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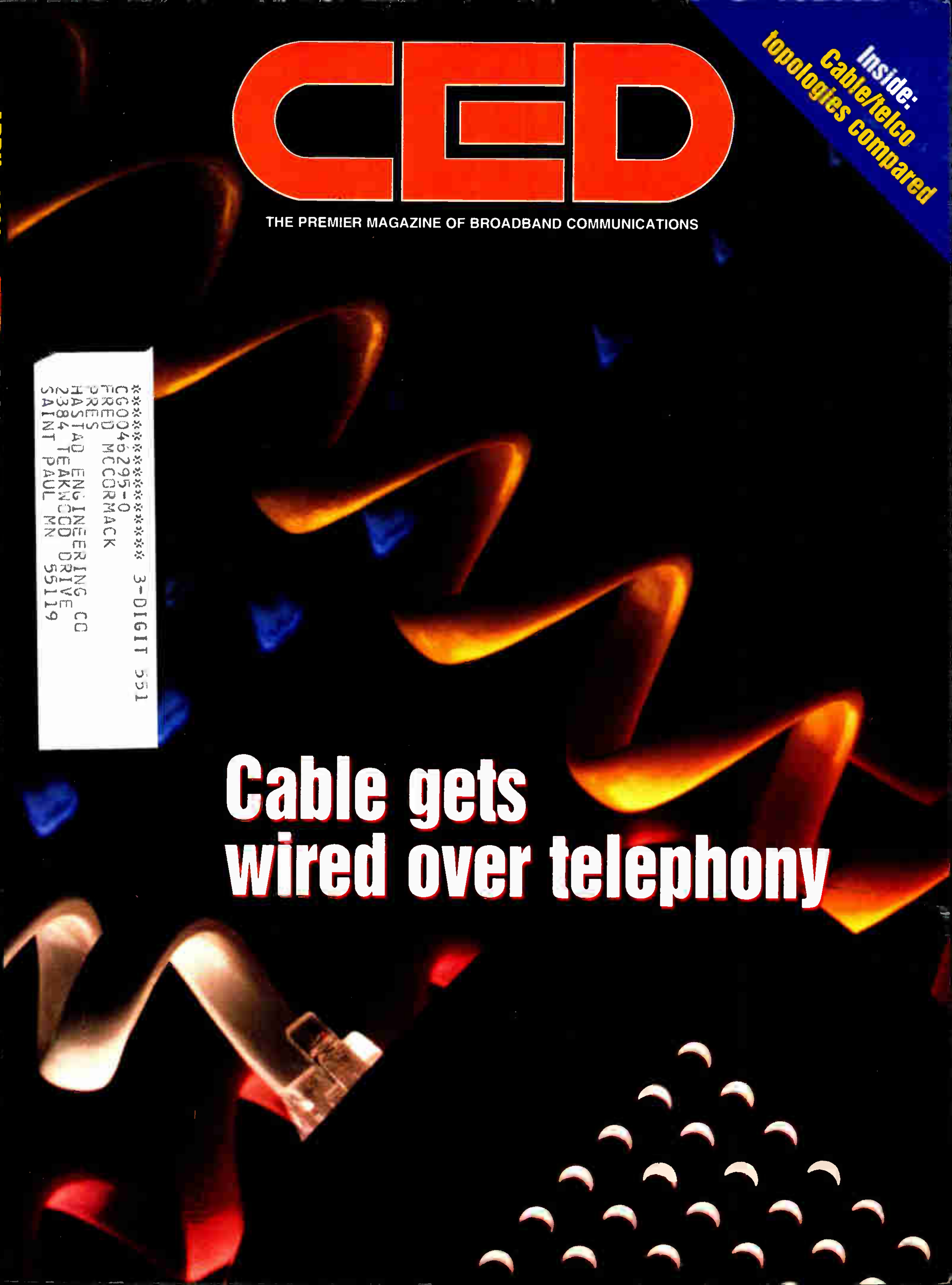

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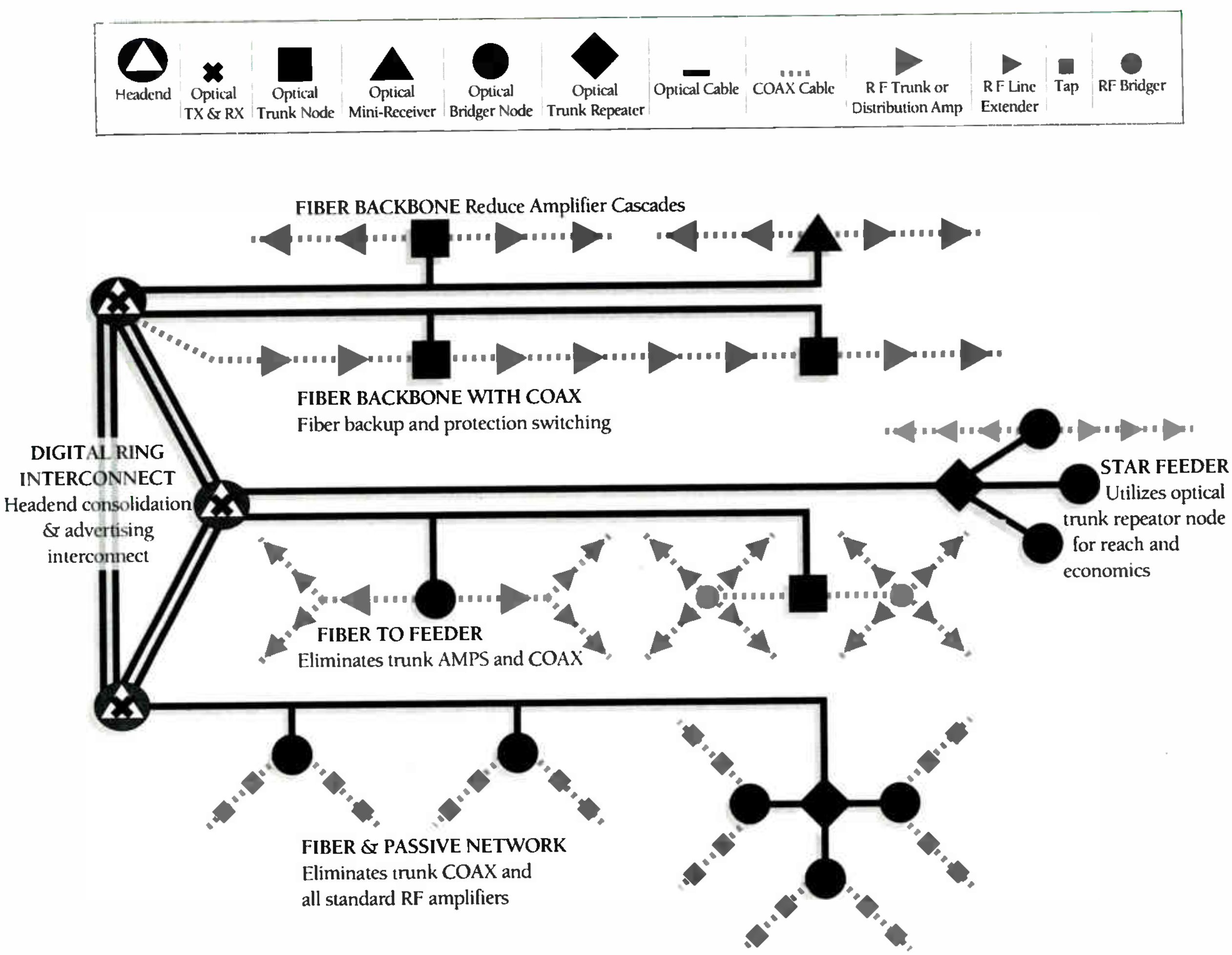

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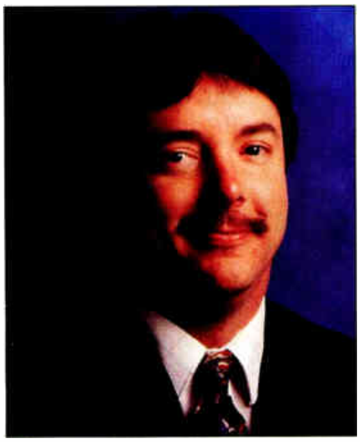

Global alliances: The next convergence?

Just as only a few people accurately predicted five years ago that the cable and telephone companies would come together in a series of mergers and joint ventures, there are perhaps fewer still who realize another convergence must occur before the potential of a ubiquitous, high-speed communications network can be fully realized. But at least one executive from a telecommunications giant predicts that a global convergence of ideas, cooperation and technology will be necessary to get everyone wired for the future.

Dr. Tsuneo Nakahara, vice chairman and deputy CEO of Sumitomo Electric Industries, was brought to Denver recently by the Scientists' Institute for Public Information, a national non-profit group that is attempting to improve American media access to leading Japanese experts in science and technology.

Nakahara's message is simple: Cooperation between globally-minded people is the best method available to evolve present-day communications technology into a shared information superhighway such as the one currently under development here in the U.S.

Nakahara argues that it's difficult for companies doing business in mature industries to compete in technologically advanced countries like the U.S. and Japan because labor and benefit costs are very high; in order to grow, these industries must innovate and seek to improve customer service.

In order to innovate via delivering new services to consumers, the communications and photonics industries should make a greater effort to share information, hardware and software across the Pacific. He also said that for global connectivity, common protocols and standards similar to the OSI model will be needed.

Nakahara argued that Japan brings a lot to the table in terms of innovative services. While the Clinton Administration is the first in decades to make communications policy a priority here in the U.S., Japan has been actively installing fiber, testing new hardware and trialing new multimedia services like interactive shopping, distance education and video karaoke. A "fiber to the office" trial connecting 100 companies with a high-speed digital fiber link has already illustrated the benefits of inventory control, shared pricing information, videotext and stock quotations to merchants; and a new trial that includes ATM switches connecting to high-fiber-count cables (1,000 fibers!) will bring full motion video to that testbed.

It's clear that in some areas, Japan is ahead of us in optical communications research, while we lead in other areas. Nakahara argues that there is little reason to fear Japan; that more can be gained by jointly sharing info and not reinventing the wheel. That idea may be troublesome for U.S. companies that have historically tried to protect their turf, but that type of protectionist thinking doesn't help anyone, Nakahara argues.

He may have a point. The cable companies and telcos fought for years over almost everything, until each had a significant benefit to offer the other. Now cooperation and joint ventures have become the norm and have fueled growth, interest in new services and a lot of innovation. Hmm . . . .

