fiber-to-the-serving-area topology with electronics provided by American Lightwave Systems serving nodes of about 400 homes (but enough fiber will be deployed to further segment the system in the future). The RF distribution electronics will be provided by General Instrument Communications and amplifier cascades will be reduced to between four and six devices each.

The Cox Omaha system will be the first to test an interactive system developed by ICTV, a California start-up that has integrated an IBM video server with its own switch and software and coupled those with billing services from New Century Communications.

ICTV claims its analog approach (see Figure 1), which places the switch physically about 10 feet from the server, reduces latency to the blink of an eye. When a consumer enters a response on the remote control, a signal is sent back to the "multimedia CPU", which, in turn, takes video off the server and sends it back downstream to the cable set-top.

The concept places the intelligence in the headend, instead of the home, says Leo Hoarty, president of ICTV. In many ways, the concept resembles a cellular telephone network, in which frequencies are reused (hence the need for the FSA topology). The cable system simply uses a standard set-top which has been modified with ICTV's two-way module.

Cox has chosen Zenith Electronics to supply the set-tops for the interactive trial. Because the rest of the system has Scientific-Atlanta's 8580 set-tops already in use for some pay services (two are negatively trapped), interactive users will need to swap boxes, according to David Woodrow, Sr. VP Operations at Cox.

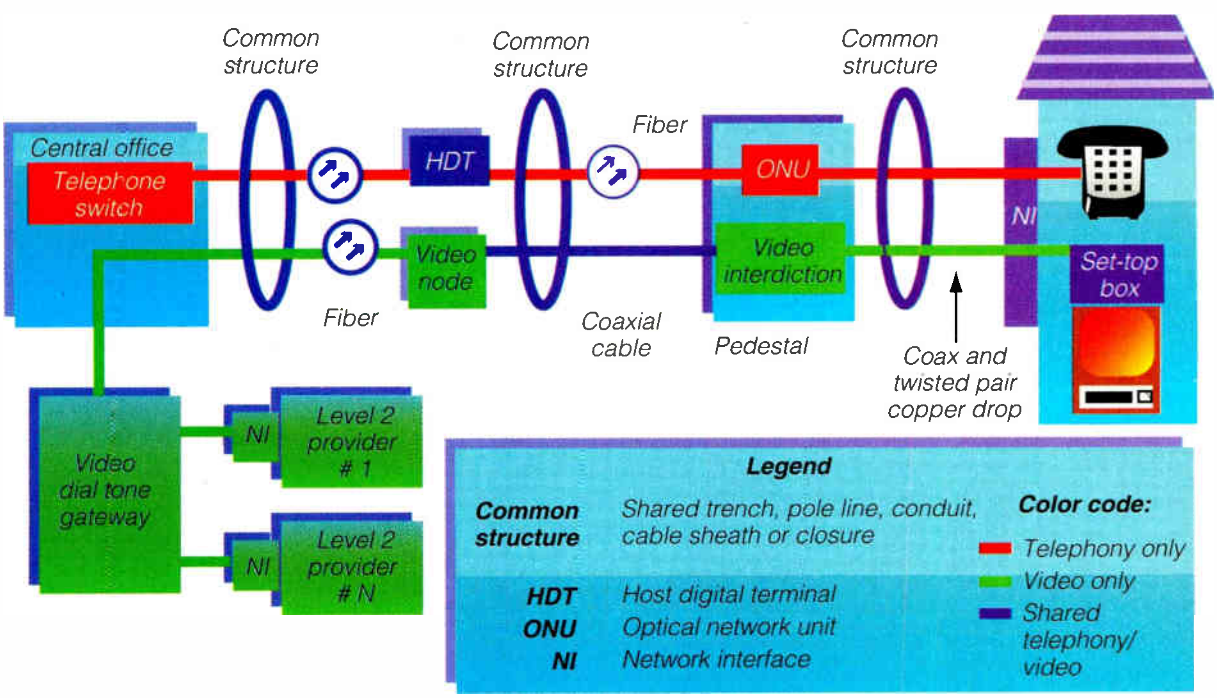
By June, Cox will choose which serving area will be the first to receive the ICTV programming, offering it to about five viewers, said Alex Best, Sr. VP Engineering. From there, it is anticipated the service will be rolled out systemwide over the two years the upgrade is scheduled to last. The sub-split return band will be activated as the interactive system comes on line.

The RBOC's technology plan

US West has also chosen to use a hybrid fiber/coax system in Omaha. According to Thomas Bystrzycki, executive VP of mass markets and operations at US West Communications, the company was looking for "off the shelf" technology that would transport several different services at costs comparable to its current fiber/twisted pair network.

Interestingly, US West plans to use dual coaxial cables from the fiber node to the home. The "A" cable will provide up to 650

Figure 1: ***Fiber-to-the-curb/passband architecture used by US West.***



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MHz of analog video (77 channels), up to 136 digital channels and 25 MHz of shared upstream capacity located in the traditional sub-split return band. The "B" cable is a mid-split design that will provide 500 MHz of bandwidth to support up to 664 digital channels and 107 MHz of shared upstream capacity. This mid-split design was chosen because it provides more upstream capacity, which US West believes will be important as interactive services come on line.

The coax feeds video into video interdiction equipment supplied by Scientific-Atlanta (this equipment is housed in a pedestal along with the optical network unit used for voice services–see Figure 2). According to Bystrzycki, "Interdiction will provide enhanced video gateway providers and video programmers the ability to provision many of their analog video channels to specific end users on a single channel selected basis and replaces the need for a set-top box for analog programming." Users of digital services will still need set-tops to decode those services, however.

Interdiction has been traditionally shunned by cable operators because of doubts about its cost, powering issues and perceived lack of security.

Intelligent set-tops

Advanced set-tops that support interactive digital services will be provided by Scientific-Atlanta. The MPEG-compatible terminals will serve as the gateway to interactive entertainment and other services, including video on demand, interactive games, enhanced home shopping, distance learning and other services.

The set-top will be based on S-A's digital platform and combined with the graphics control and display technology developed by The 3DO Company. The addressable box will be capable of running applications locally as well as generating high-resolution graphics. Software can be downloaded into the set-top, which will provide 8-to-1 video compression.

Current plans call for the four- to six-month long technical trial of the system to begin later this year, with telephony and video services passing about 10,000 homes. US West believes about 1,500 customers will participate in this portion of the test, which will focus on testing the technology, quantifying costs, and testing new processes and operational support systems for video dial tone.

Following that, a year-long market trial will commence. Plans call for an additional 50,000 homes and businesses to be passed with telephony and video service, with another 7,500 customers expected to take part. During this time, US West will test market acceptance of video dial tone and other service providers will be allowed to conduct their trials.

Both US West, during its market trial, and Cox plan to charge customers for the services they receive as they attempt to discover which services gain market acceptance and at what price.

What is shaping up in Omaha is a real shoot-out for customers between two traditional cable operators and US West. It's a situation that promises to have eyes from both industries riveted on this prairie city in which Cox and MetroVision already overbuild each other in an area of about 2,000 homes.

Amell says MetroVision's rebuild was underway long before the US West/Cox shootout began. "Our plans (for Omaha) have been pretty solid for some time," he says. "We're upgrading all our large systems, including Detroit, Cincinnati and Chicago, to

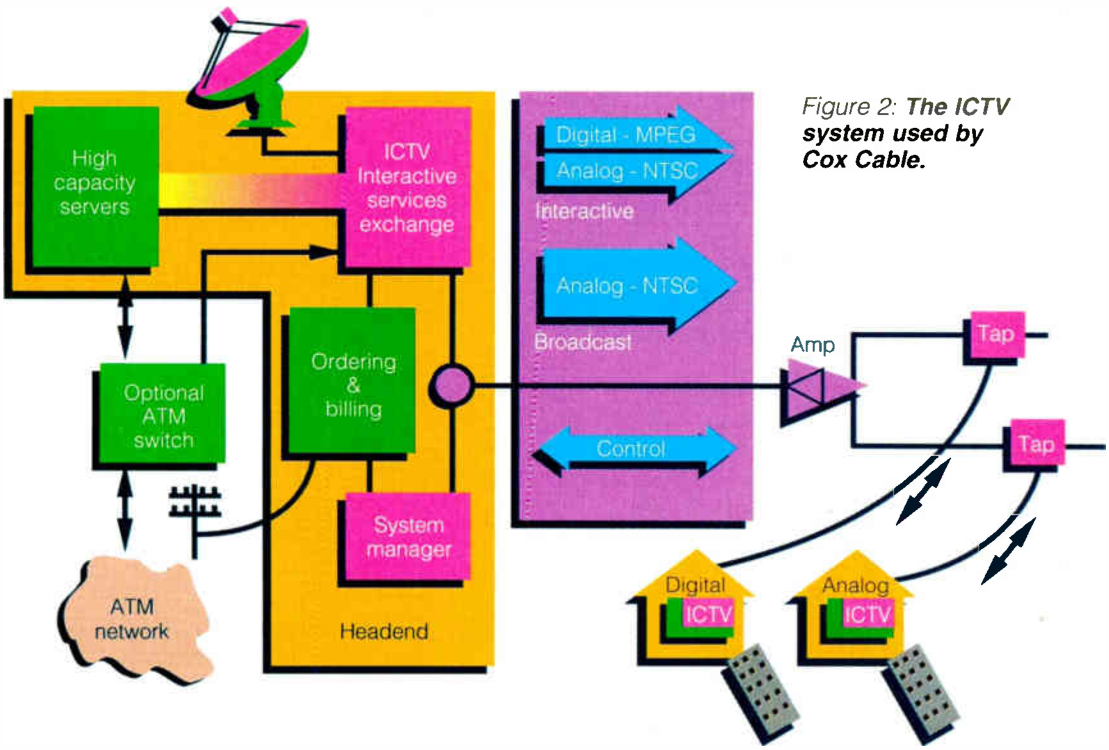


Figure 2: ***The ICTV system used by Cox Cable.***

this same architecture."

So why Omaha? Both Cox and US West say it's only coincidence and common sense that brought them head-to-head in Omaha.

Demographics, a favorable state regulatory posture and Nebraska's extensive record of being a good new-product test-bed are what led each company to the state.

"It's coincidental that we both selected Omaha, but it's not unexpected that we'd both be in Nebraska," said Woodrow. "They (US West) could've gone to Lincoln, but Omaha's the biggest system for them. Since Omaha is the only system of ours that's in Nebraska, it makes sense for us."

Once the market tests get underway, time will tell if the approaches both sides have taken will make any sense at all. CED

MMDS ops want 20% of cable biz

Compression, financing strengthen MMDS industry

By Leslie Ellis

To hear representatives from the MMDS (multichannel multipoint delivery system) industry talk, the future for that industry is bright–real bright. After all, they say, the 1992 Cable Act was nothing short of a gift from the gods for wireless operators, giving them fair rights to programming content and carte blanche to "compete fairly" with cable operators on subscriber fees. Developing digital compression standards will augment their weak link: capacity. On the money side, things are loosening up as well, with some $400 million in financing recently committed to wireless cable activities.

MMDS operators can even participate in the budding interactive marketplace, they say, through use of the 125 kHz of response channel bandwidth already allocated as companion spectrum to the MMDS channels located in the 2 GHz range.

Indeed, optimism abounds for the wireless cable industry, which now supports more than 150 individual operations scattered across the country (see Figure 1). That was the resounding message at a recent day-long meeting of wireless heavyweights and financial community participants who gathered in New York City to review the progress and future of that industry.

Should cable operators sit up and take notice, now that the wireless industry has apparently figured out what it wanted to be when it grew up? Maybe. According to the industry's research and development arm, Wireless Cable Laboratories, the MMDS industry currently counts among its ranks about 500,000 subscribers nationwide. That may not seem much compared to cable's hefty and rising subscriber count, but consider this: in 1991, wireless cable broadcasting grew 42 percent. In 1992, it grew by another 49 percent. And, say Wireless Cable Labs officials, the number of subscribers is likely to continue to grow at those rates throughout the decade.

Wireless MMDS transmission technology certainly isn't new. The industry got started more than 20 years ago, when the FCC allocated two channels in major metropolitan markets for multipoint distribution services (MDS). In 1983, the Commission established multichannel MDS service and implemented a lottery system for obtaining licenses. Now, 33 over-the-air channels are available in the U.S. for wireless cable broadcasting.

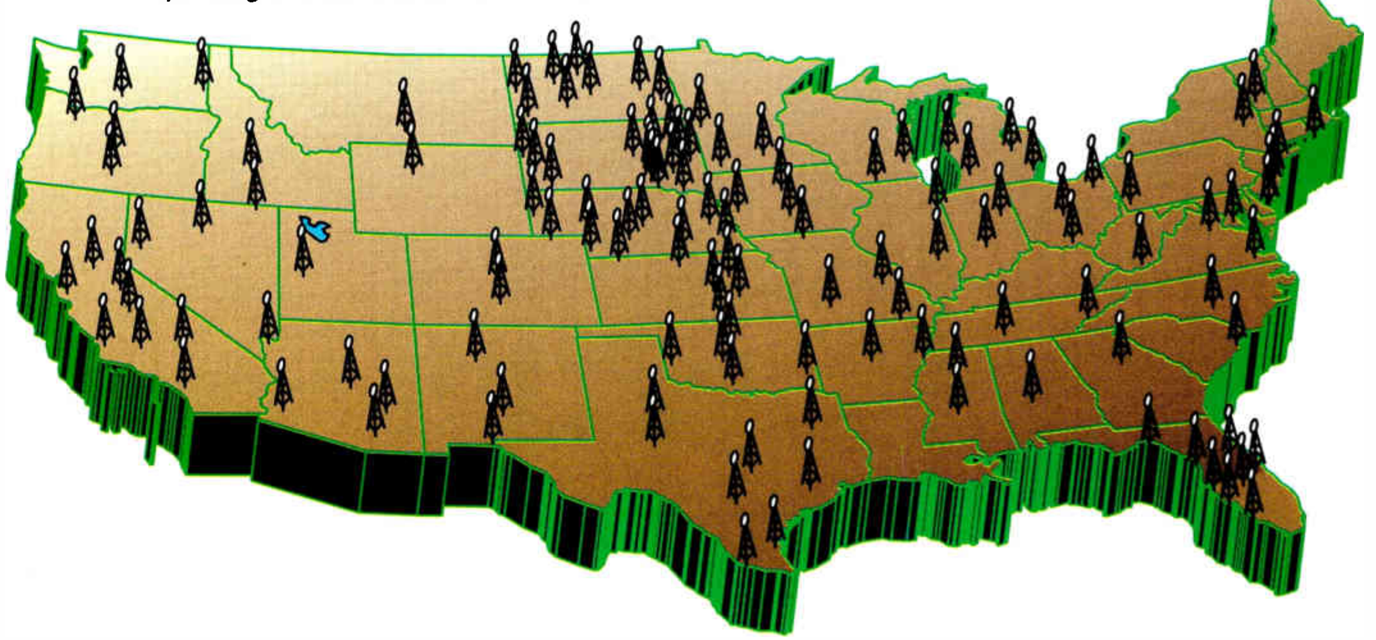
According to the Wireless Cable Association, the "most successful large wireless systems" include Cross Country Communications in Los Angeles/Riverside, Calif; ACS Enterprises in Philadelphia; People's Choice Television Partners in Tucson, Ariz.; Pac West Cable Co. in Sacramento, Calif. and Omnivision Inc. in Corpus Christi, Texas.