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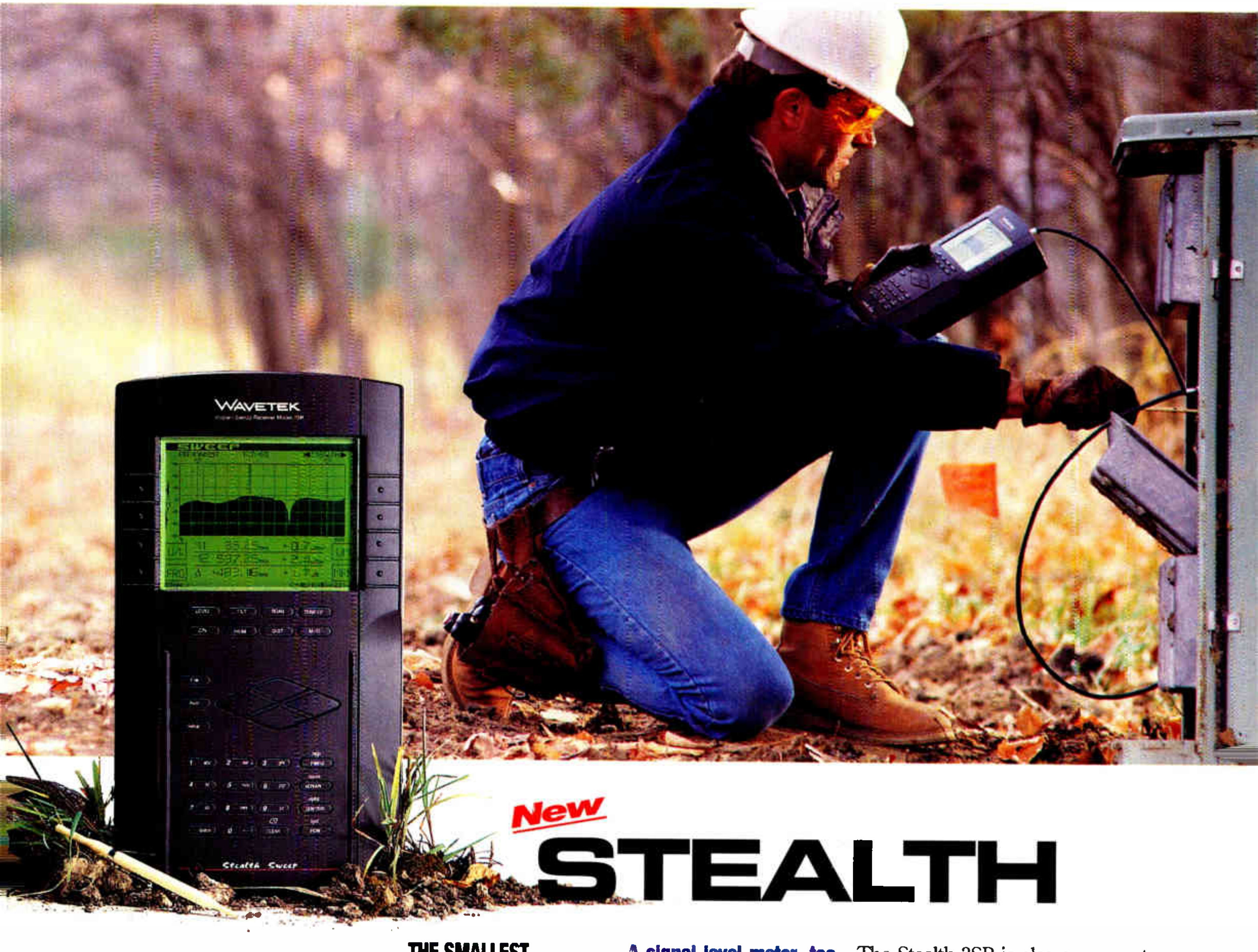

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Cablevision seeks to catch big fish in its high-speed long Island net

Cablevision's Long Island fiber network

While most are sitting back debating the merits of a national information "superhighway" and discussing who will build it, Cablevision Systems Corp. has already built a regional, high-speed interactive fiber network on Long Island to serve medical and scientific applications.

Cablevision unveiled the development of "FISHNet" (Fiber-optic, Island-wide, Super-High speed Network), which is one of the first to use Asynchronous Transfer Mode (ATM) to link facilities. On Long Island, Cablevision has linked the Brookhaven National Laboratory, State University of New York-Stony Brook and Grumman Data Systems, which is the system integrator.

FISHNet is the first real-world non-entertainment use of a planned $300 million, 3,000-mile network planned for the metropolitan New York City and Long Island areas. The development of FISHNet comes about one year after Cablevision announced its plan to build that 750 MHz fiber backbone.

Applications of the network included telemedicine, an application that is often touted at conferences and seminars that focus on the development of a nationally interconnected network capable of sharing high-speed data and images.

A demonstration arranged for members of the press included the delivery of an X-ray to physicians at Stony Brook's cardiology department via the ATM link and imaging software developed at Grumman from the Brookhaven Laboratory; a radiology/oncology exam in which doctors at Brookhaven and Stony Brook conducted medical image manipulation and real-time conferencing; and a groundwater prediction model in which researchers who track the movement of pollutants in groundwater used the ATM link to access the supercomputer located at Stony Brook.

In the future, it is anticipated that links to FISHNet will be added throughout the Long Island area as more hospitals and laboratories become familiar with its capabilities, said Cablevision officials, who anticipate that the network will one day create a medical and educational information systems for the New York area.

Zenith's technology chosen for HDTV

In what could only be characterized as a huge win for Zenith Electronics Corp., the HDTV "Grand Alliance" has chosen the company's VSB digital modulation technology as the method of choice for both terrestrial broadcast and cable television distribution of HDTV signals. Broadcasters will use 8-VSB, while cable will be able to enjoy 16-VSB, which allows two HDTV signals to be placed in a single 6-MHz channel slot.

The selection followed formal laboratory testing of both the VSB and General Instrument's QAM systems which were proposed. The VSB system was chosen because it performed better during the tests. Key factors were HDTV coverage area, signal robustness and the ability to avoid interfering with existing analog television broadcast signals.

The technology still must be further refined to ensure compatibility with MPEG 2 data packets and adaptive equalization developed by GI for its QAM system. A field test of the system is scheduled to take place later this year in Charlotte, N.C.

The announcement is the final technological piece of the puzzle. The Grand Alliance previously announced plans to use MPEG 2-based compression and packetized data; a variety of scanning formats to accommodate both computer-friendly progressive scanning and the traditional interlace scanning preferred by some broadcasters; and audio featuring CD-quality surround sound.

Just five days before the Grand Alliance announced its intention to use VSB technology, Zenith licensed its system to General Instrument, which developed the QAM system that was also tested. In fact, the two traded licensing agreements, with Zenith gaining the right to integrate GI's DigiCipher technology into its cable set-tops.

Already, Zenith and LSI Logic are developing the key digital chipset for the 16-VSB system, which reportedly transmits and receives digital info at 43 Mbps, a rate that is 33 percent faster than 64 QAM systems and twice as fast as 32 QAM approaches. Depending ont he amount of compression used, the 16-VSB decoder can shoehorn as many as 23 movies or nine live video events in a single channel.

In addition, Zenith is working with Raytheon Semiconductor to develop the IF amplifier/demodulation IC for set-top decoders. Specifically, this chip will handle the AGC and frequency phase lock loop functions. Raytheon officials say the chip should be in volume production by the third-quarter of this year.

CableLabs plans compression test lab

Two weeks after hosting an educational conference on the deployment of digital technolgy, Cable Television Laboratories announced it intends to establish a testing facility to verify the interoperability of different MPEG 2 compression systems.

The project will likely utilize CableLabs' facility in Louisville, Colo. as an international venue to test and verify different bitstreams and their ability to interoperate among each other. The tests would involve MPEG 2 syntax compliance of hardware and software components and the development of a suite of increasingly difficult bitstreams to determine decoder semantic compliance and performance.

Tests would be performed on transport streams at the system layer level using a common, agreed upon interface in order to test multiplexed video, audio and data. Tests would be performed after demodulation and other distribution specific technology. This is seen as a possible first step toward testing encoders and decoders end-to-end as well as

impairment testing.

"Digital compression is a keystone of the networks of the future and MPEG is the digital television standard for the next century," said Dr. Richard Green, CableLabs president and CEO. "Now that the technical work on MPEG 2 is over, (we) must work to assure that software and networks are compatible."

In early February, CableLabs hosted a two-day conference in Dallas for about 140 attendees that featured tutorials on digital technology followed by a case study that examined business issues as they may impact short-term operations.

"Our goal has been to foster convergence of digital compression technology," said Green. "Convergence provides a clear path to interoperability within the cable industry and beyond to other distribution platforms."

Time Warner plans to buy 1M S-A boxes

Meanwhile, Time Warner announced its intention to purchase up to 1 million analog addressable set-tops from Scientific-Atlanta over the next three years as it moves to add addressable capability throughout its systems nationwide. As part of the agreement, S-A will provide its new 8600^x terminal, which features on-screen menus, messaging and other advanced features, including a smart-card device that can be used to upgrade its functionality.

Terms of the agreement, which includes a "firm purchase order" for 500,000 units, were not disclosed. However, observers pegged the value of the deal at between $120 million and $140 million, depending on the volume discount that was negotiated.

The deal is easily the largest single order for analog boxes in recent memory and signals Time Warner's strategy for increasing the number of addressable households throughout its networks.

Meanwhile, Adelphia became the tenth MSO to order DigiCable digital set-tops from General Instrument Corp. Adelphia plans to purchase 120,000 set-tops, a deal worth a reported $30 million, according to a press release issued by GI.

Other MSOs that have already committed to purchase set-tops from GI include: TCI, Comcast, Cablevision Industries, Cox Cable, Newhouse Broadcasting, Sammons Communications, Century Communications, TeleCable and Canadian MSO Shaw Communications. GI has licensed its digital compression technology to Zenith and is negotiating licenses with S-A and Hewlett-Packard, both of which received set-top orders from TCI last December.

On the transmission side, Jones International announced it has selected GI's DigiCipher system to compress educational programming over SatCom C-3, transponder 20. By implementing digital transmission, Jones intends to launch an "education constellation" that links universities, libraries and other resources from around the world.

Jones Computer Network will launch as a full-time network on the transponder later this year, expanding from a nightly four-hour service. SatCom C-3 will also be used to launch two new educational networks devoted to languages and health.

Time Warner delays Orlando FSN launch

Finding the task of integrating disparate technologies into a single network, Time Warner Cable announced last month that is has postponed the launch of its highly touted interactive cable system in Orlando, Fla. until later this year. However, Time Warner officials insist they'll have the first 4,000 subscribers hooked up by the end of 1994.

> **"Both the hardware and software are perhaps more complex than we realized in January 1993".**

"We always knew the (April) deadline was ambitious," said Jim Chiddix, senior VP of engineering and technology for the MSO. "But both the hardware and software are complex–perhaps more complex than we realized in January 1993" when the deadline was established.

Chiddix said delays in development of custom integrated circuits for the powerful in-home set-top terminal was the primary reason for the delay. These ICs perform a number of critical functions inside the feature-laden devices. However, he said the delay shouldn't be considered a failure. "It (the full service network) will still happen," he said. "I'm entirely confident the approach is sound."

Scientific-Atlanta which, as system integrator, has the challenge of integrating Silicon Graphics' Indigo workstation ICs into its unit, also downplayed the delay. Gary Trimm, president of S-A's Subscriber Systems Division, said: "You have to remember that the Orlando box is essentially a workstation. There are a lot of rivers to cross (to integrate all the functions Time Warner has asked for into the device) and some haven't been crossed before."