Legislative zeal

Wireless industry players say they are more than excited about the Congressional turning of the worm, as evidenced by the 1992 Cable Act. Says Nicholas Allard, government relations counsel with Latham & Watkins and the attorney who represents the Wireless Cable Association: "Cable Act of 1992 could not have been more helpful to wireless cable. That piece of legislation . . . has been a great success already in removing whatever restrictions had remained on the ability of competitors, like wireless cable, to obtain rights to fair access to programming, and to institutionalize the ability."

Further, Allard said, the rate regulation sec-

Figure 1: ***US wireless cable operations operating or under construction in 1993***



tions of the Cable Act will restrict programmers from charging higher rates for content. "When a monopolist can no longer charge at will for a product, his incentive to restrict output is completely removed," Allard says. "This further reinforces the impact of the Act in propelling programming through additional outlets–like wireless cable."

Echoing those thoughts was John Hollar, senior legal advisor to former FCC Commissioner Ervin Duggan, who described a "bullish" outlook for wireless from the Commission. "You could not be at the FCC for the last two or three years and avoid the inescapable conclusion that wireless services of all kinds are the hottest technologies and the most promising technologies for the future," Hollard says. "Consumers go where they get the most value, and I think that's just going to continue to be true in the future. That's why Commissioner Duggan and his colleagues at the FCC have been so bullish on wireless cable over the last few years, and have tried to do as much as they can to increase the opportunities in competition for the cable industry."

Hollar said he "wouldn't be surprised a bit" if the funds gathered through upcoming spectrum auctions were earmarked by the FCC to accelerate the treatment of wireless cable licenses. "It's a good bet," Hollar said.

Digital compression

Not only is the regulatory environment apparently a blessing for wireless MMDS. So is the technological environment. Wireless MMDS operators are keeping a close eye on digital video compression developments, eyeing the technology as the key that unlocks acess to much more than 33 channels.

With compression, Wireless Cable Association officials say, the industry can deliver "at least 300 channels" with little modification. In addition, Wireless Cable Laboratories will begin its investigation into digital video compression over wireless MMDS this year.

"When digital video compression becomes a reality, we don't have to change plant," says Alan Sonnenberg, president of Philadelphia-based ACS Enterprises. ACS , a wireless operator in Philadelphia with some 20,000-plus subscribers, offers 36 channels in that area. "The only thing we have to change is the beginning and the end."

"Digital compression over MMDS is certainly going to be a reality–it will work," says John Bowler, VP of research and development for Zenith Electronics Corp.'s Cable/LAN Engineering division. "The only question that remains in our mind is, what is the highest level of modulation achievable over an MMDS 6 MHz channel?"

Depth of modulation is an issue for MMDS digital delivery, Bowler explained, because the MMDS transmission environment "isn't as safe" as a cable system's. "It's a question of depth of modulation. Rather than putting 40 Mbits in a single, 6 MHz channel, I may have to back it down to 25 Mbits."

Even wtih 25 megabits, though, a digitally compressed wireless system could wtill offer "at least eight to nine videos" per 6 MHz channel, Bowler says. "It gives you more than enough bandwidth to do all the things that could be possibly required via multimedia or interactivity," Bowler explains. Zenith will roll out a digital cable box for use within the wireless MMDS industry by the second quarter of next year.

> **"Cable Act of 1992 could not have been more helpful to the wireless cable industry."**

Naysayers of wireless MMDS signal delivery frequently cite line-of-sight limitations, outmoded technology and signal security as crippling characteristics for that industry. ACS's Sonnenberg thinks otherwise. "Yes, an over-the-air transmission requires line of sight. It's an impediment, but not the end of the world," said Sonnenberg, adding that most MMDS systems are able to enjoy at least a 30-mile radius without beam-bending.

Sonnenberg sputters at any accusations that MMDS technology is outmoded. "If you look across the country at the typical cable system operation, how many of them are addressable? All of the wireless systems are," Sonnenberg emphasizes.

And, he said, signal security in the Philadelphia area is better than some cable franchise holders there, which also gives the entrenched cable operator an advantage. "It's hard for us to compete against free," he says. "When people are stealing (cable) signals, it's very difficult to try to convince them that you have a good product and price structure."

How well is the wireless MMDS industry poised to wrestle away current cable sub-

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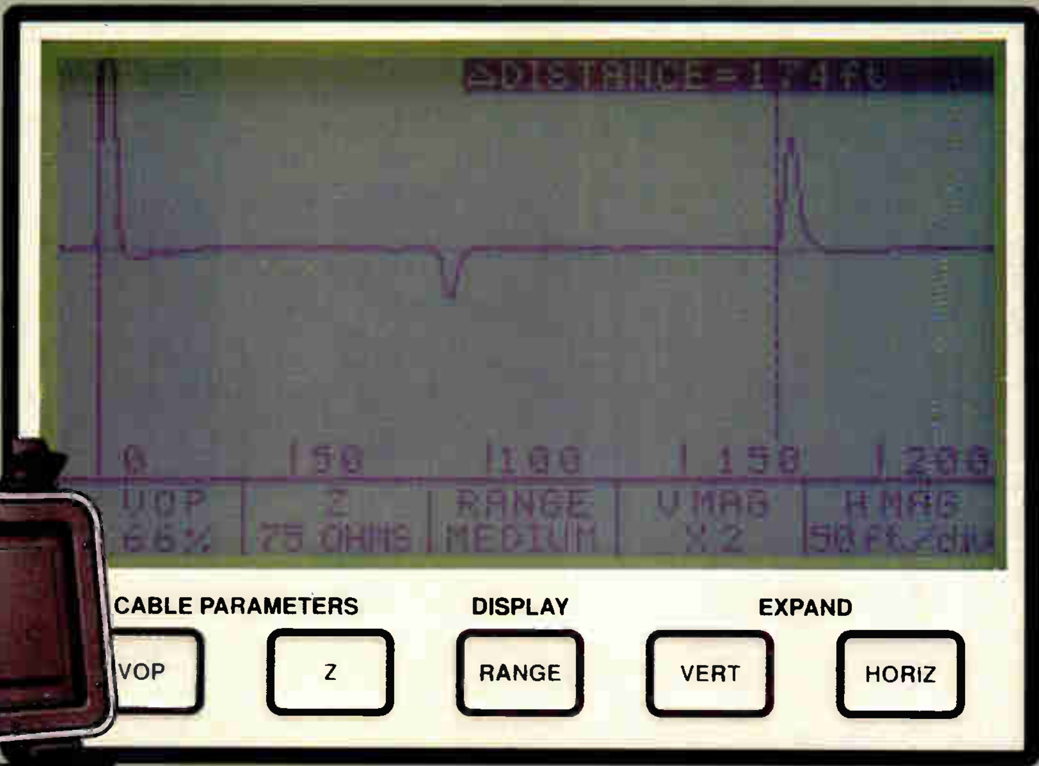

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> **"Wireless cable is a tough, stubborn group of people."**

scribers, given the glowing regulatory and financial reports delivered at the New York conference? According to wireless industry participants, the industry aims to take a 20 percent chunk of cable's existing business in the foreseeable future.

Interactivity?

And what about interactivity? True, the industry does have access to the previously mentioned 125 kHz of response channel spectrum located next to its 33 existing 6 MHz channels. Says Paul Sinderbrand, partner with law firm Sinderbrand and Alexander, a company which specializes in emerging communications: "Right now, we have the capability to do two-way," Sinderbrand continues. "We have small return channels available to us.

"I'm often asked if wireless cable operators can do multimedia," Sinderbrand continues. "The answer is yes and no."

The good news, says Sinderbrand, is that in 1974, the FCC gave wireless operators the green light to provide private television, high-speed computer data, facsimile, controlled information or other communications capable of being transmitted by radio waves. The bad news? "There's still a lot of work that needs to be done at the FCC to get the technical rules in place," says Sinderbrand.

Sonnenberg sees a wireless future that includes many communications players. "I think you're going to find with changing technologies, telcos, DBS, whatever–everyone's going to take their niche. Our niche in Philadelphia is going to be about 20 percent. In Philadelphia, that's half a million subs."

Whether or not a 20 percent take exists for other wireless MMDS operators remains to be seen. But, says Allard: "Wireless cable is a tough, stubborn, innovative group of people . . . they just don't know when to quit." CED

Ad Index

Datacom becomes latest cable/telco battleground

Data delivery services raging

By Fred Dawson

As the debate rages over what the "killer aps" might be for broadband digital networks, strategists often seem to overlook the fact that an explosion in data communications has already become a real market force behind infrastructure expansion.

Beyond the limelight of the information superhighway hoopla, a few top MSOs are moving from technical prove-ins to first-site commercial rollouts of inter-LAN, work-at-home and other variations on wideband data communications. This is occurring just as the telephone companies are scrambling to accommodate a surging demand for flexible-rate LAN and other data connections over public networks.

Cablevision Systems Corp., Tele-Communications Inc., Jones International, Continental Cablevision, Cox and, in Canada, Rogers and Videotron, are among the first big cable concerns to get serious about commercial offerings of datacom over frequency divided RF carriers. On the telephone side, demand for inter-LAN connections, all the way up to 10 mbps Ethernet throughput over public networks, has gone way beyond expectations, setting off a chaotic search for ad-hoc, low-cost solutions that get as close to full broadband connectivity as possible within allowable cost parameters.

Two different challenges

Both types of network operators have their work cut out for them. For local exchange carriers, the challenge is to provide bandwidth and transport multiplexing services at reasonable prices at all levels of market demand, from major corporations down to work-at-home households. For cable, the challenge is to establish the two-way capability and cable compatible interfaces that will serve similar needs at even lower costs.

Cable operators like Cablevision, which is launching franchisewide 10 mbps datacom service in Long Island and Yonkers, see an opportunity to match or beat the aggressive target costs of the telephone industry when it comes to providing industrial-strength data services. And, equally important, they see an opportunity to capture ever bigger pieces of the market as datacom moves down through the mid-size business range into the small-business and residential communities.

"This isn't a residential service yet," says Wilt Hildenbrand, vice president of engineering at Cablevision. "But it is well within reach of doctors, radiologists, engineers and other professionals."

At about $6,000 per customer in hardware and installation costs for a 10 mbps connection compared to the present telephone T-1 (1.5 mbps) hardware CPE cost of about $9,000 (plus $2,400 for connection), Hildenbrand and others believe the business has a very bright future. "We expect costs to come down rapidly from where they are now," Hildenbrand adds.

The MSO is conducting a two-month trial run with Long Island Savings Bank, which wants to establish Ethernet interconnectivity among its 15 offices without incurring the costs of private lines. The equipment for the trial is supplied by Digital Equipment Corp.

"We went to banks who are customers for DS-1 service from Lightpath (Cablevision's telecom subsidiary) and asked them what else they want, and they said what we really need is an Ethernet data link," says Rusty McCormack, vice president of cable operations. "They're amazed to discover they can get such a service."

The DEC "Digital Channel" system is a work still in progress. McCormack notes that commercial launch had to be postponed from the original date last fall because of software difficulties associated with raising the rate ceiling from 4 mbps to 10 mbps.

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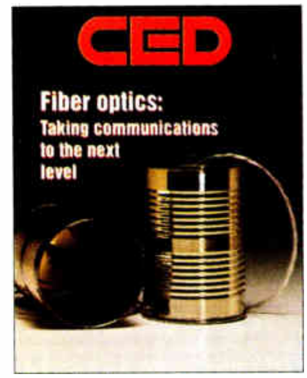

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LANs, the OSI model and layering

By Chris Bowick, Group Vice President/ Technology, Jones Intercable

Entrance into the world of data networking with respect to the Internet requires that we understand data transmission protocols such as Ethernet (a LAN standard) and Transmission Control Protocol/Internet Protocol (TCP/IP), the protocol standard for Internetworking multiple LANs (and the protocol for access to Internet). But any discussion of these standards must first include the Open Systems Interconnection (OSI) Model, developed by the International Standards Organization (ISO).

The OSI model, while not specifically developed with LANs in mind, is of interest because it provides a method of visualizing the communications process. As shown in Figure 1, there are seven layers of the OSI model that communicate between one end system and another end system. These layers cover almost all aspects of the information flow throughout the network.

There are some good reasons for layering the requirements of the communication process. Layering simplifies change by allowing the components within a layer to be changed without affecting any other layer. It allows each network function to be made transparent and independent of other functions of other layers, thereby allowing the individual layer to be modified without affecting the entire communications protocol structure.[1]

Muller[2] equates this layered communications process to that of using a series of envelopes. On the transmit side, the applications information is created and placed in its "envelope." It is then placed within the presentation layer's envelope which adds some additional information for the destination. The presentation layer's envelope is then placed within the session layer's envelope, which also adds information for the destination, and so on until the data link layer's envelope is placed within the physical layer–the "mail truck"–for transport.

At the destination, the reverse process takes place, beginning at the physical layer.

The layers

The *application layer* includes application programs and basic network services such as file or print services. It also identifies the intended communication partners, establishes communications authority and determines partner availability. The *presentation layer* controls the format of screens and files by defining a multitude of things like special graphics and character sets. It allows an application to determine the meaning of the information exchanged.

The *session layer* sets up, manages, and breaks down the user path or virtual circuits between sending and receiving devices. CCITT X.225 is such a protocol.

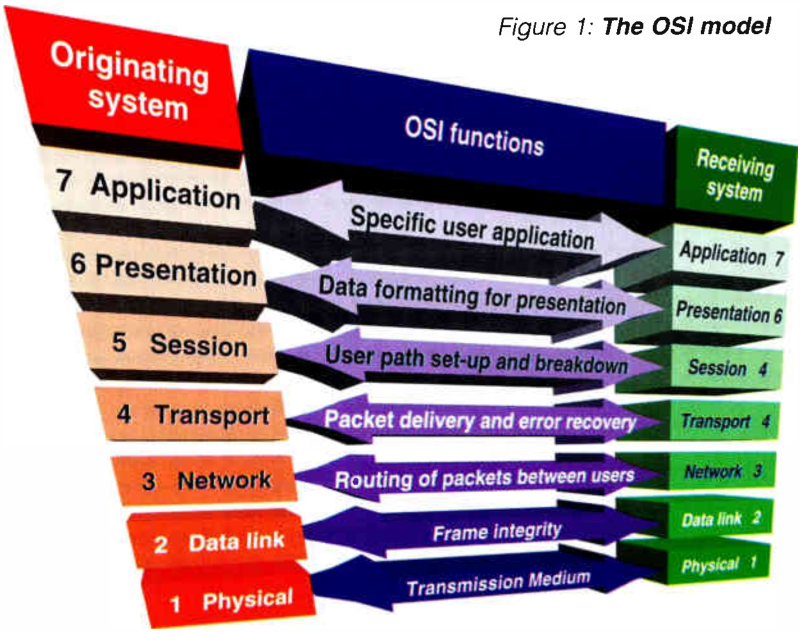
The *transport layer* is probably the most defined of the layers, and is responsible for error and flow control of the data. As packets of data wind their way through a network via various routes, the transport layer re-establishes the packet order so that the received message is put back together exactly as it was sent.

The *network layer* breaks the communication into packets and addresses each packet to the destination. A well-known network layer protocol for LANs within the OSI model would be X.25. The *data link layer* organizes the data into frames, and provides the lowest level of error control. This is the layer that may detect an error in transmission, and request retransmission. A well-known protocol within this layer is the IEEE 802.3 Ethernet specification.

The *physical layer* is the lowest in the model and provides the actual electrical and mechanical interface which connects a device to a transmission medium. EIA-232D is a well-known standard within this layer.

Note that each network node, where end-users are located, would be equipped with all seven layers of the OSI. However, not all intermediate nodes will need all seven layers. As the data is routed through the network, through bridges and routers, only levels 1 through 3 of the OSI model are needed. Layers 4 through 7 are not required and are therefore not included in network node software. CED

Figure 1: **The OSI model**



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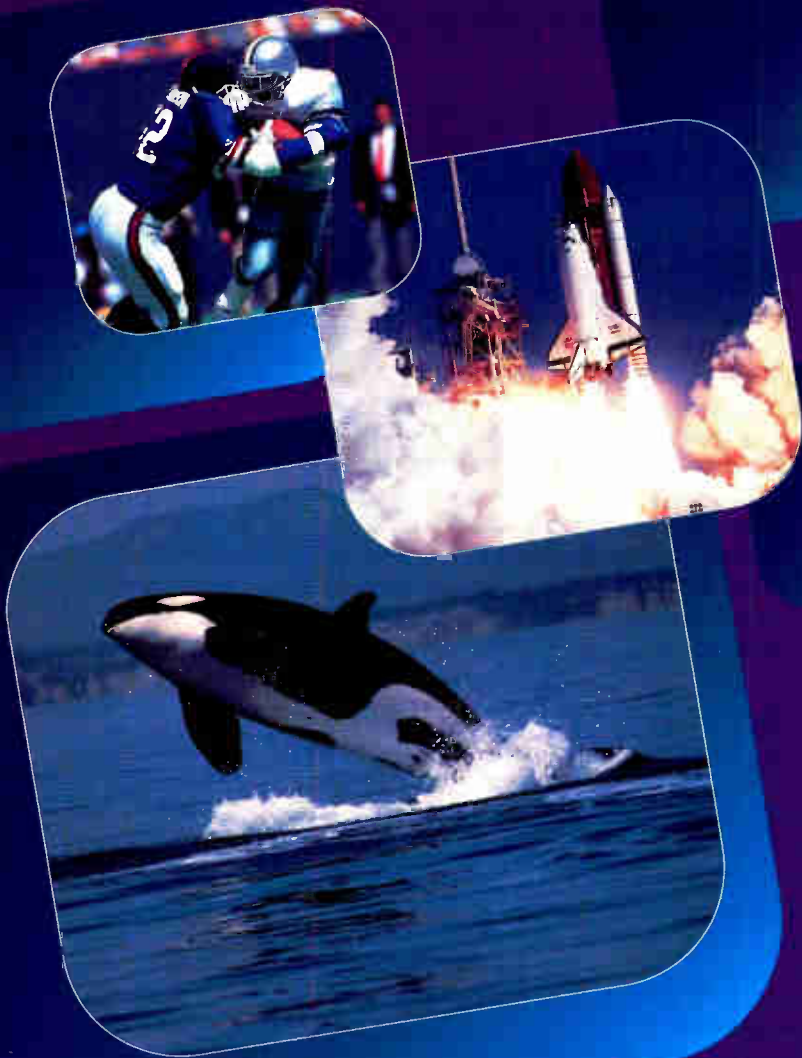
1. Datapro, "ISO Reference Model for Open Systems Interconnection (OSI)," McGraw Hill Inc., New Jersey, 1990.
2. op-sit. Muller, p.117.



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in the October 1993 issue presents several ad hominem assertions along with a regurgitation of the AT&T party line on polarization mode dispersion (PMD).

The personal attacks Michie makes are the following:

✔ That I presented "misinformation,"

✔That I "lifted" a Bell Labs FOF's statement "out of context,"

✔ That I sweepingly indicted AT&T for having market motivations, and

✔ That my "prescriptions for avoiding PMD problems are misguided and self-serving."

The only bit of misinformation that Michie specifically identifies is a quote I attributed to Jim Refi, a distinguished member of the technical staff at AT&T Bell Laboratories.

This quote was not "apparently taken from a paper," as Michie asserts. If Michie had read the article to which I was responding ("PMD: Answering the Questions," by Leslie Ellis, CED, July 1993, pp.55-56), he would have found the quote, in context, in the article. If there is a misquoting, Michie should take the matter up with the author.

Certainly, I will 'fess up to committing the "heresy" of suspecting AT&T's motivations for publishing so many papers on PMD by so many distinguished pure scientists at Bell Labs.

While Michie claims my letter includes misinformation, the letter asserts that AT&T's PMD papers include DISinformation and carefully crafted spin. I stand by that original letter.

But, can anyone blame AT&T's product manager for wanting to get out in front of a potentially damaging issue?

I cannot see how Michie can claim that my statistical method for predicting PMD is "misguided."

All I am suggesting (admittedly with sarcasm), is that if AT&T cabled fiber is the only product that has had field problems with PMD, then a method for avoiding PMD is to not buy AT&T cabled fiber.

As an alternative, I am suggesting cable operators buy Optical Cable Corporation's Tight Wrap fiber optic cable (to deal with extrinsic PMD factors) and specify Corning glass fiber (to deal with "intrinsic" PMD factors).

Corning's fiber has not had any reported PMD field problems. To do otherwise would be misguided.

Michie wants the industry to believe AT&T has "imposed a maximum PMD specification on cabled fiber–the only fiber manufacturer to do so" to show it has the quality product, rather than for the public relations image it creates.

And, he wants the industry to believe AT&T's Bell Labs has published a flurry of technical papers on PMD as some selfless "obligation to share new findings with the industry," rather than for the obscurantist spin job that it is.

Michie also claims my statistical method is "self-serving." Well, now isn't this a little like what the pot called the kettle?

It's a fact that only AT&T cabled fiber has "world class" PMD problems in the field.

It's also a fact that AT&T is actively settling warranty claims with its customers stemming from PMD–"the only fiber manufacturer to do so."

George Sell
Market Research and Product Development,
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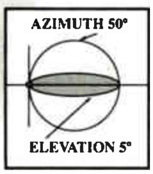

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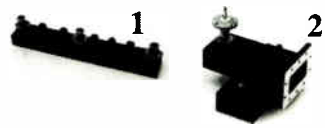

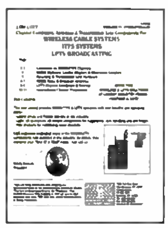

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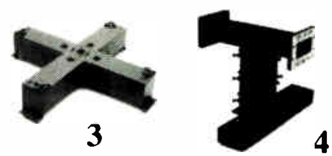

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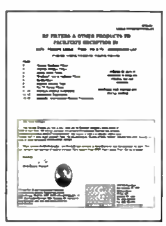

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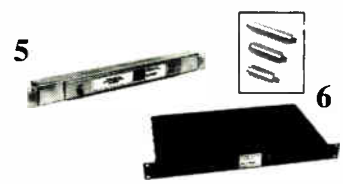

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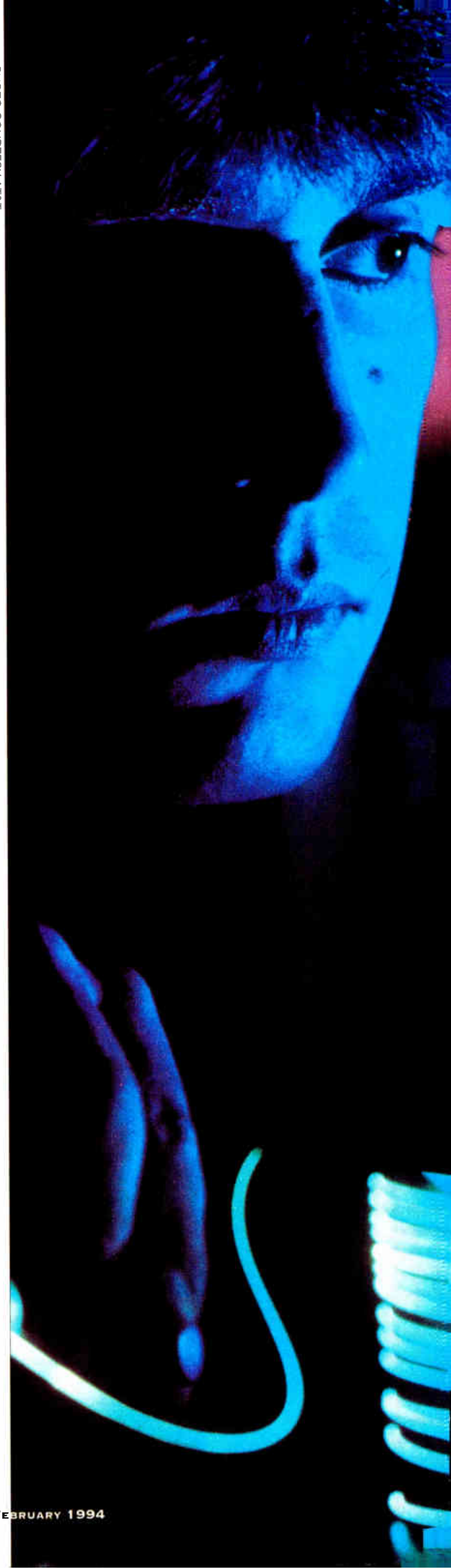
Circle Reader Service No. 15

Where are we headed with node sizes?

And, how much will they cost?

PHOTO COURTESY AT&T



By Lawrence A. Stark, Vice President of New Business Development, Ortel Corp.

The impact of falling prices of AM-VSB fiber optic equipment in CATV systems has been smaller node sizes. MSOs have made this strategic investment instead of using fiber optics to reduce the cost of distribution electronics. The trend toward smaller node sizes is expected to continue, based on the expectation of continued reduction of DFB laser production costs.

We can extrapolate today's trends to networks with nodes of less than 100 homes, with passive coaxial signal delivery. Such networks will be built with DFB lasers carrying both AM and digital signals. The bandwidth capacity of such networks will be revolutionary, compared to traditional communications networks. We can expect such bandwidth to find many applications,

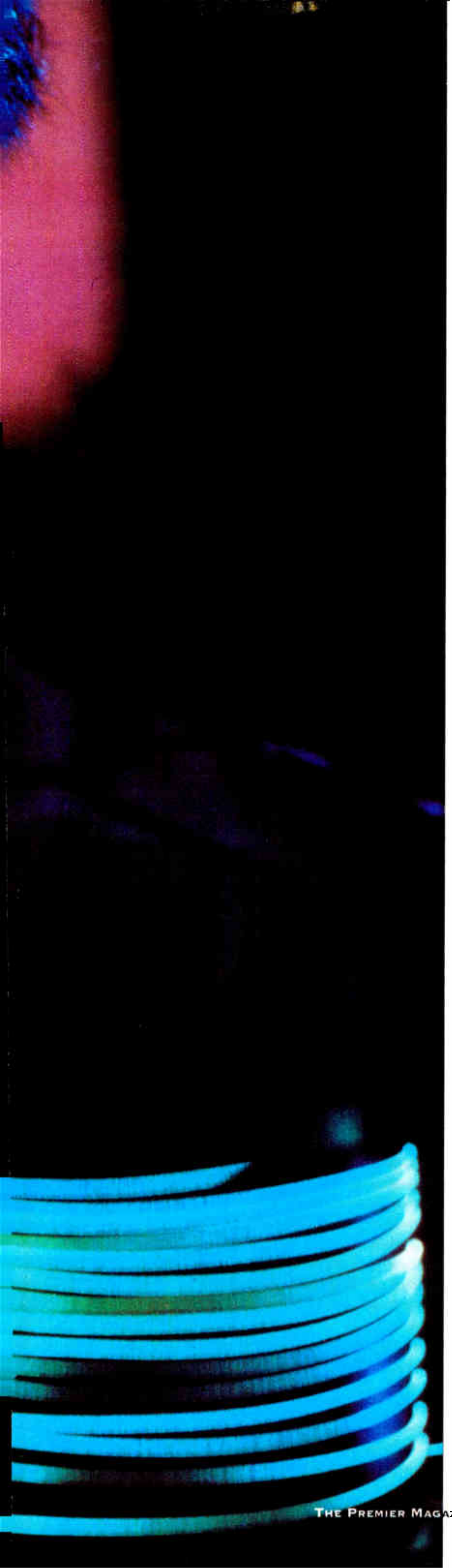
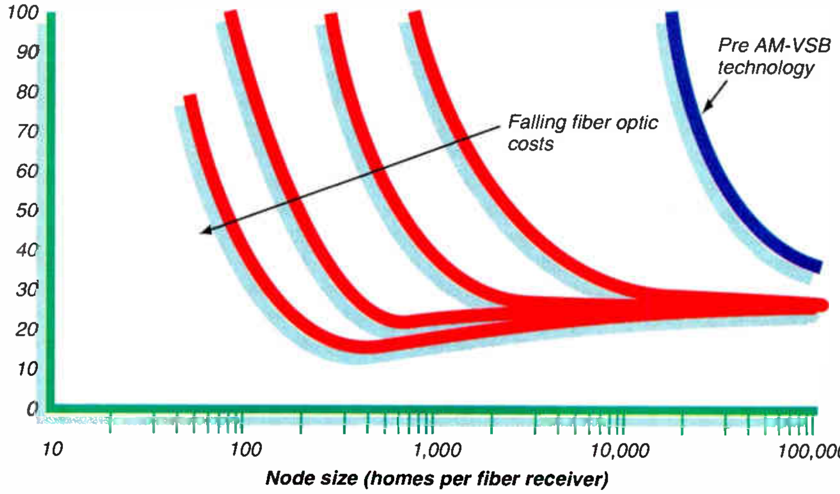


Figure 1*

CATV system cost vs. node size
Distribution electronics only



The data in this figure is based on a specific set of assumptions that may not be accurate for all networks. The important issue is the general shape of the curves, which will be reproduced for many different network architectures.

based on comparisons with technological revolutions in the software industry.

Historical perspective

It has now been six years since the CATV industry saw the first demonstration of AM-VSB fiber optics at the Western Show in Anaheim in December 1987. The subsequent development and rapid adoption of AM fiber optic products for CATV networks has fulfilled all the promises and expectations for this exciting technology.