Jottings

The breakup of the TCI/Bell Atlantic merger apparently re-opened the door to a much-rumored **TCI/Microsoft** relationship that will now result in the two companies testing interactivity and creating a new programming channel geared toward personal computers. The two companies announced last month that they will work together to test interactivity via new software developed by Microsoft over TCI's digital networks in Denver and Seattle. The new network will be dedicated to PC users, including magazine format shows and home shopping . . . **Ameritech**, the regional Bell company based in Chicago, has created a joint venture with British Columbia Systems, a company owned by the British Columbia government in Canada, to bring on-line access to a variety of vital records to governments in the U.S. and elsewhere. The venture, called Ameritech Information Access, hopes to offer PC-based service later this year . . . **Pioneer, General Instrument, Scientific-Atlanta** and **Philips** all announced that they plan to work with **Oracle** to ensure their set-tops will work with Oracle's new multimedia software . . . **Wegener Communications** and **News Datacom** will jointly develop and market encrypted transmission systems featuring Wegener's audio and video products and News Datacom's "smart card" conditional access system . . . To commemorate its 25th anniversary, the **SCTE** is sponsoring a nationwide new-member drive during which one sponsoring member will receive a free registration, lodging and up to $500 in travel expenses to attend the Cable-Tec Expo in St. Louis in June. Applications are available by calling 610/363-6888. The winning name will be drawn May 1 . . . **Texas Instruments** has demonstrated a digital prototype of a high-definition display system based on proprietary technology that promises to make high-quality projection TV systems a reality. The progressive scan system projects images up to 12 feet high in the 1920 x 1080 HDTV format . . . **Optibase Inc.** of Dallas says it is now shipping its real-time MPEG 1 encoder, what it calls the first real-time MPEG encoder for the PC/AT platform. CED

–Compiled by Roger Brown

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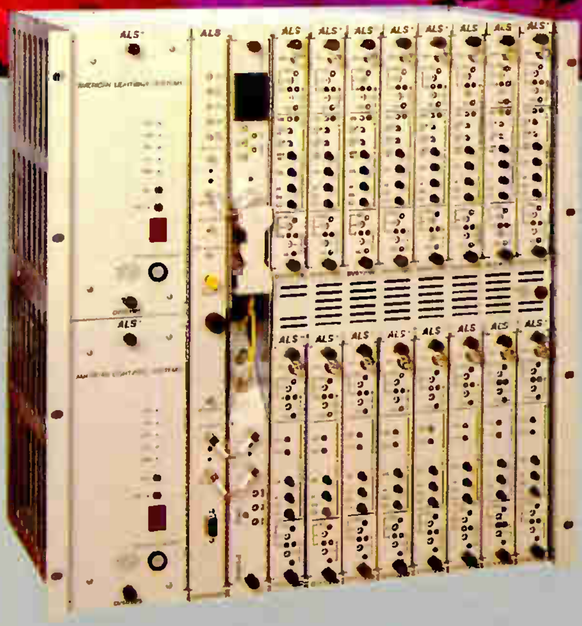

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Skinner: Pioneering telecom change

By Leslie Ellis

It's not by accident that Russ Skinner, the 20-year cable hand renowned for his trademark brown Stetson with the rattlesnake band, is riding a different herd these days. As director of video engineering for US West in Boulder, Colo., Skinner is unarguably on "the other side of the fence." But, he's there by design: he wants to be a pioneer in the new frontier of telecommunications.

"I want to be a mentor, a teacher and a champion of the convergence of companies and industries," Skinner explains. "That's what turns me on: being part of the change."

If that kind of change is what Skinner's after, he's likely to be in a lather for some time. At US West, Skinner is in charge of designing and implementing the company's broadband trial in Omaha, Neb.; after that, he'll likely continue doing the same in other US West broadband projects.

But, being a pioneer isn't always easy, and Skinner is the first to admit it. After all, the very term–pioneer–is an earned moniker, usually describing someone who has toiled during sometimes blinding and almost always less than fortunate conditions. A pioneer enters a project with limited information, and creates something worthwhile.

That's exactly what Skinner aims to do for US West. It ain't gonna be easy, he says. A pervasive "us versus them" cable/telco mentality, uncertain technical standards, and limited knowledge of how customers will react to the telecommunications renaissance may fetter a smooth transition into the digital age.

"The 'us versus them' thing is not good. It doesn't accomplish anything," says Skinner. His elixir for the malady is an intensive "cross-pollination" of people from both industries. "We all need to work more closely together. We need more telephone people on the cable side, and vice versa," theorizes Skinner. "We have to jointly realize we'll never have a critical mass business if everybody's building something with a different plug on it, or a proprietary operating system."

Cable cowboy

Skinner, an admitted cowboy who likes to ride horses through the Rockies with his wife, Mickey, is by birth a Midwesterner from Columbus, Ohio. It was there he started in cable, in 1973, with ATC (now Time Warner Cable) as a technician and worked his way up to a corporate-level engineering position for the company, in 1980. He relocated to Denver and handled new construction engineering during that feverish franchising period. "It was in the days when we promised them everything and did it in 90 days," Skinner recalls.

In the mid-1980s, when the franchise commitments had been satisfied, Skinner turned to product development issues for the MSO, starting the laboratory which is now Time Warner Cable's R&D lifeline.

A few years later, United Artists offered Skinner an opportunity to get back into the thick of system design and engineering in its Montvale, N.J. system. The location didn't exactly suit him–"they looked at me like I was nuts when I walked in with my cowboy hat," he recalls–but the job did. Skinner was director of engineering for 14 United Artists systems, serving 1 million subscribers, when TCI stepped in and bought UA. "They took all the systems and almost none of the (corporate level) people," Skinner laments.

That was in 1990. Consulting work kept him busy following his severance from UA, but it wasn't enough for Skinner. So, in August of 1992, Skinner hired on with US West, eagerly anticipating a chance to put his broadband background to good use.

It hasn't been an easy adjustment. Skinner, accustomed to the entrepreneurial and growth-oriented pace of the cable industry, is often frustrated by the regulations which harness the telephone company.

"It's completely different. There are so many rules here about the way we have to do business, which can really be a burden. We lose competitive advantage from the get-go because of (FCC) 214 filings," Skinner explains.

A prodigious question

"If I had to pinpoint what the biggest convergence challenge is, it would be this: how do we get to the right magic? How do we handle standards, and consumer electronics compatibility, and make services easy enough for subscribers to use, so that they see our services as a real value?" asks Skinner.

There is no easy answer to that question, Skinner says, and "that's the problem. There's no single technological, architectural, regulatory or customer answer. We're all groping on how to get there."

One place Skinner does know how to get to is Omaha, Neb. Because of the trial, he spends a lot of time traveling there, with wife Mickey by his side as often as possible. Skinner laughs that because of their preference to share his industry connections, "she has more friends than I do." The two have a daughter, age 28, and two sons, ages 19 and 16.

But in a perfect world, the Skinners would be taking in the Colorado wilderness on horseback. "There's something to be said about observing nature on horseback," says Skinner. "You can move into a herd of deer, and they think you're just another animal. Go anywhere near the same herd on foot, and they'd be long gone."

And who knows–perhaps 10 or so years from now, Skinner can ride off into a Colorado sunset with the certain knowledge he desires: that he's pioneered a difference in telecommunications. CED

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How to avoid thinking "it's a job"

By Wendell Bailey, VP of Science and Technology, NCTA

On February 22, the FCC decided that its earlier efforts to put money back in cable customer pockets had not resulted in enough people getting a rate reduction. It therefore decided that a further rate rollback of seven percent was needed. This, added to the already established 10 percent rollback, is expected to produce a $3 billion savings for cable customers.

The news of this action may have been a major element in the decision by TCI and Bell Atlantic to dissolve their planned merger.

While many people may not have been happy about the planned joining of these two companies, we must all recognize that the telephone and cable television industries have more similarities than differences these days.

On the technical side, the architectural changes undergone by the telephone industry over the last decade have an impact on their operational capability, similar to the impact that the adoption of the fiber-based changes in our system layouts are having on our ability to deliver new services.

Working for a telco

The question that is most interesting to me, however, is this: if we all end up in a sort of cable/telephone business, then what will it be like to work with, and in some cases, for, a person who was raised and trained in the telephone world?

I don't know if I'm the right person to ask, seeing as how more than half of my working life has been spent in the telephone business (seven years at AT&T followed by eight years at MCI). While that career history may have had positive implications on the "me" you know now, it also may have scarred me in ways that only a shrink will be able to understand someday in the future. (Although, the way my current job in the cable business goes, I may need one sooner rather than later!)

The major area of difference between the two industries may surprise you. It's unions, and the way a union shop could affect the way you work. Most of the people working in the non-management, telephony jobs are members of one or more unions. For most of them, there was likely little or no choice in the matter. Based on my experiences, it's my guess that most of them were simply instructed that, since everyone else is a member, it would be best if they join as well.

"You have no choice, boy"

In my own case, for instance, I was told that I had to pay union dues–whether or not I believed in or wanted to join the union. Needless to say, that at the tender age of 20 and on my first full-time job, I felt there was little choice.

Life under union rules is distinctly different than what most cable people are accustomed to. I can clearly remember those distinctions. While assigned to work on a transmission test board, for example, one was simply not allowed to do any work or activity that was in another's area. Even if no one was available in the other area to take care of a simple repair or needed measurement, the task could not be performed–not even if a customer was left high and dry without service for a longer than necessary period of time.

As bad as this sounds, we became accustomed to it. If this situation occurred, which it often did, we simply told the customer that we would call them when the needed repairs were completed.

Compare this way of working with typical, daily situations encountered by cable's technicians. The issue for cable's technical foundation is more likely to be one of not enough time, tools or training for a particular job, and not rules preventing job-crossover.

If I learned anything about the differences between cable and telephony in my days with the old Bell System and MCI, it was that I'm the type of person who is much happier being allowed to do what I can for the customer, no matter what segment of the plant held the trouble, nor whether I needed more time or resources. The times that my colleagues and I had to make customers wait for repairs because of union rules was not only frustrating, but largely depressing.

Telco training abounds

In case anyone reading this wonders whether or not my fellow test board co-workers were competent to perform the measurements or repairs needed, let me just say this: YES. One thing workers received in abundance within the old Bell system was a chance to go to school. If you wanted to, and your supervisor agreed, you could get a lot of training, and meet a lot of interesting people. But, being trained and tested in different areas gave you no right to adjust and measure there, if that was not your assignment for the day. Go figure.

So, if there are more cable/telco joinings to behold, we will all have to decide if the management style and union work rules are things we can learn to live with, or if our method of doing things is agreeable to people from the telephone side.

One thing I may have failed to mention is that the inability to do everything to satisfy a customer was not universally disliked. In fact, that one single factor led me, after seven years at AT&T, to take a chance with then start-up company MCI. Too many of the people I shared a shift with were starting to actually believe that work rules were the reason they were employed, and not service to customers.

I hope that those of you in the cable TV industry who have worked so hard to make this business what it is–even when less than completely trained and short on the resources you need–never get to the point where you forget why we are here...to satisfy customers. CED

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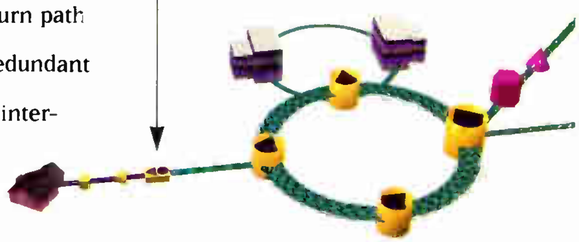

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Circle Reader Service No. 8

Cable telephony: operational considerations

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

A few months ago Jones announced a major telephony trial, in partnership with MCI and Scientific-Atlanta, that would take place in a couple of our systems beginning in 1994. The trial has been both rewarding and invaluable, because of our in-depth preparation and experience providing switched residential and commercial telephony in the UK.

Combine with that the knowledge we've gained in our experience provisioning for Internet access, and LAN/WAN interconnectivity in several of our systems, and it's clear to see that we'll need to examine practically every aspect of our business to ensure that the products and services we provide have both the quality and reliability that is expected.

Telephony and data communications services, because they are considered "life-line" services, will dictate across-the-board changes in the way we run our businesses.

Let's face it, it's a high-speed digital world out there, and most of our technical associates are simply not familiar with the test equipment or the methodology for dealing with such signals. This is true both at the RF level, with new modulation techniques such as QPSK, QPR, QAM, or multi-level VSB, and at the bit-level in dealing with a multitude of protocol "standards." Forward and reverse plant "commissioning" by our technicians for these types of signals will be somewhat different than the current requirements for today's AM-VSB video services.

Installers may often be asked to not only hook up cable TV service, but to install a new telephone line, and while they are at it to "hook up my computer (or LAN) for high-speed access to Internet."

Not only must these services be installed efficiently, but they must be extensively tested before bringing the customer "on-line" as a paying customer.

Non-invasive PM a key

Our procedures and processes, or the way we conduct business on a daily basis, will also change. This will be especially true in the preventive maintenance and service departments. "Non-invasive" preventive maintenance and service/troubleshooting techniques will be crucial to the success of these new services. Such techniques allow routine preventive maintenance as well as troubleshooting without disruption of service. While a good many operators in the industry have been working to perfect such techniques for a great many years through end-of-line and headend monitoring, for example, there is no doubt that as a whole, the industry could stand some improvement in these practices. While it will certainly be necessary to "bring-down" the network on occasion for certain purposes, the time of day (night) and the manner in which we do it, as well as the length of down time, might spell the difference between success and failure for us.

Trouble handling and escalation procedures will also be key. *Immediate* response to service interruptions will be necessary with technical and operations staff *on-duty* (as opposed to *on-call*) 24 hours a day, seven days a week. In these businesses, a service interruption to a *single* circuit or customer would be considered an "outage," and must be responded to with the same enthusiasm and vigor to correct the problem as we would respond to a major portion of the network being down. But what happens if we can't find the problem within the confines of our own network? Do we simply go about our business after telling the customer "Sorry, but it's a problem at the programmer's uplink facility and there is nothing we can do about it!"?

I'm sorry, but that line simply won't cut it when dealing with life-line services. Very specific procedures must be in place on the local level to escalate the problem to someone who can find it and resolve it in a very expeditious fashion. After all, when we are dealing with voice and data services, a network problem could reside practically anywhere in the world, including with such entities as the interexchange carrier, the local exchange carrier, another regional service provider, or the customer's own on-premises equipment or network.

Ongoing associate training essential

Through ongoing training for our associates and through modification to our provisioning and troubleshooting/maintenance processes, our perceived plant reliability, and therefore the quality of our customer contact, will improve dramatically. Our focus must then turn to the ongoing Operational Support Services (OSS) process that will be critical in a transaction-oriented telecommunications environment. This would include an infrastructure and process that would have the capability of such things as real-time transactional billing, and real-time theft-of-service analysis, real-time traffic analysis (how close are we to capacity and what should we do about it?), and real-time monitoring of both network and service quality.

In such a short column, I have been able to touch upon only a few of the hundreds of operational issues that must be considered as we forge ahead as telephony and data service providers. As you can see, provisioning for such services is not necessarily a "plug-and-play" operation.

As an industry, everything we do, and every process that we have in place today, will need to be evaluated and perhaps re-engineered for us to be successful. It will take significant time and resources to accomplish the task, but if we're successful (and I think we will be) the returns could be immense. I, for one, am looking forward to the challenge. CED

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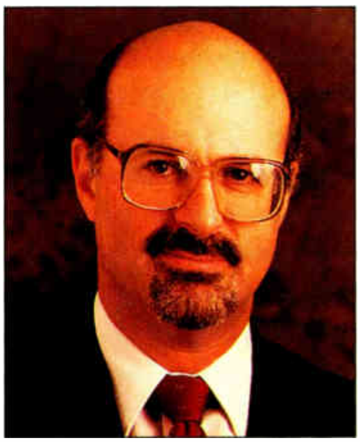
Circle Reader Service No. 9

What is privacy anyway?



By Jeffrey Krauss, a tow truck driver on the information superhighway and President of Telecommunications and Technology Policy of Rockville, Md.

Are private communications really private? Congress has enacted legislation to try to assure privacy. More legislation is pending. Some parts of the Government are trying to protect privacy, while others are trying to invade it. In practice a telephone subscriber has little privacy. And it may be getting worse.

Today, one set of privacy requirements applies to traditional cable operators. Other rules apply to telephone companies, and little or no restrictions apply to other firms that provide information services or private electronic mail services. It's illegal to listen to cellular phone calls, but it's easy to do and the prohibition is seldom enforced; on the other hand, it's perfectly legal to listen to cordless phone calls.

The 1984 Cable Act prohibits cable operators from monitoring the viewing habits of cable subscribers, or from collecting personally identifiable information about their subscribers, without subscriber consent. Cable operators may sell their mailing lists to third parties only if they have given their subscribers an opportunity to limit such disclosure, and if the disclosure does not reveal the viewing habits or other transactions of the subscriber.

Telephone companies have no such restrictions. The 1986 Electronic Communications Privacy Act (ECPA) prohibits eavesdropping on electronic mail, radio communications, data transmissions and telephone calls without consent, but it imposes no restrictions on the internal use by providers of an "electronic communication service" (e.g., telephone companies) of transactional records. Telephone companies are free to make any use of the identity of the parties to the communication or the fact of the communication.

Indeed, telephone companies are expressly permitted to disclose transaction information about a subscriber to any person, for any purpose, without notice or subscriber consent.

Automatic Number Identification

Firms that subscribe to 800-number and 900-number telephone services get monthly listings of every telephone number that called them, and can get real-time Automatic Number Identification (ANI) of the calling number. ANI is like a super version of Caller ID. ANI is used for billing and routing, account management and security purposes. For instance, cable TV systems can retrieve the account information of a pay-per-view customer as soon as the call is received.

The only state that regulates the use or sale of ANI data is New York. ANI information associated with an intrastate service in New York cannot be used to establish marketing lists or to conduct marketing calls. Firms may not resell or disclose ANI information to third parties unless there is prior written consent from the subscriber.

Wireline telephone calls have been protected from eavesdropping and wiretapping for years. The 1986 ECPA extended that protection to cellular calls, due to the lobbying of the cellular industry trade association. But cellular calls are not encrypted, and widely available scanning radios ("scanners") can receive these calls. Moreover, some cellular telephones can be put into "test mode" and configured to act as scanners.

Meanwhile, cordless phones, which probably outnumber cellular phones by a factor of 10 or more, are not protected by law. The same scanners can be tuned to the cordless phone frequencies, where listening is perfectly legal.

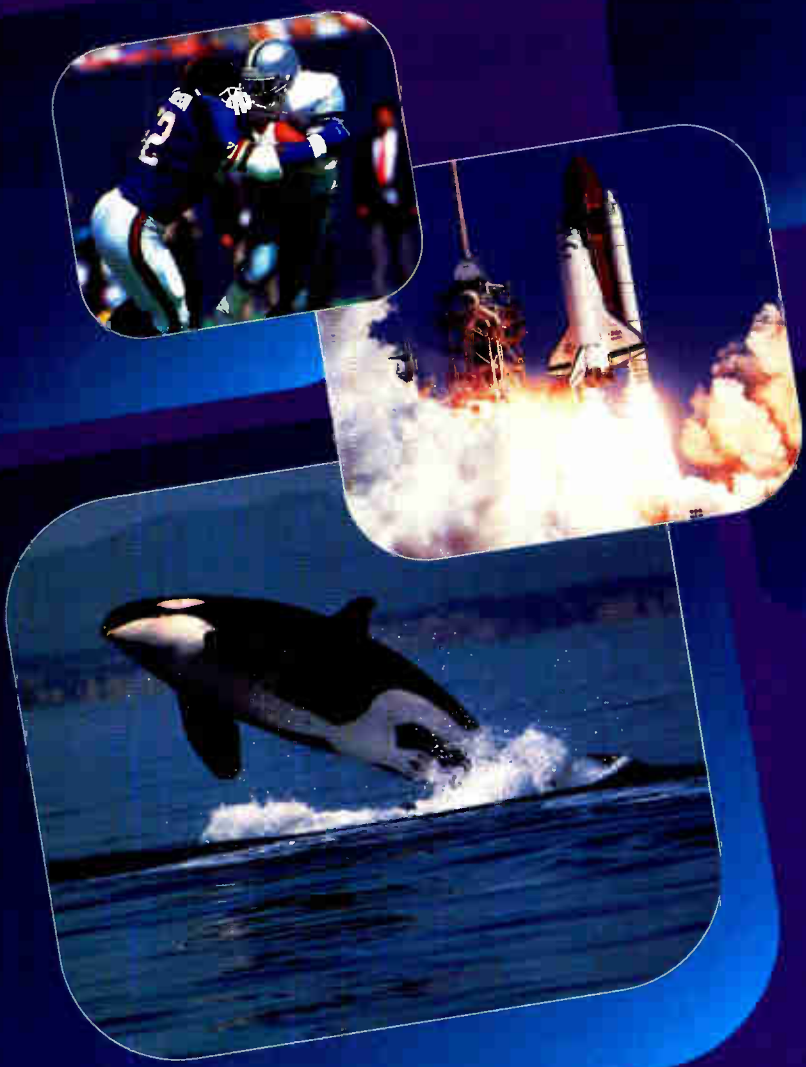
Telephone service offered by cable systems will have some of the characteristics of cellular service, since customers will have to share the cable's wideband capacity with other customers. With the right equipment, a cable telephone customer will have access to all of his neighbors' phone calls. Those neighbors that today use cordless phones won't know about this shortcoming, or won't care. Others will, particularly if the news media plays it up, or if Congress requires full disclosure. This could be a major marketing challenge for cable systems.

Electronic mail

While commercial e-mail vendors fall under the 1986 ECPA, private in-house e-mail is not protected. Employers can and do sniff around through employees' messages. As a result, there are numerous lawsuits pending, some because an employer found messages from an employee disclosing company secrets to a competitor. If you want to cheat on your employer, first look for the e-mail equivalent of a payphone.

While some branches of Government want to protect your privacy, others have the job of invading it. At present, there are restrictions against using certain kinds of encryption for international communications, but no restrictions for domestic communications. So you can encrypt your telephone calls, using suitable equipment, if you want to foil eavesdropping. But elements of the Clinton Administration are pushing for adoption of the "Clipper chip" technology, an encryption system that would allow Government agencies to eavesdrop on your encrypted calls. Government contractors would be required to use this technology.

You can expect to see continuing attempts in the next few years to harmonize the inconsistent privacy regulations. And customer privacy probably will be improved, at least with respect to billing records and data bases. But new technology and lack of enforcement enthusiasm will make it difficult to protect communications against unauthorized interception. Meanwhile, you might as well assume that they really are listening! CED



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Circle Reader Service No. 10

New engineering title: Technology futurist?