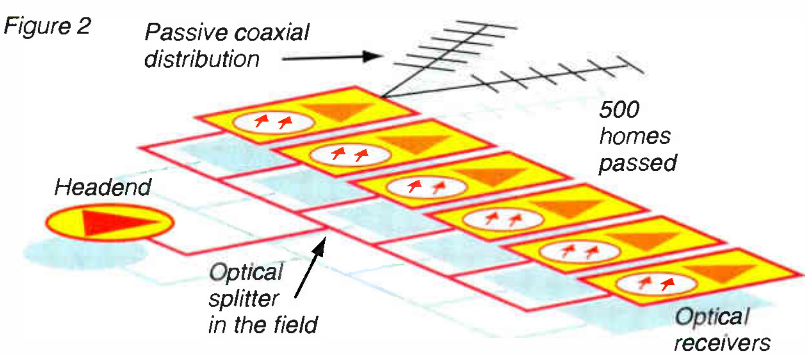
The numerous advantages of fiber optics in today's systems are well known: improved reliability, signal quality, bandwidth and reduced maintenance cost. These critical benefits of fiber optics came at a time when the CATV industry has come to the forefront in the national communications agenda.

After early debates about the optimum fiber optic technology for CATV, the industry has essentially adopted 1300 nm DFB lasers as a de facto standard. This is based on proven performance and reliability, superior cost/performance ratios, widespread product availability and continuing performance advances. Armed with confidence that 1300 nm fiber optic technology is flexible enough to support future architecture expansion and upgrades, MSOs have implemented highly aggressive fiber deployment plans, designed to assure CATV system competitiveness for the foreseeable future, and beyond.

The impact of aggressive fiber deployment on DFB suppliers has been highly beneficial to MSOs. Increasing production rates of lasers has brought costs of fiber optic products to a fraction of their early levels; resulting in lower end-user equipment prices. With nearly universal adoption of the AM DFB laser-based network architectures, the trend of increasing volumes and dropping costs will surely continue.

Impact of dropping costs

Historically, CATV system designers have budgeted between $25 and $30 per home passed for distribution



electronics, or about $2,500 to $3,000 per mile of plant. This included all active electronics in the distribution portion of the network: trunk amplifiers, bridgers and line extenders.

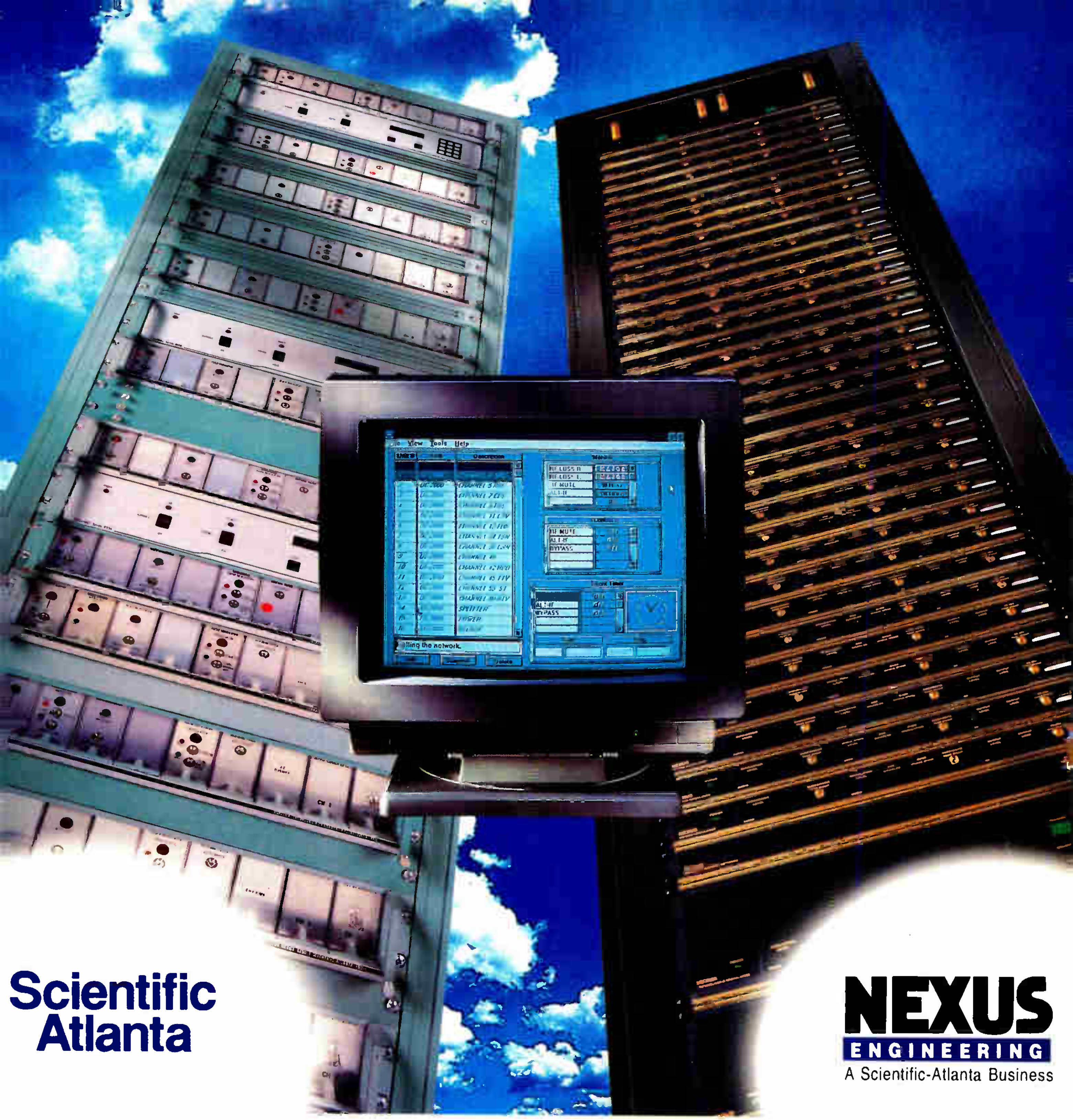
The cost philosophy for incorporating AM fiber optics in CATV networks has been quite interesting. One could have argued that the best use of fiber optics would be to reduce system costs. By late 1990, fiber optic technology had matured to the point where network costs could have been reduced, using AM fiber optics. PResumably, system designers could have implemented enough fiber to reduce cascades, eliminate expensive trunk amplifiers, and achieve a less costly system design, especially for large systems.

Instead, the CATV industry adopted a much more farsighted philosophy to the design if hybrid fiber/coax networks. The approach has been to install as much fiber as possible, without significantly exceeding the historical budget for distribution electronics. Today's networks are designed with essentially the same $25 to $30 per home cost budget, but now the money is allocated to coaxial amplifiers, headend fiber optic transmitters, optical receivers and fiber cable. This represents a strategic investment by MSOs in networks that will be competitive into the future.

Figure 1 shows a qualitative graph of the cost of distribution equipment as a function of node size. The graph shows four curves, which represent the cost of building hybrid fiber/coax networks at four different points in time. The horizontal axis is the number of homes served by a single optical receiver.

The curve on the far right in the graph applies to the era before AM fiber optic products were available, wich is pre-1989. At this time, only digital or FM-based products were available to the CATV industry. These products cost hundreds of thousands of dollars, and were only cost-effective for supertrunking; i.e. node sizes of 100,000 homes or more.

The other three curves, moving from right to left, represent the same information, but based on the steadily dropping costs of AM fiber optic transmission prod-



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Circle Reader Service No. 17

CATV fiber cable management

How to improve productivity

By Steve A. Day, Comm DOC Services

In today's CATV networks, fiber optic cable management is becoming increasingly important. At the same time, many CATV engineers still endorse a "direct connect" philosophy vis-á-vis fusion splicing of cable to transmitter pigtail and from cable to receiver pigtail.

A good fiber management philosophy can easily pay for itself in the years following initial fiber optic installation through savings in engineering, installation and maintenance costs. Initially, fiber optic cable installations were associated with simple AM fiber optic link design. Cables of 12 fiber count or less were connected to fiber optic nodes by direct fusion splice or by mechanical connector.

However, as CATV companies expand the propagation and size of fiber optic cables, the importance of cable management comes into play. The CATV headend becomes the hub for AM-VSB CATV channel transport, digital video transmission, switched services and competitive access. The evolution of these services and proliferation of fiber optic nodes in Star-Star-Bus and fiber-to-the-feeder architectures demands that fiber cable management be taken seriously.

The risk of ignoring this vital element of CATV network design will result in lost productivity, unnecessary service interruptions, poor cable management and limited plant access. All these elements become important in their own right.

Lost productivity

Cable Management systems similar to the one shown in Figure 1 represent a "point of access" that technicians and engineers can use to isolate the outside plant optical cable from the transmitter or receiver. At this location, fiber cutovers can be accomplished. For instance, if one were to require movement of a fiber optic link from fiber #1 to fiber #12, this could be accomplished at the patch panel with a labor function taking a few minutes. No extraordinary test equipment or splice equipment and no materials would be required. If this same fiber cutover were to be accomplished without the patch panel, the following lost productivity would occur:

✔ Fiber #1 and Fiber #12 would require physical disconnect from the transmitter.

✔ Fiber #1 and Fiber #12 would need to be respliced to the appropriate terminal equipment (i.e. receiver, transmitter).

✔ If the fibers were not in a management system, a "tone and tag" process would have to occur to locate #1 and #12 at each location.

Fiber patch panel

However, with fiber management systems, this process could be accomplished by simply searching for the appropriate fiber in a patch panel. In the outside plant environment, this could be a 12 to 96 fiber optic cross connect location. In the CATV headend, it could be an unlimited number of fiber management frames such as those shown in Figure 2.

Equipped with the proper fiber management system, a CATV headend is rigged for the future. Activities such as addition of a fiber optic node or transfer of a fiber optic node can be accomplished in minutes, with no lost productivity.

Unnecessary service interruptions

When a fiber optic hub or a fiber optic node feeds several thousand subscribers, any downtime can mean lost revenue and lost customer satisfaction.

Again, a connector panel design, described in the preceding section, portrays one obvious way to rapidly respond to outages. The speed of response, when good fiber management is deployed, saves the operator precious time in outage restoration.

Equipped with the proper fiber management system, a CATV headend is rigged for the future.

Yet this is only one aspect of unnecessary service interruptions. The other is not as obvious. To date, CATV operators have invested in a large amount of dark fibers. These fibers remain dormant and dedicated to future services such as telephony, video on demand and so on. This "sleeping" informational highway is like

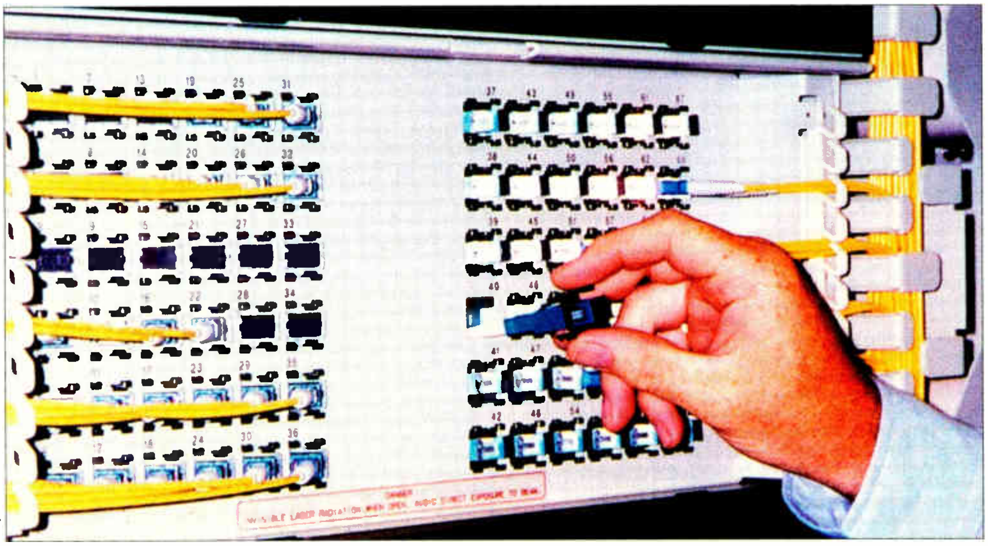
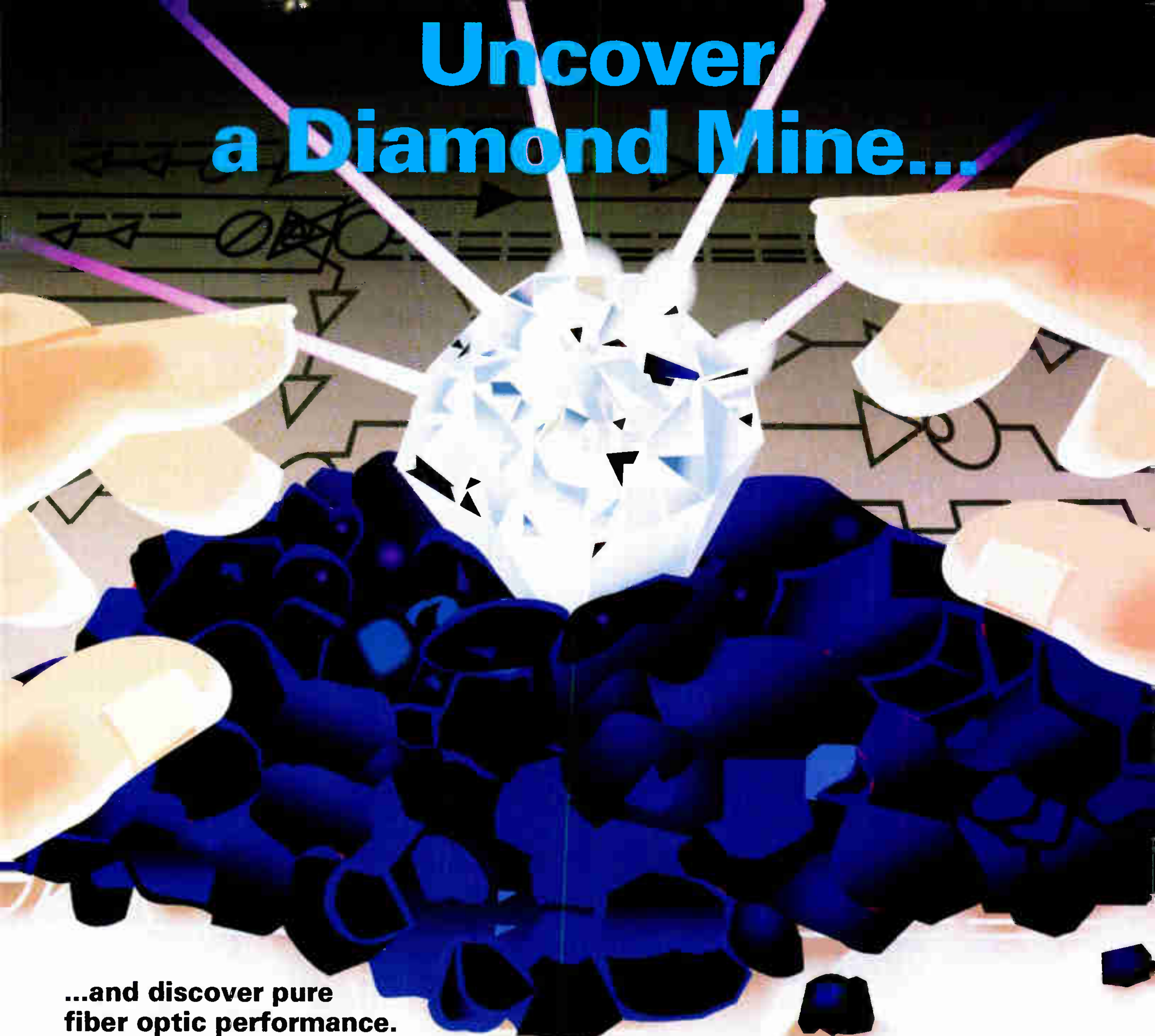


Figure 1. ***This "point of access" can be used to isolate outside plant optical cable to perform fiber cutovers.***



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Circle Reader Service No. 20

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The migration to passive networks

Points to consider

By Mike Sparkman, Vice President and General Manager, Broadband Transmission Systems, ANTEC

With the market environment for video entertainment and interactive applications rapidly changing, so too, is the need for a telecommunications infrastructure capable of supporting voice, video, and data applications. Cable operators are building cable plant with 750 MHz capabilities and deploying fiber closer to the home to support today's entertainment video business. Future applications will drive the evolution of the cable television network even further, toward an incrementally more sophisticated, capable and complicated architecture.