"Seeing" into the future with fiber

By Kathy S. Rauch, Cable TV Market Manager and Douglas E. Wolfe, Senior Applications Engineer, Corning Inc.

Already, before a single tollbooth has been constructed on the information superhighway, before another communications company has merged, converged or submerged, and before the 500-channel universe has been fully explored or even explained, significant change has occurred along the cable television technology landscape.

As a result, today's cable television engineering manager has inherited a new, unofficial job title: that of the technology futurist.

These enhanced responsibilities come at a time of unprecedented change in U.S. telecommunications history. With change comes challenge, posing a series of profound questions for every cable television engineer. These questions include:

✔ What network configuration will best serve our subscribers?

✔ How can large and smaller cable operators maximize capital investments in their infrastructures?

✔ What can I do now to ensure my competitiveness in the future?

✔ What new services are a good fit with my company's business strategy?

Figure 1: 1993 North American Cabled Optical Fiber

In responding to these questions, today's cable TV engineer is tasked with no less than designing the future of the cable TV industry. Optical fiber deployment has been a key component of the cable TV industry's network modernization strategy for several years, providing the means to reduce operating expenses and deliver reliable, enhanced signal quality to subscribers. Indeed, the operational benefits of fiber has made cable TV the fastest-growing fiber market segment in North America.

Cable TV now represents between 15 percent and 20 percent of the North American fiber market, up from just five percent in 1991 (see Figure 1). That position was achieved in large part by a doubling of fiber growth in 1992, and a near repeat performance again in 1993. Although estimates are difficult to calculate, it's safe to say that more than 10 million subscribers now receive their cable TV services through a network that includes optical fiber.

Fiber: How far is enough?

Most new construction or rebuilds of cable TV systems today rely routinely on a fiber-rich/coaxial hybrid architecture. This type of architecture has evolved from the all-coaxial networks deployed over the last 30 years to fiber-rich trunks and feeders that provide cable TV operators with the immediate benefits of improved signal quality and reliability, as well as reduced operating and maintenance care.

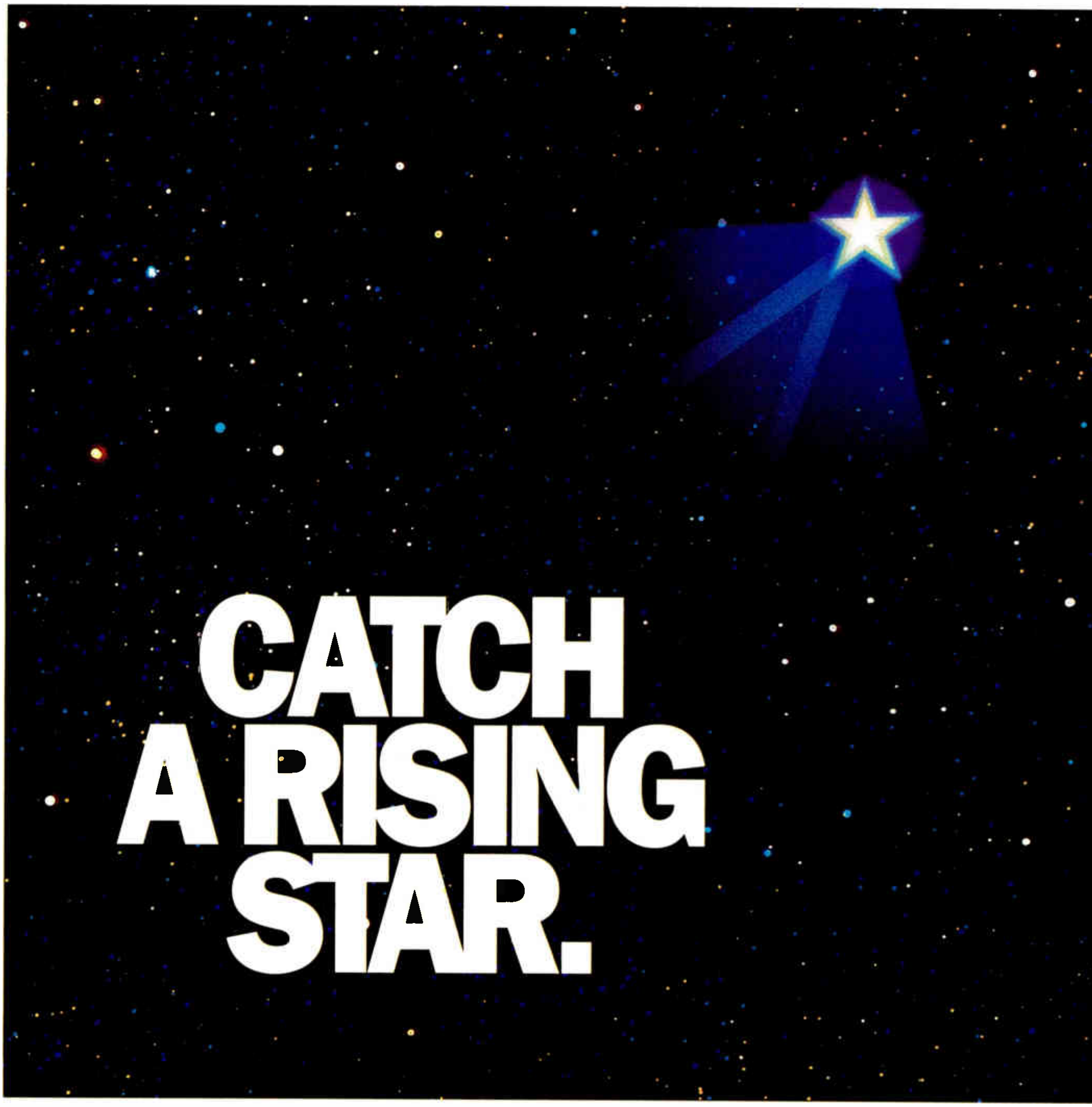
Cable TV operators quickly realized the operational benefits of combining fiber trunks with their high-bandwidth coaxial delivery systems, and node sizes were driven in large part by performance requirements (i.e., reducing amplifiers) and the cost of optical video transmitters. As commercial prices for optical video transmitters have come down, fiber has continued to provide cost-effective for smaller and smaller subscriber serving areas. But another consideration is driving node sizes down from the 2,500 to 5,000 ranges to the 500 homes-per-node range (see Figure 2), and that's an allowance for the ultimate in flexible bandwidth capability. Cable TV engineering managers are, once again, rethinking the rules within the context of their "technology futurist" roles. Many are planning 750 MHz upgrades of their coaxial networks with fiber-rich architectures, brining an average of four to six fibers to optical receiver nodes serving approximately 500 homes.

This fiber-to-the-serving-area approach creates an excellent optical platform for cost-effective and high-performance delivery of enhanced video services, such as NVOD, but also offers cable TV operators basic functionality to provide a host of other residential and business services.

In addition to taking an aggressive approach to fiber deployment, cable TV operators planning for future services must take a hard look at reliability requirements. Although upgrading an existing coaxial cable TV system with fiber substantially improves reliability for delivering video by reducing the number of coaxial amplifiers in cascade, additional planning may be required to provide the type of reliability necessary.

Future business and interactive users of the network will likely purchase services on the assumption that the cable TV delivery system can provide network reliability rates approaching that of other service providers, generally in the 99.998 percent range or even higher.

And while the practice of building fiber to smaller and smaller node sizes reduces the number of sub-



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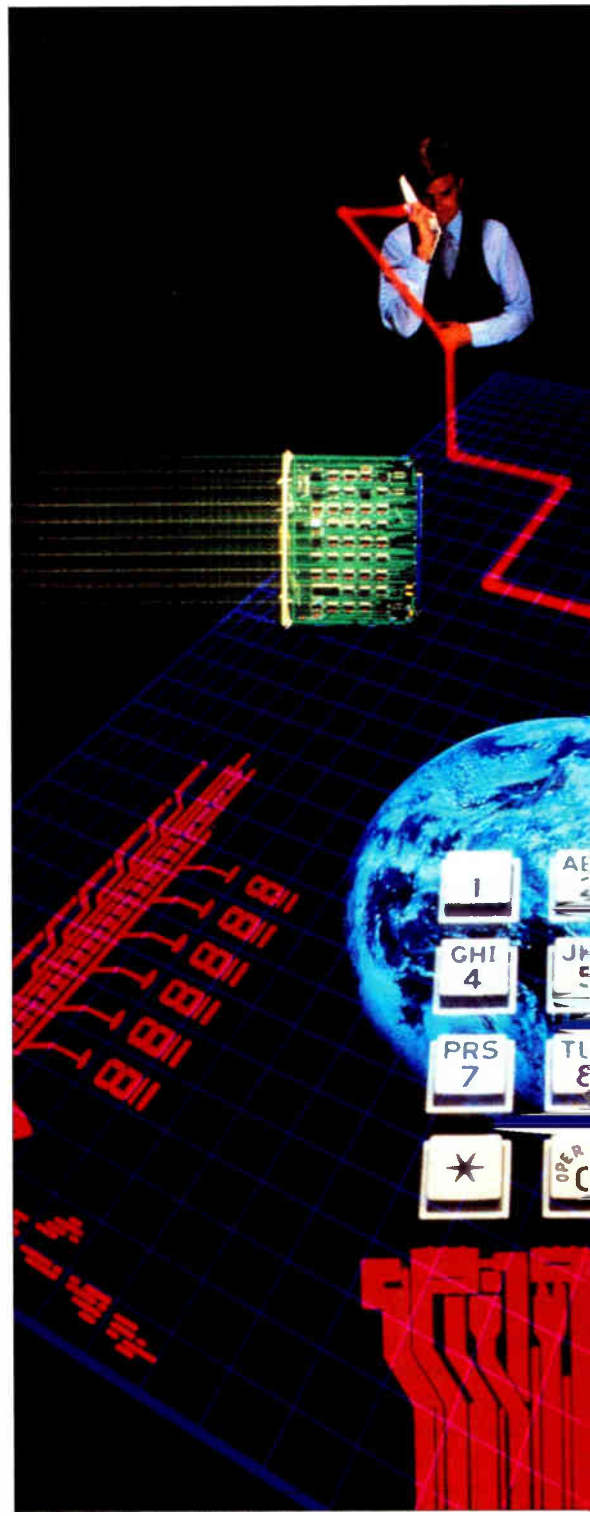
Telcos rush headlong into video

RBOC plans to deploy video detailed



By Roger Brown and Leslie Ellis

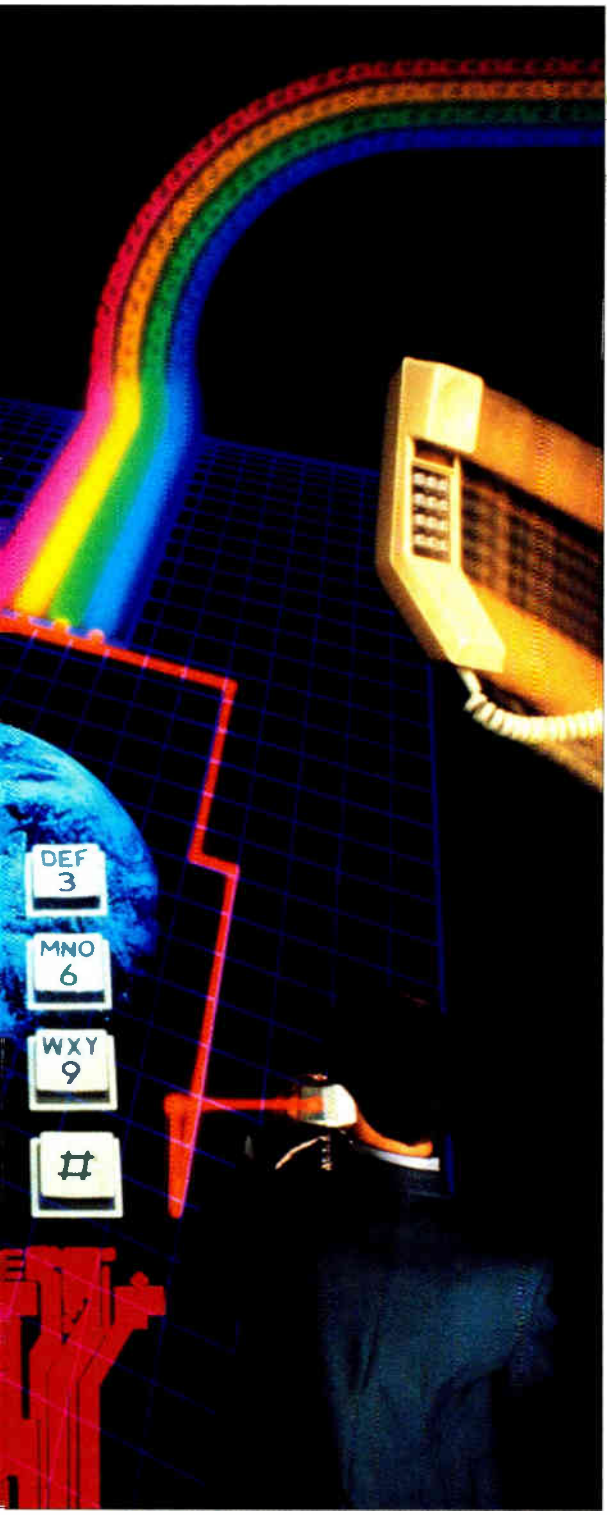
The seven Regional Bell Operating Companies (RBOCs)–including Ameritech, Bell Atlantic, Bell South, NYNEX, Pacific Bell, Southwestern Bell and US West– and independent telco GTE, are making significant strides to enter the broadband video market, eager to capture revenue that they're losing in their traditional core businesses.

Some are more active than others, namely Bell Atlantic, GTE and NYNEX. All, however, have a plan. And, literally from coast to coast, the regional Bells are partnering and experimenting their way into fiber-to-the-curb and similar digital, switched video delivery.

This article provides a snapshot of each company's stated objectives and provides some technical detail of the trials that are already underway or slated for 1994 implementation.

Ameritech

Chicago-based Ameritech may have been one of the last RBOCs to announce its grand video dialtone strategy, but when it did, it went all out. A few weeks ago, Ameritech formally filed plans with the Federal Communications Commission that detailed its strategy for building digital video networks that will serve more than 1.2 million customers in 134 communities located



in and around major cities in Illinois, Indiana, Michigan, Ohio and Wisconsin.

Specifically, Ameritech said it will spend about $400 million to build networks in Chicago, Cleveland, Columbus, Detroit, Indianapolis and Milwaukee. This is considered to be the RBOC's first step in a 15-year, $4.4 billion project that will add video services to its network via a 750 MHz overlay network of fiber and coaxial cable that will serve a maximum of 500-home nodes. This is in addition to the $29 billion the company plans to spend for other network upgrades over the same 15-year period.

In Chicago, Ameritech plans to serve 500,000 homes at a cost of more than $158 million for the video overlay, for a per-home-passed cost of about $316. In Cleveland and Columbus combined, the company will pass 260,000 homes and spend $83 million ($318 per home passed); in Detroit, it will pass 232,000 homes and spend $55 million ($237 per home passed); in Milwaukee, 146,000 homes for about $53 million ($362 per home); and in Indianapolis, 115,000 homes at a cost of almost $50 million ($422 per home).

Construction of the video overlay is expected to commence shortly after the FCC approves the request, which will take at least several months, unless the Commission works to clear the requests faster. Ameritech plans to pass about 1 million additional customers each year through 1999, ultimately serving about 6 million homes and businesses by the end of the decade.

Ameritech's upgrade to video capability builds on the company's Project Looking Glass initiative, an agressive, $1 billion fiber deployment effort launched in 1992 that resulted in a tripling of the amount of fiber deployed in its outside plant. According to Ameritech, the initiative put a fiber optic connection within two miles of 60 percent of the company's 12 million customers, a number which is expected to grow to 95 percent by the end of 1995.

An Ameritech spokesman said technical details of how the video network will be built are still forthcoming, but the company expects to "deploy a mix of broadband switches, video servers, fiber and coaxial cables in its digital video network to deliver switched broadband and video dial tone services from multiple providers, including itself," according to a press release issued by the RBOC.

According to the five Section 214 filings it made to the FCC requesting permission to build, Ameritech said the platform will have a total of 390 analog and digital channels that will be made available on a first-come, first served basis to content providers. Seventy of those channels will be analog and 240 will be compressed digital, with the remainder being switched digital channels.

The 70 analog channels will deliver traditional cable-TV programming, which is considered "critical" by Ameritech to help pay for the deployment of the digital network. The need for set-top boxes will be dependent upon what type of programming the viewer intends to consume.

Although residential entertainment services are seen as drivers for the new digital video network, Ameritech plans to push the capability toward business users as well. The RBOC has completed a lengthy test of server-delivered multimedia services in the Chicago area to employees of Ameritech and Andersen Consulting. The service allowed users to access video information remotely for field training and other uses. A current trial has 150 Michigan grade school children accessing multimedia educational material.

"The interactive multimedia services we'll provide know no boundaries."

Later this year, Ameritech plans to begin deploying Asynchronous Transfer Mode (ATM) switches built by AT&T Network Systems in the business market as a precursor to wider deployment for video services to residents. According to a story that appeared in MultiChannel News last December, Ameritech is planning to deploy SMDS (switched multi-megabit digital service) and frame relay technology in 14 cities to serve the local low-speed datacom market while preparing for higher speed communication links that are expected to become much more popular.

Ameritech expects to deploy ATM and have it serve as the core Tandem routing mechanism after the datacom market matures to the point where it demands faster speeds and cell relay technology. In addition, the RBOC envisions a day when all services are delivered via ATM, including video.

From the top, Ameritech intends to aggressively pursue legislation that would allow it access to markets which are now off-limits. In addition to video, that includes long distance service, which generated $6.5 billion in its serving area in 1992.

"The interactive, multimedia services we'll provide know no boundaries, just as the world's economy and the electronic highway know no boundaries," said William Weiss, Ameritech chairman, and Richard Notebaert, president and CEO, in the company's annual report. "There are many important services–such as information gateways for smaller cities and less populated areas, and broadband distance learning applications for schools in certain areas–that we need to bring to the marketplace."

Bell Atlantic

By virtue of its planned merger with Tele-Communications Inc., Bell Atlantic was considered perhaps the leader in the broadband video marketplace, with chairman and CEO Ray Smith touting the need for interactive video services and interoperability across various platforms.

Now that the TCI deal is dead, what does anyone really know about BA's video migration strategy? Not much. "We're still exploring Plan B," said BA spokesman Larry Plumb.

However, the company continues to test different approaches to delivering video–it already has three fiber tests, a test of ADSL and a wireless test through CellularVision. On Dec. 1 last year, the company issued a request for quotations for a swiitched, fiber-based, integrated voice and video system that could be deployed quickly with a minimum investment. According to Plumb, a decision on that RFQ is "imminent" and details will be made available at that time.

Rapid deployment has been a key provision in BA's plan to roll out video dialtone. During a press conference at the Western Show last December, Smith said a video on demand trial would commence this month in northern Virginia with service being offered to 2,000 homes initially. By the end of the year, Smith said 250,000 homes would be passed; and 1.5 million homes would have video available over the BA network by the end of 1995. After that, Smith says BA will continue the pace of deployment at 1.5 million households per year, resulting in 9 million homes serviced by 2000, all at a cost of about $15 billion.

According to Smith, this trial will deploy fiber to neighborhood nodes serving no more than 24 homes and bring video to each home via coaxial cable. Voice services would be brought to the home via twisted pair until it could all be integrated over the same wire.

While most industry players go around looking for the "killer app" that will pay for this infrastructure upgrade, Smith sees five immediate applications, including: video on demand; transactional services; games; gaming; and advertising.

Of course, BA will be gaining significant experience in the video industry via subsidiary company New Jersey Bell, which last year announced an agreement with Sammons where the Bell company would build a video network developed by BroadBand Technologies and provide Sammons with video signals. The digital network is being built to serve nearly 12,000 phone customers and about 8,000 cable subscribers in Morris County N.J.

In addition, N.J. Bell is installing BBT fiber-to-the-curb technology to 38,000 homes in Dover Township, N.J. to provide video to FutureVision, which will package the programming and offer custom packages to different neighborhoods.

The New Jersey legislature allowed these projects to go forward as part of its aggressive push to have the state enjoy state-of-the-art communications systems. The Bell company has been given permission to spend $1.5 billion to replace existing copper with fiber plant. N.J. Bell's stated goal is to deploy a statewide broadband network by 2010.

Last summer, BA announced that it signed a contract with BBT to purchase and deploy a large volume of the vendor's Fiber Loop Access (FLX) switching and transmission gear. The equipment will serve up to 100,000 Bell Atlantic homes.

Finally, BA is also testing video over copper with ADSL technology and wireless delivery of video as well. "The operative word is flexibility," Plumb said. "We're testing several approaches to determine which one gives us the most flexibility."

BellSouth Services
A BELLSOUTH Company

Bell South recognized the future customer demand for interactive, residential services "a long time ago," says Karen Roughton, national media relations manager for the RBOC. Its first residential video trials, in fact, were conducted in 1986. Hunter's Creek, Fla. served as the proving ground for the first video trial over fiber to 250 homes; the company's Heathrow trial began a year later and combined voice, video and data through a prototype video switch which carried digital, optical signals at a speed of 107 Mbps, also to 250 homes.

Both trials provided the RBOC with needed primary market research to begin developing its broadband deployment strategy, says Roughton. In 1988, Bell South and Northern Telecom jointly conducted additional market research, using a prototype device to simulate "new, high-tech broadband services," Roughton explains. "This research was the first of its kind, we think, and gave us the additional information supporting demand for these kinds of services."

Bell South believes future broadband services will continue to be a combination of switched voice, video and data services, Roughton says, and will largely focus its efforts on the evolving multimedia market. Access speeds for these services will vary from 64 kbps "up into the gigabit range," explains Roughton. The key, she explains, is asynchronous transfer mode (ATM) switching, which provides a flexible enough platform to accommodate any of the services.

Bell South, in fact, will adopt ATM as its network backbone, and in mid-1993 purchased eight ATM switches from Fujitsu. It will deploy ATM switching as an overlay on its existing narrowband network to "complement the company's existing voice switching systems," says Roughton. In the near-term, ATM will be the platform to deliver existing and future broadband services.