Figure 1

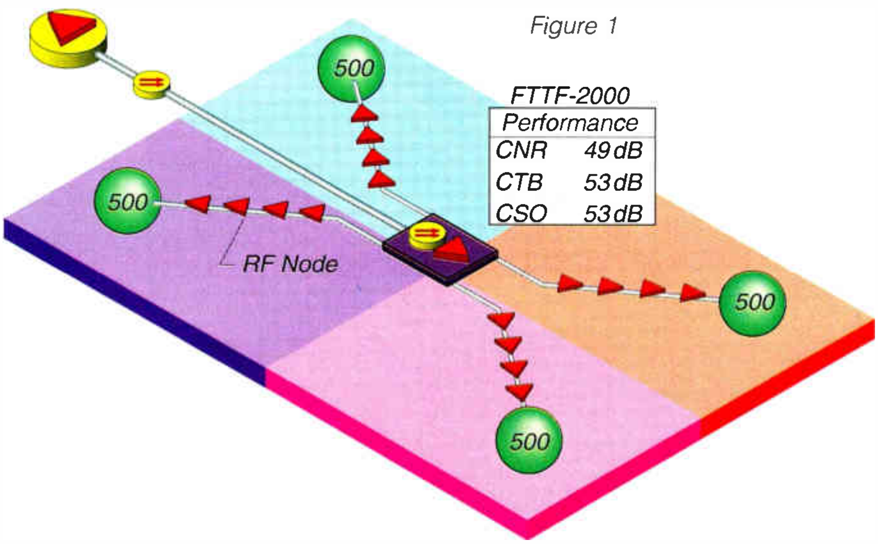
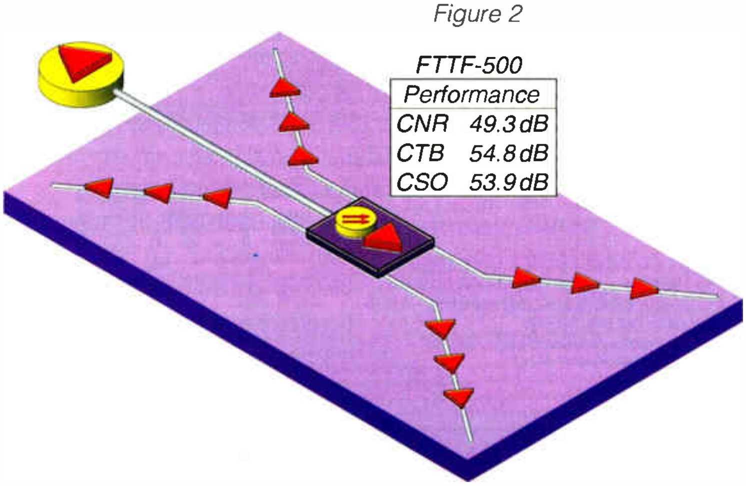


Figure 2



Clearly, the residential network is evolving in several key directions, including smaller node sizes, more bandwidth and interactive service planning. For this reason, much attention has been focused on how the passive optical network (PON) can provide a future pathway for data and high bandwidth services required by near-video-on-demand (NVOD), video-on-demand (VOD), residential telephony, and other interactive services.

Why go passive?

First, PON architectures eliminate all active electronic components by driving fiber far deeper into the cable plant than other architectures. Reliability increases since the distribution network is protected from service outages caused by RF active device failure. Because clearly, as the cable industry begins to offer such critical telecommunication services as residential telephony, such service outages simply won't be tolerated by subscribers.

Second, PONs size serving areas to less than 500 homes. This sizing provisions the network with ample capacity to handle peak load demand for any number of interactive services in the return path.

Third, the PON is limited only by the transmission, switching, and terminal equipment capacity. If, for example, 1 GHz taps and passives are installed, network flexibility increases since the system will be able to provide up to 1 GHz of spectrum within the distribution portion of the network.

Fourth, eliminating actives helps reduce distortions and noise, a benefit that may not be realized today but will be critical as new digital video services come online. Implementation of high-quality subscriber drop systems will become an even more crucial network element.

And fifth, there is an inherent operations benefit. Personnel will no longer manually test an array of RF amplifiers. PONs also require no network powering for traditional entertainment signals.

The fully passive architecture is, however, expensive to implement today and operators may not see its benefits in the short term. But as new interactive and digital services prove in, the increased capacity, reliability, network flexibility and transmission quality will make PONs more attractive and feasible.

For this reason, it is important to establish a migration path toward the PON that allows cable systems to "future-proof" their networks. In this way, another complete rebuild will not be required as new applications arise.

Any such plan should chart such a growth pattern by incrementally building on today's existing cable network. Core business revenues are helping drive future network evolution today, and new revenues of the future will enable systems to migrate to the PON as interactive services begin to be delivered tomorrow. By strategically laying fiber today to attain smaller node sizes, cable systems can incrementally migrate toward a PON to facilitate the delivery of any number

of new services.

Fundamental design considerations

Any strategy involving long-term network evolution toward the PON must begin by defining the long-term business objectives and relating those objectives to the network configuration. Analyzing the network demands of such new services as NVOD, VOD, telephony services, data transmission and other applications is essential in defining the transmission system characteristics.

To illustrate, cable television has the means of delivering a product that could compete directly with the $15+ billion market in videocassette rentals. Initially, this will take the form of NVOD. The basic idea is to use digital video compression to enable the broadcast delivery of several movies, each starting at short intervals around the clock. This would provide subscribers with convenient access and better quality over VHS cassette rentals. Programmers will be provided with better control of product distribution, and, presumably, will gain more participation in home viewing revenues.

However, delivering this service today relies on the network capacity that won't cut into bandwidth currently required for traditional analog broadcast signals. Emerging MPEG-2 video compression techniques will squeeze more programming into available bandwidth, and NVOD will most likely take up capacity in the 550 MHz to 750 MHz area. Thus, systems planning to offer NVOD services must position the network today to utilize this higher level spectrum. Return path needs could be achieved with a simple telephone call from subscribers to obtain service, but may also involve a return data path on the cable network.

Unlike NVOD, VOD and residential telephony require not only increased bandwidth, especially in the return path, but smaller service nodes as well. Since both VOD and telephony demand that subscribers have immediate access to services, ANTEC recommends sizing nodes to under 500 homes, allowing subscribers that immediate availability without encountering a "busy signal." Achieving this node size, however, does require proper provisioning of fiber today for extending optical reach in the future.

The prudent system designer should begin by identifying the services the network will be positioned to provide.

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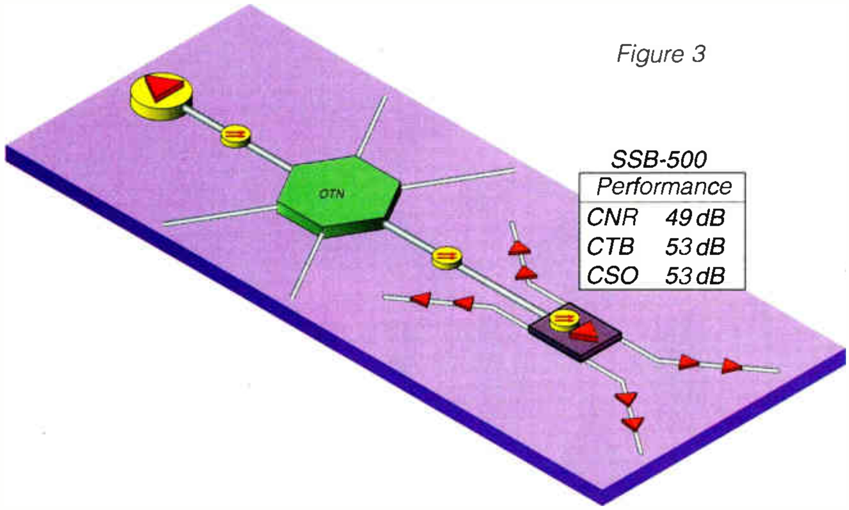


In addition, any number of the other emerging interactive services (e.g., distance learning, telecommuting, home shopping, subscriber vs. subscriber games) will each require their own allocation of bandwidth and immediate availability to such services by subscribers on the return path. Here, the PON allows for increased flexibility over other architectures since any number of services can be offered within the network's total bandwidth capacity.

Today's active electronics act as the bottleneck for return path and downstream bandwidth allocation. By eliminating these actives within the network, this bottleneck can be substantially reduced or virtually eliminated.

It's obvious from this simple overview that a number of considerations must come into play when designing the appropriate evolutionary strategy toward the PON. The prudent system designer should begin by identifying the services the network will be positioned to provide and evolving the network toward delivery of those services once revenues from each can be realized.

Analyzing network options

One common network design is the fiber-to-the-feeder (FTTF) architecture. Initially, most FTTF designs serve 2,000 home nodes (as shown in Figure 1) and are most often deployed as part of a trunk amplifier cascade reduction project. Links are typically point-to-point with AM optical supertrunking offering cost savings over the all-RF cable network. However, a long-term disadvantage of supertrunking results from the reduced ability to narrowcast to each secondary node. While this is probably not an issue today, it will impact future revenues from interactive services tomorrow.

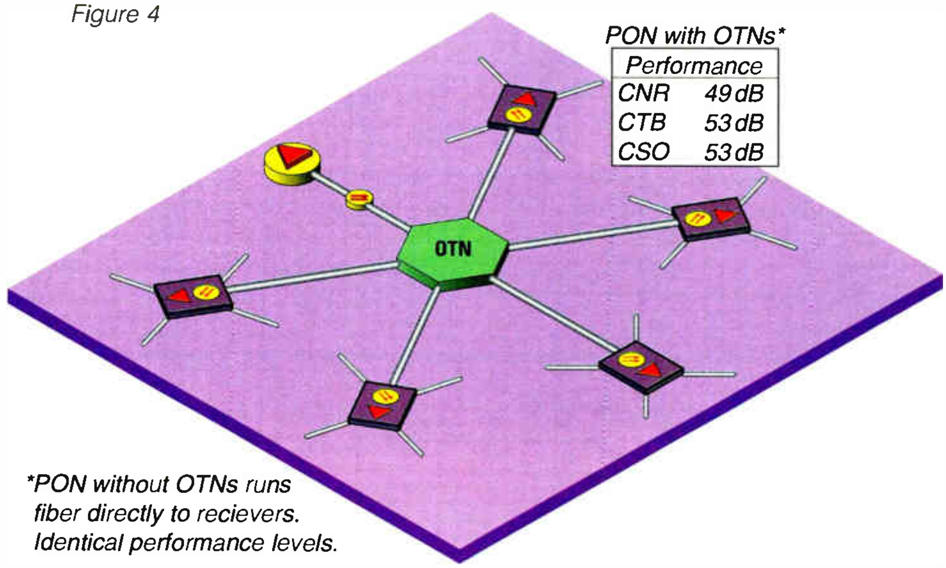
Most systems implementing FTTF architectures are installing enough dark fiber to extend fiber's reach in the future. As demand increases and corresponding node sizes must be reduced, this fiber can further subdivide serving areas into pockets of 500 homes, thereby increasing network capacity (as shown in Figure 2).

The Star-Star-Bus-500 architecture (shown in Figure 3) emerged as the next step in network evolution. The SSB-500 simplifies network powering, reduces RF electronics in the distribution plant, and can cut fiber counts by as much as 60 percent compared to FTTF architectures.

In the SSB-500 design, each subscriber will be located no more than two active devices past the optical bridger (the FTTF-2000 has four amplifiers, the FTTF-500 has three).

The PON architecture also sizes nodes to accommodate the potential demand for interactive services, serving anywhere from 150- to 500-home passings depending on the topology of the cable plant and subscriber density in a given geographic area. In the near-PON design, six fibers are allocated from the headend to each optical receiver where signals travel through one amplifier over coax. Then, when further network expansion is required, pre-installed dark fiber can be activated to migrate the network to the all-passive network (as shown in Figure 4)–whether that expansion is systemwide or in individual serving areas. This allows subscriber demand and revenue potential in any given service area to drive further network evolution.

Figure 4



Cost Issues

	FTTF-2000	FTTF-500	SSB-500	PON	PON w/OTN
Total Cost	$1,166,052.00	$1,167,622.00	$1,287,829.00	$2,917,338.00	$2,280,303.00
Cost/Mile	$10,139.00	$14,501.00	$11,198.00	$25,368.00	$19,828.00
Cost/Passing	$55.05	$78.95	$60.97	$138.00	$107.95

Pricing does not reflect construction costs

Reflects complete rebuild cost of system actually designed.
115 miles of plant with 21,122 passings.
Actives spaced at 750 MHz. 1 GHz taps & passives at drop.

Figure 5

In addition, the PON design can also incorporate Optical Transition Node (OTN) units to economically reduce fiber counts from the headend. In some instances, directly feeding fiber from the headend to nearby optical receivers will be warranted while OTN units–which would house low-powered transmitters and act as optical repeaters–could be deployed to reduce fiber counts to outlying areas. From there, the OTNs could be interconnected with bi-directional rings, offering enhanced network redundancy.

Cost issues

In evaluating these alternative designs, pricing shows the disparity in costs between the architectures. Figure 5 numbers are based on five different network topologies and bill of materials all designed on the same cable system. Because construction rates fluctuate by region and type (underground, aerial), these calculations do not reflect construction costs. Costs do include the current prices for all fiber/coaxial cable, optoelectronics, network powering systems, RF actives and OTN units (if applicable to the design), and 1 GHz taps and line passives. Note that the PON is the most costly at $138 per passing. With OTN units, the PON costs drop to $107.95. The SSB-500 architecture runs $60.97 per passing for the system while a complete rebuild using FTTF-500 costs $78.95 per passing. The FTTF-2000 remains the most inexpensive option at $55.05 per passing.

Cost issues alone, however, cannot determine the proper residential network architecture or establish the correct migration strategy. Systems seeking to move into the interactive world should also consider other factors that will be especially important in delivering interactive digital signals. The long-range network development strategy toward a passive architecture should include the role network capacity, reliability, flexibility and transmission quality will play on the overall cable system.

✔ Network capacity. Current state-of-the-art cable television systems utilize bandwidth from 50 MHz to 750 MHz to provide up to 80 NTSC channels at 550 MHz and up to 110 channels at 750 MHz. In the future, both downstream and upstream bandwidth and corresponding channel capacity is expected to continue expanding. Most cable systems have responded by implementing 1 GHz residential drops and passives to prevent a future retrofit at the home. With a passive architecture, this 1 GHz capability can be fully utilized once the remaining active components within optical receivers no longer limit capacity to 550 MHz or 750 MHz.

✔ Reliability. Improved system reliability is widely recognized as another key requirement in advanced networks, particularly with regard to potential telephony and data transmission opportunities. The PON's elimination of amplifier cascades means the distribution plant can be protected from failures. PONs also require less maintenance. In addition, built-in redundancy features in optical receivers will provide for improved reliability between the headend and receiver locations.

✔ Flexibility. Most of the business opportunities that define growth potential have network transmission requirements that differ significantly from those of the past. Systems being engineered must have flexibility built into them today to handle these requirements and preserve future options. Smaller node sizing allows the same bandwidth to be used by multiple subscribers. This capability provides greater flexibility in the management and allocation of bandwidth. In the case of digital services, this capability minimizes the capacity required to deliver return signals from each node location.

✔ Transmission quality. System performance requirements must also be evaluated. Most new designs are specifying a minimum carrier-to-noise (CNR) of 49 dB, composite second order (CSO) of 53 dB, and composite triple beat (CTB) of 53 dB as appropriate end-of-line performance benchmarks. While all of these designs meet this criteria, other important factors include the role microreflections, phase, and delay characteristics will have on transmission quality as digital signals impact the network design. Any active devices in the system can have a negative impact on digital signal delivery. While industry engineers are looking very closely at this issue, actual thresholds and impact on digital video transmission/reception have not been determined.

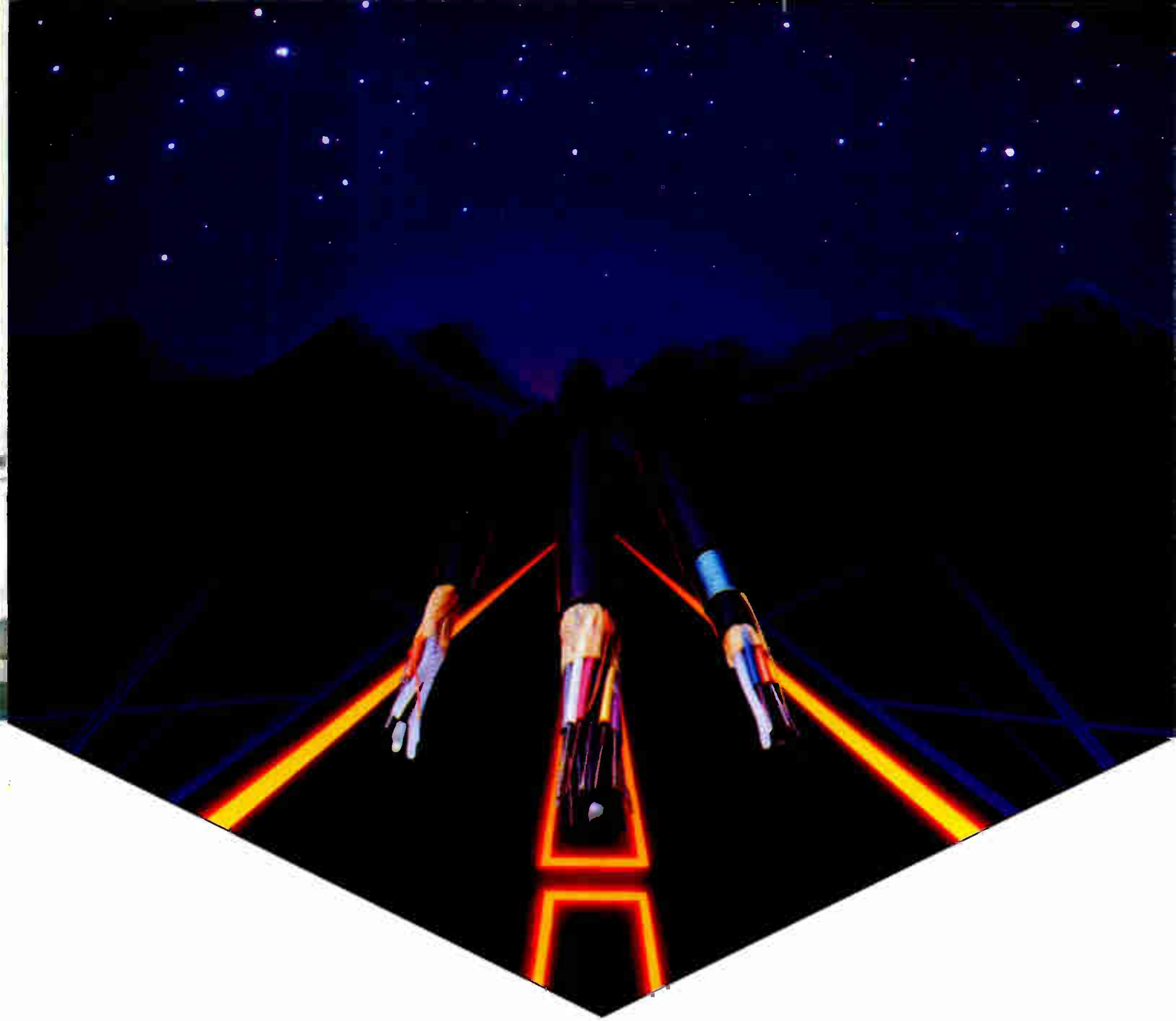
Another critical factor in digital transmission lies in the quality and reliability of the subscriber drop. In many cases, today's drops are the weakest link in the cable network, resulting in as many as 80 percent of all service calls.

Once the industry fully adopts a full service network and begins transmitting digital services, subscriber drops that provide satisfactory NTSC signals today may provide insufficient quality for the digital signals of tomorrow. Thus, the drop should be viewed as one of the most vital links in the network evolutionary plan.

Today, cable operators can reduce some of these problems by taking special care to choose components that don't affect the impedance of the cable. High shielding standards for passives, connectors and cable, effective connectorization, and component compatibility will all continue to be critical issues in the installation process, especially as the cable industry moves into the digital world.

Conclusion

Interactive digital services of the future will be available for delivery by virtually all cable systems. Whatever network design is being implemented, the need to deliver high-quality, reliable digital signals will be crucial in the years ahead. While passive architectures need not be completely built today, network planners should evaluate the various network topologies they're putting in place with an eye toward migrating to the PON to meet the digital demands of the future. Keys to this migration path lie in provisioning fiber, developing service nodes of 500 homes or less, and ensuring that a solid drop system will deliver quality analog and digital signals to the home well into the future. CED



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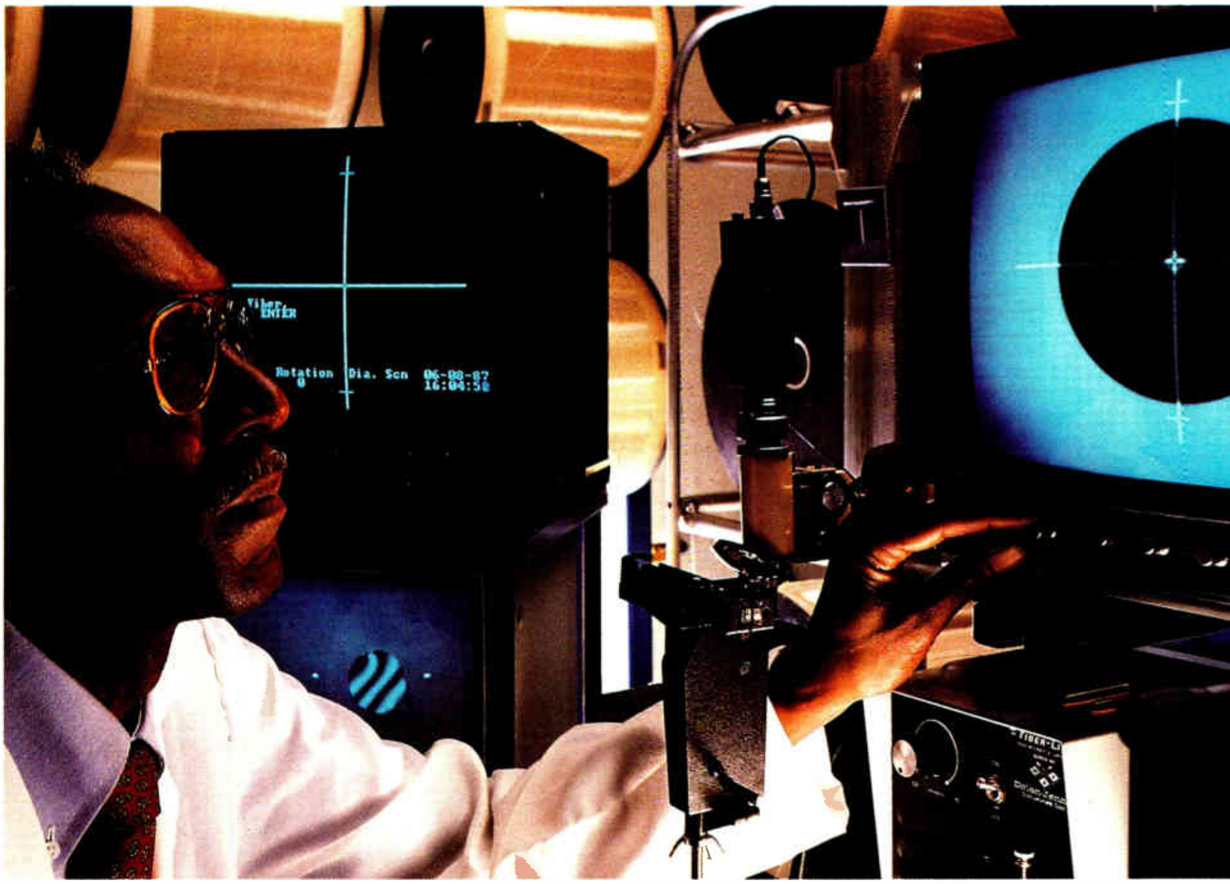

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Rebuilding for the digital future

A look at Ventura County Cable

By Ron Goodrich, Staff Engineer, Western Communications; and Tom Williams, Project Manager, Ventura County Cable

When you're rebuilding a system for the digital future, especially in this era of converging technologies and applications, there is no established pattern to use as guidelines. Operators have to guide themselves through an array of choices of architecture schemes, technology and equipment to meet objectives based on existing plant, demographics, geography, resources and budgets. Ventura County Cable in California, a part of Western Communications, is a system that is successfully navigating a major rebuilding program using innovative approaches in design, technology and implementation.

In 1990, Western Communications faced the need to rebuild the Ventura County Cable (VCC) system to meet franchise requirements. Western Communications, however, had never experienced a major rebuild in its history. The company had grown primarily through acquisition and newbuild.

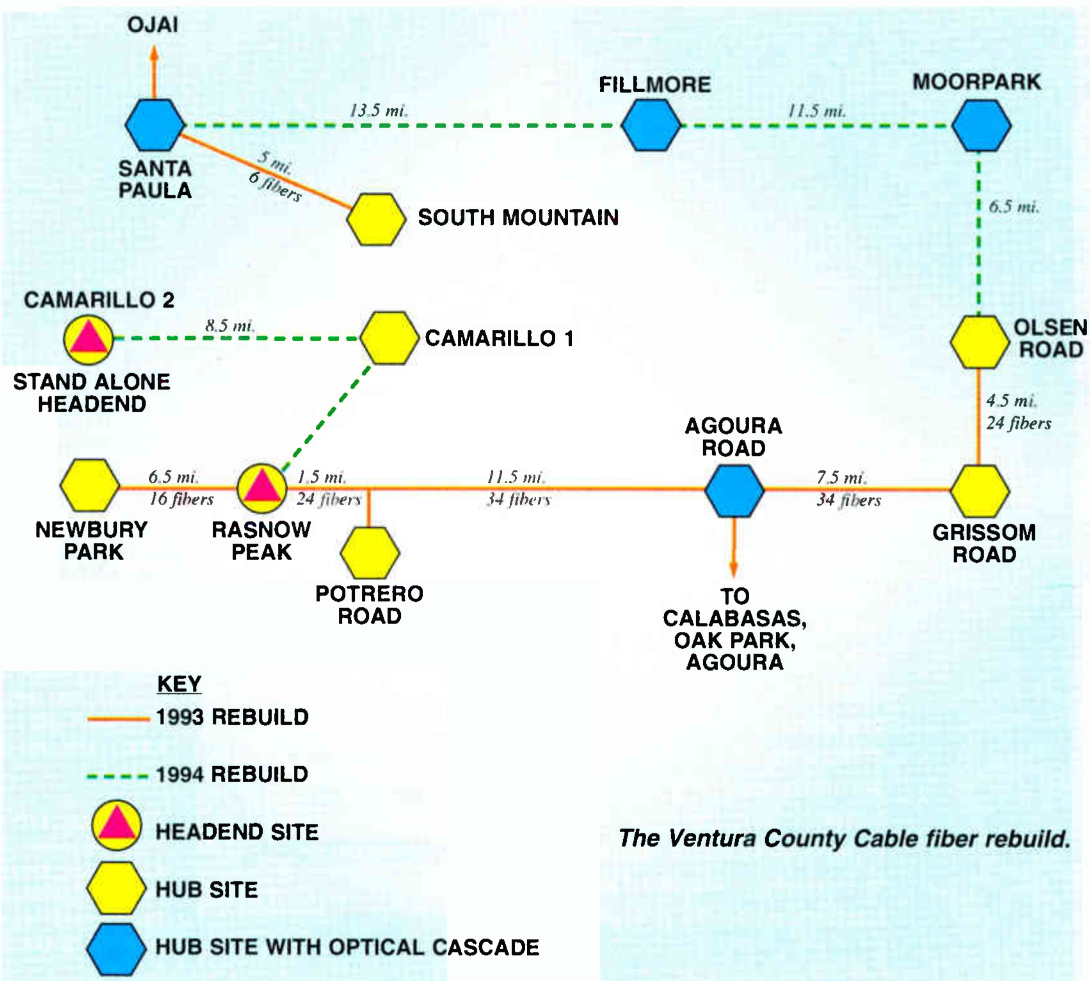
Although the rebuild objectives were broad in nature, they were basically: 1) have the ability to accommodate the maximum channel capacity that was possible, 2) incorporate fiber technology for lower maintenance and higher reliability, 3) implement an architecture that would provide the best possible service to an existing subscriber base and be fully flexible and passive to enable migration to future services such as video-on-demand, interactive programs, and any telecommunications traffic in the area.

The assignment to explore technology and architecture concepts for the rebuild fell to Ron Goodrich, who at the time was the director of engineering for Ventura County Cable. Ron, along with Par Peterson, the corporate director of engineering and Tom Williams, the VCC project manager, conducted comprehensive research by reading industry publications and white papers and talking to equipment vendors as well as other cable systems.

The first rebuild segment of the Ventura County Cable system had a classic "tree-and-branch" architecture with a very long cascade. Located in a long, narrow valley, the system has a unique topology: at its widest point from east to west, it is only two to three miles, while being 18 miles from north to south. It was being served by a 45-amplifier cascade which did not provide satisfactory signal quality or reliability levels.