The installation of fiber optic cable is another important element of Bell South's broadband migration; the company already has over 1 million miles of installed fiber and is installing the fiber at a rate of 106 miles per hour, says Roughton.

In May of last year, Bell South announced the construction of the "North Carolina Information Highway," a statewide fiber optic, ATM, SONET-based network. Also, Bell South has announced its intention to expand its interactive media expertise through three recent announcements:

nel capacity of 64 kbps," isn't the technology of choice for GTE. Rather, it's more of an "interim stage," says Jones. "It's done over traditional twisted pair, but we've realized that we get better quality and more bandwidth over fiber optics."

Why the breadth of tests on GTE's behalf? "Because we've stated publicly that GTE will be a player in the delivery of voice, video and data," says Jones."Part of it is to evaluate the opportunities outside of franchises, as some of the other regional Bells are doing."

NYNEX

NYNEX, the northeast Regional Bell Operating Company which services some 15 million telephone customers in New York and New England and 19 cable/telephone franchises scattered through the United Kingdom, is striding boldly into broadband territory. According to Bill Morris, director of the company's broadband deployment corporate planning, the RBOC this month will begin construction on a 750 MHz, fiber-to-the-curb broadband network in Warwick, R.I., which Morris calls a "rollout, not a trial." Another broadband trial is underway in Manhattan and a Portland, Maine trial is "on the drawing board."

The Warwick rollout will hit some 150,000 subscribers in that area by next June, says Morris, and will use an FTC design with a hybrid fiber/coax overlay for video signal carriage. "That's not our long-term vision," Morris explains, "but we wanted to do something, and (an overlay) is all that's available now." NYNEX will change architectures around the middle of next year, when integrated fiber/coax systems are anticipated to be available to deliver ATM cells over a fully integrated network.

In Warwick, optical nodes will service 300 to 400 customers with 80 analog and "120 plus" digital channels, Morris says, although he's considering reducing the number of analog channels to reduce expense.

"We'd like to go with a single, coaxial line (into the home)," explains Morris. "If an architecture comes out with a subscriber network unit on the side of the house, which we could feed with coaxial and split out with coax and twisted pair, we'll do that." Morris says he could also live with a pole-mounted optical network unit which sends a siamesed coaxial cable/twisted pair cable into the home.

NYNEX has selected Raynet Corp. to provide the network components; Fujitsu Corp. will provide the ATM switches, Digital Equipment Corp. will provide digital video servers and, on the receive end in Warwick homes, Zenith Electronics set-tops will be used. "We just hope they all talk to each other," Morris says.

NYNEX is still waiting for FCC 214 permission for the Warwick deployment, says Morris. "If we get that, we hope that it will go up working, stay working and become a revenue producer."

In Manhattan, NYNEX is already "well underway" on its "Liberty Trial," implemented primarily to exhibit the company's desire to become active in broadband. The trial provides voice and video services to three high-rise apartment buildings. Morris says it's highly unlikely the trial will be repeated elsewhere, because "it's simply too far advanced for its

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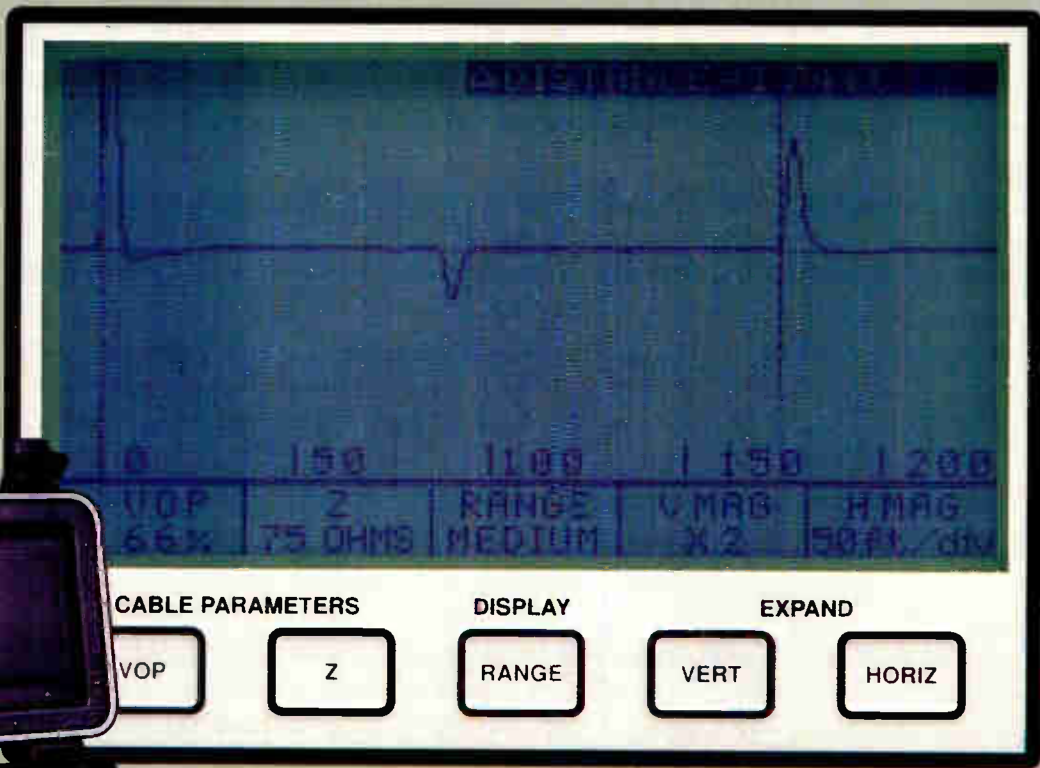

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time."

"We'll never repeat this," Morris says, explaining that the Manhattan network is "pieced together, like when you build a car by hand, and you first put the fender on, then all the pieces go in hand by hand." NYNEX received FCC 214 permission to conduct the trial through next January.

NYNEX is also poised to launch headlong into an overbuild of Time Warner's Portland, Maine cable system, pending the results of a First Amendment filing there "similar to what Bell Atlantic and Ameritech have done," says Morris, to win permission for video programming distribution within franchise boundaries.

"We chose Portland because of a perception that the courts there are more speedy," Morris explains.

"Having done that, we need to be prepared to provide service there, should we win–and we expect to."

Morris says the RBOC is "on the very initial stages" of its broadband development plans for the states of Massachusetts and New York.

PACIFIC BELL®

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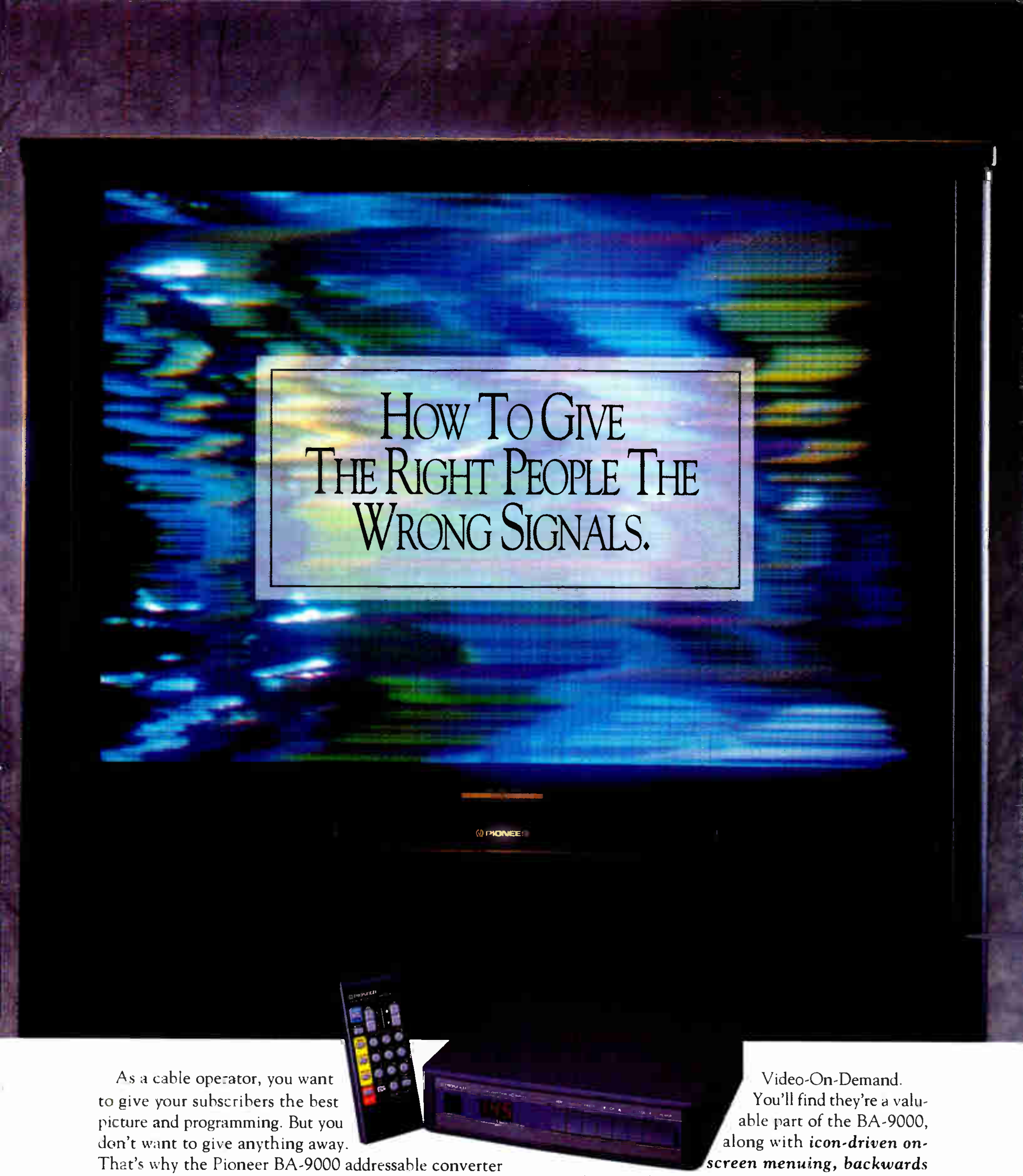
To the West, Pacific Bell, the RBOC owned by Pacific Telesis Group, says it will spend $16 billion to upgrade its core network infrastructure over the next seven years to an integrated telecommunications information and entertainment status providing advance data, voice and video services. The new network will provide voice telephone service, ISDN, switched data services, narrowband data, wide area networking and video telephony. Video dial tone services will include broadcast video, pay-per-view, multimedia, premium channels, video-on-demand and interactive games.

The program initially targets parts of the San Francisco Bay area, Los Angeles, Orange County and San Diego, said Craig Watts, a spokesperson for Pacific Bell. More than 1.5 million homes will be hooked up to the system by 1996, Pacific Bell officials estimate, with more than five million homes on-line by the end of the decade.

In San Francisco, Pacific Bell will upgrade its operations in Campbell, Cupertino, Los Altos, Los Altos Hills, Milpitas, Mountain View, San Jose, Santa Clara, Saratoga, and Sunnyvale. In L.A., it will upgrade Canoga Park, Reseda, Sherman Oaks, Calabasas, Hidden Hills and Inglewood; in San Diego, it will upgrade Central San Diego, Del Mar and Poway. Orange County upgrades will hit Anaheim, Buena Park, Cypress, Garden Grove, Orange and Stanton Villa Park.