This led the technical team to the conclusion early on that a Star-Star-Bus architecture was the best concept for the system needs. It was also determined that, initially, 12 fibers could run to nodes serving 500 homes as compared to larger node sizes of 2,500 homes, resulting in improved reliability levels. This concept would also provide a platform for the future in which the 500-home pockets could be narrowed to 75-home pockets.

At the time, it seemed that the only fiber optic product that was available for this architecture was based on DFB technology. Although the ultimate goal was to have a digital fiber application, digital technology was not perfected and was not within financial consideration. Then, Ron Goodrich, who by this time had become the staff engineer at Western Communications' corporate office in



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San Francisco, learned about a new technology based on a diode-pumped Nd:YAG laser. The system features an optical transmitter with an externally-modulated solid state laser and advanced predistortion linearization.

Cost-effective YAG technology

After seeing a demonstration of this new technology, Western Communications requested performance specifications and pricing based on the planned concept. Although the specifications numbers were impressive, the initial pricing seemed to be outside the budget. However, a closer examination was made of the application requirements. Up to that time, YAG technology had been used only in point-to-point, long haul supertrunking applications. However, the technical team came to realize that by taking a single YAG transmitter and attaching a number of couplers on the output, one transmitter could serve multiple nodes, providing approximately an 8 to 1 efficiency ratio. If an equivalent number of DFB transmitters were purchased to serve the same number of subscribers, the costs were almost equal.

Once the financial issue was resolved, the next step was to test the field viability of this architecture concept and new technology. The Ventura County Cable system ordered and installed a number of YAG transmitters and receivers as well as a network management system that could remotely monitor and pinpoint trouble spots. Installation and set-up proceeded quickly since the YAG system allows set-up functions to be done upfront at the headend rather than in the field.

Highest quality in worst case

At the end of 1992, the system ran a proof of performance test on all areas that had been rebuilt up to that point. An independent testing firm, not affiliated with the equipment manufacturer or the system, was commissioned to conduct the testing. Measurement began at the deepest part of the system using a fully loaded 80 channel non-modulated MATRIX generator.

The technical team expected to see carrier-to-noise (CNR) numbers in the 48 dB to 49 dB range, composite triple beat (CTB) in the 57 dB to 58 dB range, and composite second order (CSO) in the 57 dB to 58 dB range. In fact, at the deepest point of any subscriber from the headend, CNR measured 53 dB and 54 dB, CTB at 65 dB and CSO at 63 dB and 64 dB. Nineteen separate tests were conducted at 19 different locations throughout the system to confirm the validity of the outcome. At every point the numbers were significantly higher than expectations. The results were so impressive that the individual performing the tests remarked that he had never seen those kind of distortion levels acheived anywhere in his career.

After the proof of performance tests confirmed the viability of the concept, VCC was ready to implement the second stage of the rebuild. In order to accommodate future digital services and new revenue streams, the system designers wanted to create a 360-degree bi-directional fiber ring in the service area. First, they needed to retire some of the existing high power AML microwave equipment to improve performance and add channel capacity without having to invest in additional microwave equipment that would have to then be retired in a few years. But, the question was: How can this be accomplished when digital technology is still not quite ready?

Optical cascades

Goodrich proposed the idea that YAG transmitters could be used in cascade. In parallel, the manufacturer of the YAG transmitter was developing a new product that could be used for that purpose. Ventura County Cable volunteered to be the Beta test site for the new transmitter and shortly afterward became the first system to place it into operation in the United States.

The new YAG device produces an RF output that has a 3 dB higher CNR than is generated from a single link. This is accomplished by the transmission of two dual complementary-phased optical output signals (as in a "push-pull" amplifier) to two separate receivers. The receivers each output an RF signal which is combined in the next transmitter.

The first transmitter is used from the main headend to feed another transmitter, and that in turn feeds into the local distribution sites. This architectural approach opens up the possibility of having three different levels of fiber rings in a single service area. For example, a small ring can be executed for a commercial area to accommodate PCN or telephony services. In 1993, the system rebuilt approximately 350 miles of plant and successfully retired seven microwave sites using this method. And once again, superior performance levels were acheived with the added benefit of expanded channel capacity.

The rewards

What has Western Communications learned from this experience? First, this method of rebuild keeps the customer disruption level at a minimum. Ventura County Cable didn't completely rebuild its distribution system nor did it rebuild it all at once. The system used or upgraded existing cable whenever possible. The portions that needed rebuilding were done in very small "modules," disrupting service to only a small number of homes at a time. Much of the work was pre-staged and then completed in a two- to three-day period between the hours of 7 a.m. and 3:30 p.m. The timeframe was based on the community demographics–two-job households where the majority of the customers were gone during the day. Therefore, hardly any subscriber complaints were received.

Second, the system has more control over the implementation process. Supervision is easier because installers are concentrated in small areas for shorter periods of time. Therefore, it is easier to maintain a high level of quality control.

Third, a practical feature of this architecture concept is the flexibility when it relates to node sizes. The nodes in the Ventura County Cable system, on average, serve 500 homes each. However, the architecture allows the system to create varying size nodes where natural geography (mountains, lakes, etc), man-made geography (highways, power grids), political boundries (cities, counties), and existing plant come into strong consideration.

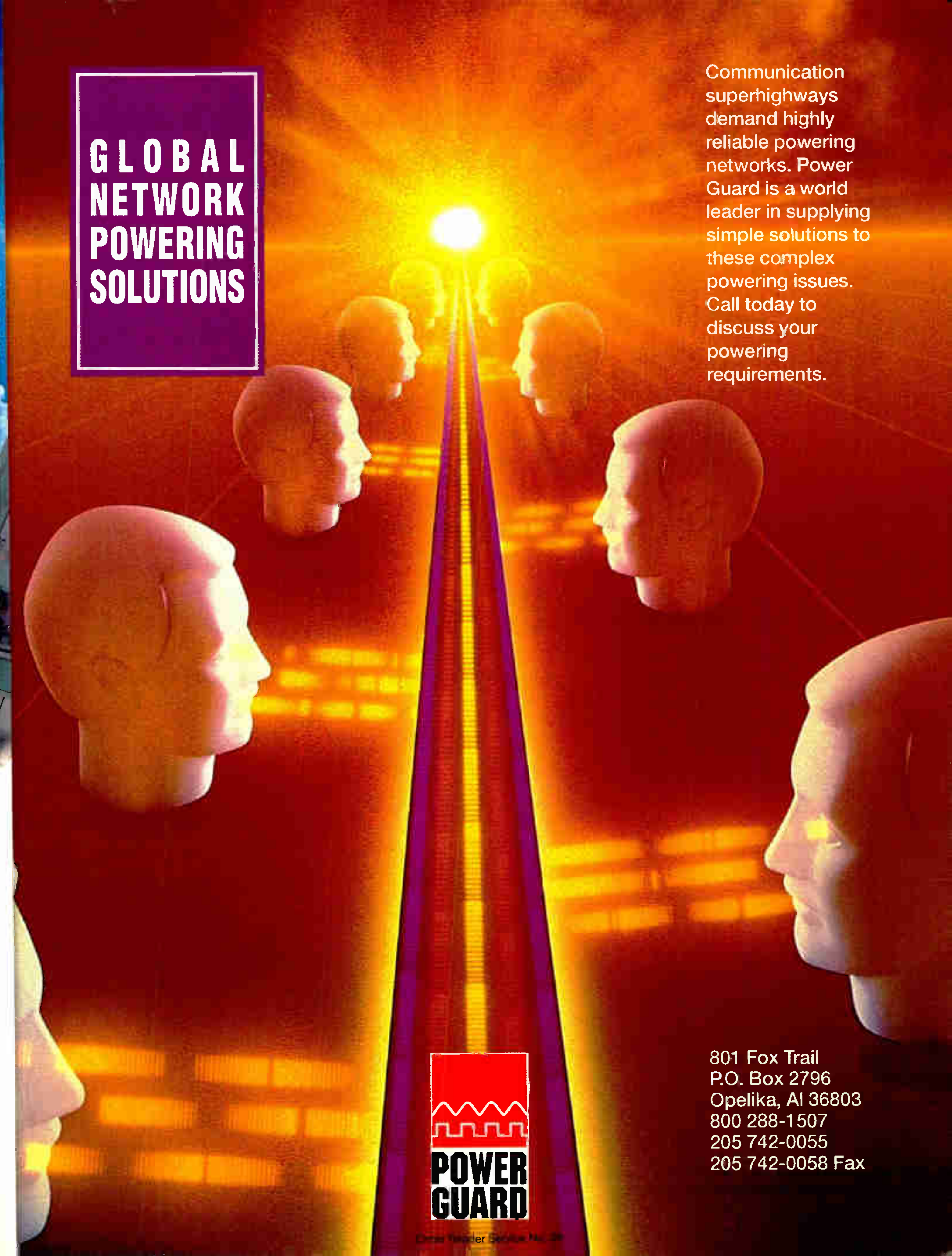
Some of the nodes have as few as 300 homes. Each node is totally "independent" of one another and in no case does a node straddle any kind of barrier like the ones listed above. Reliability is vastly improved since an outage in a pocket can be contained without affecting service to other homes.

Ventura County Cable is now 24 months into its rebuilding program. The system has approximately 35 optical receivers in operation and has yet to experience a failure.

Best of all, 45,000 subscribers to date are receiving dramatically improved picture quality–in fact, they are seeing headend quality pictures. VCC has documented calls from subscribers wanting to know what the system did to improve their reception so much. At 55 dB carrier-to-noise, VCC is acheiving near studio quality and has already exceeded the 1996 FCC recommended standard of 47 dB CNR.

And finally, the system can easily and cost effectively migrate to digital technology. All the fiber will be inlaid in preparation for future SONET applications.

Western Communications and Ventura County Cable is continuing its major rebuilding program into 1994. And as a result of the willingness to move forward with new techniques and concepts, will be fully prepared for whatever develops in the cable industry in the next decade. CED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Time Warner's Jim Ludington takes top honors as Polaris Award winner

$2,000 donated to fiber optic training in his name

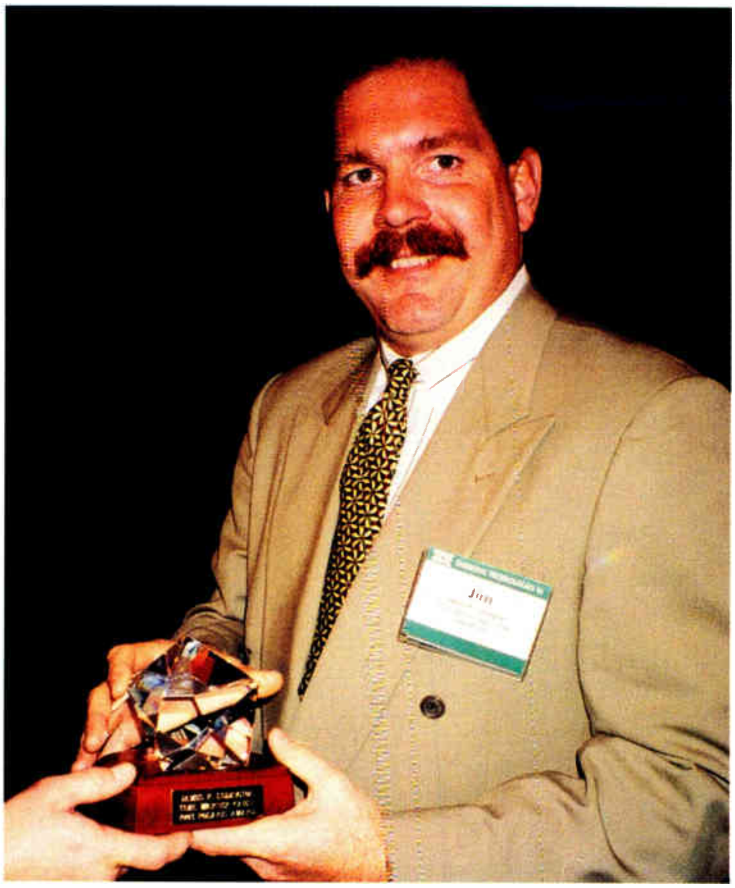

PHOTO BY ROB STUEHRK

By Leslie Ellis

Jim Ludington, VP of technology for Time Warner's Full Service Network project in Orlando, Fla., last month received the coveted Polaris Award, presented in recognition of a decade's worth of exertion in fiber optic technology deployment.

The award, created by CED, Corning Inc. and the SCTE, is named after the Polaris Star, known as both a navigational standard and the brightest star in the evening sky.

Tom Staniec, director of engineering for NewChannels Corp. and last year's Polaris Award winner, presented the award during the SCTE's annual Conference on Emerging Technologies, held in Phoenix, Ariz. last month.

Ludington earned the award for his work at Time Warner over the past 11 years, where he pre-engineered and installed "thousands" of sheath miles of optical cable in some 20 Time Warner divisions.

In accepting the award, the humble Ludington said he was "flattered but embarrassed" to receive such a distinction, citing instead a team effort to implement the designs of Time Warner engineering gurus Jim Chiddix and Dave Pangrac. "Projects like the ones I've been working on don't happen because of one person," Ludington said, referencing his Denver, Colo.-based engineering colleagues.

But it is Ludington's interesting blend of panache, wit and determination that likely propelled the 36-year-old to his role as one of the cable industry's rising stars. His ascent has been swift at Time Warner. From his start in 1983, Ludington has worked his way up from routine construction work to some very high profile projects, including the company's 1-GHz project in Brooklyn/Queens, N.Y., which he spearheaded just over two years ago.

"Projects like the ones I've been working on don't happen because of one person."

These days, he's consumed with the much-touted Full Service Network trial, slated to fire up in Orlando, Fla. in April.

Specifically, Ludington's roots in lightwave technology started in fiber backbone installations, followed by fiber-to-the-feeder networks when that concept materialized. A self-starter, Ludington completed the National Cable Television Institute's fiber optic course and has penned numerous fiber optic construction articles in trade publications.

For his efforts, Corning officials presented Ludington with a piece of Steuben crystal aptly entitled "Rising Star" and donated $2,000 in his name to the SCTE to fund fiber optic educational programs. CED

Congratulations
to Jim Ludington
from the rest
of the Full Service
Network Team

The only constant is change...

By Leslie Ellis

Just under 1,000 technical personnel representing cable, telco and related communications industries fled to sunny Phoenix, Ariz. last month–many left behind bitter cold, snow and ice storms on the East Coast–to attend the SCTE's annual Conference on Emerging Technologies. Attendance, up 25 percent over last year's record 750 attendees, apparently reflects a thirst for details about digital, lightwave and advanced networking technologies.

There were no earth-shattering or startling announcements at this year's conference–no cable MSOs were gobbled up by an RBOC; no massive interactive trials introduced. What did emerge from the conference were these oft-repeated conclusions: digital is real; the tried-and-true cable TV business is changing; network preparedness is key.

MPEG-2 discussions abound

Digital video compression, standardization and implementation issues dominated the first phase of the three-part conference. In particular, panelists focused heavily on MPEG-2, an ISO standard under development for digital video storage and transmission applications.

"The cable industry will play the key role in deciding interoperability issues for the MPEG-2 video compression standard," said TV-COM International's Larry Leske, who presented a pre-conference tutorial session on the subject. MPEG-2, Leske said, was designed to be economically asymmetrical, such that decoders are simple and inexpensive and encoders are complex. However, he explained, the MPEG-2 motion prediction technique imposes a massive real-time computational burden on encoders, possibly beyond the current state-of-the-art processing technologies.

Detailing the MPEG-2 standard was Ken Metz of AT&T Bell Laboratories' CATV Systems Group, whose presentation illuminated the cost vs. benefit tradeoffs of the different MPEG-2 profiles. The type of processing used, memory and powering are three variables which embody decoder cost, Metz said.

"Memory cost (within the MPEG-2 decoder) is clearly an issue. How much, and how fast? That's what's important," Metz said. "Any time you add speed, you need to add memory."

Digital implementation

Stepping back a bit from the bit-level digital compression presentations was Bill Nash, TCI project engineer on compression technology, who related findings

on TCI's digital compression field tests in Colorado. The good news: Nash said all indications point to successful digital signal carriage if all FCC performance specifications are met.

"Systems meeting FCC performance standards should be home free for digital," Nash said. Potential system performance problems encountered during TCI's digital compression trials included interference from terrestrial microwave links into C-band satellite downlinks; inadequate performance of some older low-noise block downconvertors; excessive phase noise in some types of AML systems; and direct pickup, ingress interference and reflections in drop cables, connectors and consumer-installed equipment.

Brian Bauer, applications engineering manager at Raychem Corp., detailed the potential performance problems in drop line and inside wiring. Splitters, for example, are likely to be a major cause of reflections, which result in intersymbol interference in digital signals.

Other sources of potential interference to digital signals include loose F-connector fittings and customer-installed cables with inadequate shielding, which could cause noise from motors and radio signals from pagers to enter the system and cause interference, Bauer said.

However, both Bauer and Nash agreed that adaptive equalization techniques in digital set-top boxes should correct for those reflections.

Optical technologies

Fiber optics, for many years the featured attraction of the Emerging Technologies conference (back when it was called the "Fiber Optics" conference), still dominated a significant portion of the conference schedule. Topics within that segment ranged from SONET-based regional interconnects and passive optical networks to fiber feeder cable and fiber organization within the cable headend.

During a discussion related to advanced network development, Time Warner's Senior VP of Engineering and Technology Jim Chiddix unveiled a new concept being considered to drive fiber deeper into the neighborhood.

Dubbed "fiber deep," the new design aims to serve nodes of 150 homes or less. "We would still bring a single fiber into a neighborhood of about 500 passings," Chiddix explained, "but the idea is to then split that to feed several different nodes with the same signals."

The idea of "fiber deep," Chiddix said, is to make the system more reliable and flexible. "Feeding four, low-cost nodes instead of one central node reduces the

Ad Index

Product Showcase

amount of coaxial plant necessary, so system reliability is increased," Chiddix said. In Time Warner's Kansas City, Mo. model, for example, outages totaling nine hours per year were reduced to 1.3 hours per year after implementing the "fiber deep" approach. "That closely approaches the 99.99 percent reliability number we're all striving for," Chiddix said.

Chiddix also related "encouraging results" from Time Warner's Orlando, Fla.-based experiments in using the 900 MHz to 1 GHz spectrum for reverse signal transmission from the digital set-top to the headend. In Orlando, Time Warner has tested the higher band upstream transmission capability instead of the traditional 5 MHz-35 MHz subsplit, Chiddix said.

In a discussion following the conference, Chiddix said Time Warner is investigating three different methods to handle two-way transmission. "It's an important consideration for the industry," Chiddix said, because of forthcoming video telephony, PCS and other, unforeseen applications.

In addition to the high frequency return experiment in Orlando, Time Warner will also be testing an expanded subsplit (from 5 MHz to 42 MHz), and spread spectrum technology developed by Unisys for military defense applications. The latter test will be conducted in conjunction with CableLabs at its Louisville, Colo. location over the next four months.

If you build it . . .

But what of two-way communications, deep fiber deployment and advanced, self-healing cable networks: will subscribers want and pay for the onslaught of new services the emerging technologies enable?

That was interactive TV expert Gary Arlen's question during a luncheon address, where he rattled off a historical list of almost a dozen failed, '80s-era interactive ventures–or, as he put it, his"hall of shame" entries.

Will history repeat itself in the '90s? Probably not, according to Arlen. Instead, interactivity will likely thrive in the '90s, because of technological innovation, home preparedness and "the Nintendo generation."

"Soon enough, the ideal subscriber won't be the couch potato, but the mouse potato," Arlen said. "This person goes far beyond the power zappers to the people who love to point and click."

He cited a survey of families with earnings over $35,000 a year as further evidence of interactivity's potential. In that survey, 26 percent said they'd be "very interested" in interactive services; 40 percent said they were "somewhat interested."

Still, hovering in and even among the throngs of engineers at this year's event were competitive forces–and questions.

In fact, most attendees ignored the beckoning Arizona sunshine to sit-in on a panel titled "Who are these guys?", which included representatives from two RBOCs, an MMDS provider, a DBS provider and a 28-GHz technology provider.

Each panelist provided an overview of his company; a lively question and answer period followed which challenged moderator and Post-Newsweek Cable VP of Engineering Ted Hartson's glib insight–"the cable industry has more bandwidth by accident than the telephone industry has on purpose."

Which contender did attendees find the most scary? According to a Hartson's "applause-o-meter," where attendees clapped for the panelist they found most disconcerting from a competitive perspective, it was the telcos–and specifically, Pacific Bell. . . . CED

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The issue: Proof testing redux

By now, cable systems with more than 1,000 subscribers should have completed the third round of technical tests mandated by the FCC. A year ago, technicians performed the tests and often found a lot of network shortcomings. This month, we'd like to know how you feel about the tests and whether you think your system has improved over the past 12 months.

The questions:

1. Has your system completed the mandated proof-of-performance testing for January/February 1994?

❒ Yes ❒ No ❒ Don't know

2. Do you think the results gathered during the test reflect the overall performance of the entire system?

❒ Yes ❒ No ❒ Don't know

3. How do the results from this latest round of tests compare to last year's results?

❒ Same ❒ Worse ❒ Better ❒ Don't know

4. Do you think you have the proper resources (manpower and equipment) to perform these tests regularly?

❒ Yes ❒ No ❒ Don't know

5. Have you made any changes to your preventive maintenance program since the advent of the tests last year?

❒ Yes ❒ No ❒ Don't know

6. Do you think the current method of testing causes too many service interruptions, even if they come late at night?

❒ Yes ❒ No ❒ Don't know

7. Do you think performing the tests twice a year is necessary, or would one test annually be enough?

❒ One's enough ❒ Two's OK ❒ Don't know

8. Roughly how many manhours were required to complete the proof tests, including the documentation?

_______________ manhours

9. Is this more, less or about the same amount of time you anticipated to spend doing the tests?

❒ More ❒ Less ❒ About same

10. Are you required to submit the test results to your local franchise administrator?

❒ Yes ❒ No ❒ Don't know

11. If so, has your local franchise administrator consulted with you or requested more information about the tests?

❒ Yes ❒ No ❒ Don't know

12. Has your system been tested by an independent consultant or engineer?

❒ Yes ❒ No ❒ Don't know

Your comments about testing:

FAX US

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Make a copy of this page and fax it back to us at the number above or mail it to *CED*, 600 South Cherry Street, Suite 400, Denver, Colo. 80222.

We will tally the results and print them in a future issue. Your suggestions for future questions are always welcome.

We also want some written comments from you on this subject. Names won't be published if you request your name to be withheld, but please fill out the name and job information to ensure that only one response per person is tabulated.

Your name and title:

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Your MSO:

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Your job function:

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Results

Operators who have systems covering more than a single geographic community are increasingly interested in interconnecting those facilities to save money and reduce redundant facilities, according to our survey on interconnects. Importantly, operators are also increasingly interested in cooperating with a neighboring operator to cover entire geographic areas, the survey reveals.

While only 17 percent of the respondents said their system was interconnected with another operators', two-thirds of those responding say they are considering such an interconnect and 83 percent say they think their neighbor would welcome such an arrangement.

Why? Most operators are intrigued because of the prospect of additional revenue through data transfer or advertising sales over their systems, the survey points out. Some respondents even said the advent of telephony over cable would be greatly facilitated through such interconnects.

All respondents said interconnects will be very important in the future, and that proprietary approaches to issues like signal security can be overcome through technological advances to make interconnects more feasible.

The issue: Interconnects

During the Atlantic Cable Show last October, an enlightening panel session focused on interconnects both within a cable system and between neighboring cable systems. Interconnects will likely become an important issue if cable operators want to be the conduit through which data and voice services flow across the country. But are cable operators ready to approach business opportunities cooperatively? This survey intended to find out.

The results:

1. Does your system geographically cover more than one community?

Yes	No	Don't know
83%	**17%**	**0%**

2. Does your system have multiple headends serving the local franchise area?

Yes	No	Don't know
33	**67**	**0**

3. Does your system use microwave to deliver television signals throughout a wide area?

Yes	No	Don't know
17	**83**	**0**

4. Has your system considered interconnecting adjacent cable plants with fiber optics (or already completed an interconnect project)?

Yes	No	Don't know
83	**17**	**0**

5. Do you think an interconnect could save your system money over the long term?

Yes	No	Don't know
67	**17**	**17**

6. Has your system considered interconnecting with neighboring system(s) owned by another MSO?

Yes	No	Don't know
67	**33**	**0**

7. Is your system already interconnected with a neighboring MSO?

Yes	No	Don't know
17	**83**	**0**

8. Do you think your neighboring MSO would welcome the opportunity to interconnect with your system?

Yes	No	Don't know
83	**17**	**0**

9. Do you think it's important to interconnect with a neighboring MSO for business reasons (data transfer or advertising interconnect)? In other words, would an interconnect bring you more revenue?

Yes	No	Don't know
83	**17**	**0**

10. Why or why not? (multiple answers allowed)

Ad sales	Data transfer	Telephony	Other
83	**17**	**17**	**34**

11. In your opinion, how important will interconnects be in the future?

Important	Not important	Don't know
100	**0**	**0**

12. Do you think cable operators can overcome individual approaches (i.e. signal security) and interconnect their systems effectively?

Yes	No	Don't know
100	**0**	**0**

13. Do you think the technology exists to effectively integrate two neighboring cable systems?

Yes	No	Don't know
100	**0**	**0**

Your comments:

"Interconnects must be made for more system reach, i.e.: data transfer for banks, etc."
– John Wallis, Adams CATV of northeastern Pennsylvania

"I like the concept of a super headend. With the huge increase in bandwidth, we'll be able to effectively target smaller markets."
– Elmer Day, Northeast Cable, Dunmore, Pa.

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Telco vs CATV battles: A review

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

Almost from the beginning of time (CATV time, that is) the telcos have contended that distribution of video by wire was their divine right, ordained at the creation of public service commissions.

Some time in the 1950s, we stumbled upon a confidential internal Bell System feasibility study, analyzing not only the technology of wired video, but the politics and economics as well. Clearly, the 500 or so CATV systems then in existence, with a combined total of fewer than 500,000 subscribers, were perceived as trespassers on sacred turf.

The 1956 Consent Decree

In 1956, AT&T and the U.S. Department of Justice signed a Consent Decree resulting in the dismissal of antitrust litigation initiated in 1949. AT&T agreed to limit its activities, and those of its Western Electric manufacturing subsidiary, to the field of tariffed and regulated common carrier telecommunications services. Before the divestiture order in 1982, the Bell Telephone Companies were part of AT&T. Therefore, they could not provide unregulated CATV services directly to the public, although CATV operators felt like they were indeed regulated by FCC and municipalities. Non-Bell companies, such as General, United, Continental, and others were free to establish CATV networks, frequently within their own service areas. And they did.

Then, about 1963, Frederick W. Ford, then chairman of the FCC and later NCTA president, advanced an idea based on Section 214 of the Communications Act of 1934, as amended. Section 214 relates to the extension of communication lines to provide common carrier services under strict regulation and public tariffs. This provided the legal basis for the so-called "leaseback" services offered to potential CATV operators by several Bell companies in the late '60s and mid '70s.

Cable TV is a capital intensive business, and the leaseback was particularly attractive to capital-starved cable operators, or canny investors who saw the opportunity to tap into the enormous financial resources of the Bell System. It was a great idea, but the devil was in the details.

The plan was for the telco to construct the plant, and assume responsibility for performance, from headend multiplexer to subscriber tap. The lessee, i.e. operator, would be responsible for contstructing and maintaining the headend, and for all dealings with subscribers, including marketing, sales, installs, disconnects and trouble calls. The Section 214 tariffs established a fixed monthly lease payment, per channel, based on plant mileage. No allowances were provided for varying degrees of penetration. Thus, if a military base was closed down, the operator took the hit, since the lease payment was fixed for 15 to 20 years, regardless of revenues.

The telcos were heartless landlords. When the city demanded an increase in channel capacity or new services, the telcos refused to upgrade the system until the plant had been fully amortized over the "normal" 15-20 year life. After all, the telco was not subject to city franchise requirements.

The surprising thing was that the telcos, who were highly regarded for their technical and maintenance expertise, did a very poor job of constructing CATV networks. In one case, they designed the network based on the architecture once proposed but quickly abandoned by Jerrold, using alternating channel loop-through connection of headend processors with negligible isolation. It did not work, and the telco refused to provide the additional amplification required for what should have been considered conventional multiplexing.

Perhaps even more difficult for the operator was the divided responsibility for service. The lessee was obligated to make the initial response to trouble calls, and to make any repairs indicated in the headed, service drop or customer premises. If the fault were found (or suspected) to be in the distribution network, the service technician could notify the telco service department, which would put the problem in the queue for processing along with all other telco service problems.

Of course, this led inevitably to controversy as to whether the fault was in: (1) customer owned equipment; (2) the service drop; (3) the headend; (4) the originating signal source; or (5) the leased facilities. The operator was not supposed to conduct tests on the telco plant. Naturally, the telco repairman was likely to contend that the telco plant was not at fault.

By the mid 1970s, the telcos began selling back to the operators their television plant, overlashed on telco strand. The operators then would have to rebuild in order to provide the required 12-inch clearance.

MFJ and divestiture

Then, in 1982, came another AT&T consent decree and the Modified Final Judgment (MFJ) in settlement of antitrust litigation initiated in 1974. AT&T was required to divest its local telephone operations, the Bell Operating Companies (BOC). The 1956 Consent Decree was modified to give AT&T the conditional right to expand into new markets for information processing equipment and services. The remaining restrictions imposed by the MFJ, the FCC, the Cable Act of 1984 and others on telco entry into cable TV are rapidly being dissolved by the courts, Congress, and the FCC.

The principle is often expressed, even by legislators and regulators, that as the barriers to telco entry in cable fall, barriers to cable entry in telephony must also fall. It remains to be seen whether this will happen with effective symmetry, and whether cable TV can muster the necessary capital and technological skill to take advantage of the unfolding opportunities. CED

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