"The new network will offer telephone customers an alternative to the existing cable television monopoly," Pacific Bell said in a November 1993 news release. Pacific Bell cites a "technological breakthrough" by AT&T as the reason for the upgrade. "As strategic partner and systems integrator for the new network, AT&T will help fulfill our vision of the communications future," said Pacific Bell President Phil Quigley.

In the Pacific Bell/AT&T network, fiber will be run from Pacific Bell facilities to a node serving less than 500 homes; coaxial cable will continue to the home and into a set-



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Architecturally, Pacific Bell will build a 750 MHz star-bus, hybrid fiber/coax network using a single physical path into the home (coaxial. On the side of the home will sit a network interface unit, an intelligent processor which delivers analog and digital telephone services to the home and constantly monitors the quality of the network.

A host digital terminal, located at Pacific Bell central offices, serves as the interconnection point into the local switching system, and acts as a collection point for any information coming from the network interface units.

Over the next seven years, Pacific Bell will bring down its aerial copper plant and replace it with coaxial cable; underground copper will stay intact with coaxial cable laid alongside it.

In a fact sheet, the RBOC described its service management system as one in which "we will manage digital circuits carrying a minimum of 24 voice/data channels, rather than copper circuits carrying a single analog channel. In the distribution area, we will manage a single, coaxial bus in the neighborhood rather than many copper pairs." The network will accommodate both ISDN and ATM, Pacific Bell officials said.

In January, Pacific Bell and AT&T announced their first foray into the interactivite network they foresee, in Milpitas, Calif. Described as a "robust digital test," the Melpitas trial begins this November to 1,000 residents. The trial will be enacted under a Pacific Bell subsidiary, called Pacific Telesis Video Services. PTVS will be responsible for developing and marketing interactive video services to consumers.

Elsewhere in California, PTVS will join with Hewlett Packard to build a similar interactive video system that will offer consumer movies and other on-demand programs by the end of 1994. Hewlett Packard will provide the video servers for the four California markets. It may also provide the set-top convertors, video printers and billing computers.

Southwestern Bell Telephone

Arguably the least aggressive RBOC when it comes to announced video trials, Southwestern Bell (SW Bell), based in San Antonio, Texas, is taking only prudent and deliberate steps toward deployment of broadband video.

SW Bell, which just last month was renegotiating the financial terms of its $4.9 billion partnership with Cox Enterprises to better reflect the value of Cox's cable properties, has announced just one in-region video dialtone trial so far.

Scheduled to take place in the Dallas suburb of Richardson, where the cable incumbent is TeleCable, the trial will be under the supervision of Southwestern Bell Video Services, a separate company set up by the telco to develop video networks.

The trial (company officials prefer to call it a "market probe") will target 2,000 homes initially and will expand beyond that if the market demands it, said Steve Dimmitt, VP of Southwestern Bell Video Services. But because the company's engineers haven't yet made key technology decisions, the exact topology and vendors remain unknown, and likely will for another month or two after this article appears, according to Dimmitt.

However, Dimmitt did say that SW Bell plans to offer a broad mix of cable-TV programming in addition to services not offered by TeleCable. SW Bell expects to offer between 40 and 50 standard analog channels and movies in both digital broadcast (near video-on-demand) and switched (true video-on-demand) modes, said Dimmitt.

SW Bell plans to build a fiber-rich network, but hasn't yet decided whether to use the fiber-to-the-curb architecture or hybrid fiber/coax, said Dimmitt. The benefits and drawbacks of the fiber-to-the-curb and fiber to the serving area approaches are being scrutinized by SW Bell the phone company, he said. "We'll be riding on whatever approach they decide is best," Dimmitt said.

In addition to architecture, the company's engineers are sorting through the options related to deploying set-top terminals, according to Dimmitt. "That's going to be a real key decision," he said. "Do we want a simple set-top and match it up with a complex video server or should we distribute the intelligence throughout the network?" Either way, Dimmitt says he prefers to purchase a readily available set-top off the shelf instead of designing a custom unit. This approach will allow the RBOC to procure the units faster and at less cost.

The company also expects to deploy service to customers who don't want a set-top at all. In that case, the RBOC will simply pass video to a cable-ready TV or may even use interdiction, much like US West has chosen to do. In fact, the only technology the company has ruled out is ADSL. "We don't think ADSL is competitive with cable services delivered over fiber" in terms of quality, Dimmitt noted simply.

Why did SW Bell choose Richardson for the market test? Dimmitt said market research shows that residents of the north Dallas community have a high interest in new, advanced services. "We felt it would be a good testbed because we already have a lot of fiber in place there and the home density is favorable." Incumbent TeleCable has a combined 43,000 subscribers in its system that serves both Richardson and neighboring community Plano.

Outside of the SW Bell five-state region, the RBOC last year purchased two suburban Washington, D.C. cable systems from Hauser Communications. Also, the company expects to gain a lot of market knowledge and expertise from Cox after their deal is officially consummated. High-level discussions between the two companies are already taking place, according to Dimmitt.

But don't expect SW Bell to make headlines anytime soon with grand announcements about spending huge amounts of money to rebuild its entire infrastructure. "We don't think it's imperative or wise to spend billions to upgrade when there are so many unanswered technology questions," said Dimmitt. "That's not our style." Instead, decisions regarding accelerating the pace of broadband deployment will be made based upon technology availability, the amount and kind of competition the company faces, customer demand for new services and timing.

US WEST

Denver-based US West was the first to find a cable partner (it invested $2.5 billion in Time Warner) and perhaps started the merger mania between the two industries. It may also be the first RBOC to actually sink its teeth into some competition with an established cable system when it fires up its much publicized video trial in Omaha, Neb. later this year. There it will go head-to-head with Cox Cable in the provision of traditional cable TV programming as well as new interactive services like home shopping, video classifieds, home banking, etc.

US West chose to deploy a fiber-to-the-curb overlay architecture that provided video services over a hybrid fiber/coax plant that runs parallel to the fiber/twisted pair network that will carry voice traffic (see CED, March 1994, p.33 for a detailed diagram of the architecture).

From the fiber node, which serves about

500 homes, a dual cable video network connects to a Scientific-Atlanta interdiction unit located in a pedestal. From there, the two coax cables feed video into the house as well as deliver upstream information back to the headend.

Cable "A" will deliver up to 77 analog channels, 136 digital channels and 25 MHz of shared upstream bandwidth. Cable "B" is a mid-split design that offers more upstream capacity (107 MHz) while providing 500 MHz to support 664 digital channels downstream.

Custom MPEG-compatible digital set-tops from Scientific-Atlanta are being constructed that are driven by graphics control and display software developed by The 3DO company. The set-top will be able to run applications locally and can also be downloaded with additional software.

Current plans call for a four- to six-month technical trial of the service that will pass about 10,000 homes. A year-long market test will commence after that and the serving area will include an additional 50,000 homes and businesses.

In all, US West hopes to capture about 10,000 homes and businesses during its technical and market trials.

Since receiving formal permission from the FCC to provide video services, US West has since announced plans to file for authorization to offer the same services in Denver , Boise, Portland and Minneapolis/St. Paul. Ten more cities will be identified as additional roll-out sites later this year and a total of 20 sites are planned to be named by the end of 1994. The goal is to have 100,000 households hooked up by the end of the year, with the addition of about 500,000 homes per year over each of the next five years.

The RBOC doesn't intend to use the Omaha architecture throughout its region, according to executives. "We issued an RFI in 1992 for a hybrid fiber/coax network with integrated video and voice and no such system existed," said John Boe, technical director of wireless and broadband planning for US West Communications. "No response was complete enough."

As a result, the company chose to deploy the overlay network it's constructing in Omaha. However, US West is "actively looking toward deploying an integrated network, but there are major issues that have to be overcome," said Boe. Those issues include: reliability, privacy and security; service; and maintainability.

In February, US West issued RFPs that outlined a new network topology that provided video with plain old telephone service (POTS) that would cost about $1,000 per home passed, which is the industry average for deploying a twisted pair network. The $1,000 price point was also the RBOC's goal for its Omaha trial.

Cost "is a moving target," admitted Boe, but he said it continues to be their overall goal. According to a US West spokesman, this new topology will allow them to roll out video services incrementally as market demand dictates.

In addition, US West has announced a plan where it will work with Oracle to develop a multimedia information server that will store, retrieve and deliver video, voice and data to computers, TVs, phones, faxes and other devices located in homes and businesses. US West officials said they will use the platform to bring multimedia messaging service to market this year. CED

How telcos plan to deliver video

The narrowband alternative

Table 1:
The Evolution of Video-over-copper

1988:	HDSL (high bit rate digital subscriber line) conceptualized
1990:	2B1Q baseband bit coding (similar to ISDN PRI) used for HDSL
1991:	Bellcore HDSL Technical Advisory released to vendors
1991:	Asymmetrical Digital Subscriber Line (ADSL) announced
1992:	ANSI T1E1.4 standard issued for HDSL
1992:	QAM/CAP/MPEG-1 solutions proposed for implementing ADSL
1993:	DMT/MPEG-1 & 2 solutions proposed for implementing ADSL
3/93:	ADSL "Olympics" competitive field trial held
6/93:	Bell Atlantic ADSL phase 1 field trial commences
7/93:	DMT standard recommended by T1E1.4
5/94:	DMT standard proposal to go out for T1E1. 4 letter ballot
1/94:	DcT announces non-ADSL solution for video-on-demand
1994:	Bell Atlantic ADSL phase 2 field trial commences
1995:	Tariffed ADSL-based video-on-demand service to commence

By Alan Stewart

Like merging galaxies, when high-tech industries come together, the results of their engineering collaboration can be awe inspiring. Nowhere is this more true than in computer data processing, telecommunications, and cable TV. The results of this collaboration means that a full-motion TV signal can be compressed both at the source and during transmission.

This article describes those two processes and forecasts that the result will have an impact on the services provided by telephone companies and cable TV providers.

Concepts such as pre-processing eliminate bits that do not contain information essential to producing an acceptable picture. Coding and decoding techniques further reduce the number of bits needed for transmission. The final result is a TV picture that must be judged on its merits by a human viewer.

A value judgment is made on the relative importance of the constituent parts of a television picture signal. This process is highly dependent on both human perception and the characteristics of the specific system being evaluated: Two related types of information are identified during a pre-processing stage:

✔ Signals that are particularly difficult to code
✔ The contribution of these to final picture quality.

Temporal (transient event) prediction and motion compensation are employed to do this. The amount of data needed to maintain picture quality is reduced by coding only the changes in information in successive frames. Using small groups of pixels called "predictor blocks" (see Figure 1), enough bits must be used to communicate detail and rapidly changing scenes. This avoids "motion artifacts" (visible effects that are not part of the original motion).

Signal energy containing these differences (the motion compensation residual) is concentrated in a relatively small band of low frequencies. A two-dimensional analysis of the signal identifies them and permits fewer bits to be assigned to other frequencies. Because this analysis mirrors human visual image processing, it helps with the subsequent signal quantization process which represents the remaining signal as a series of discrete steps (analog to digital conversion).

One result of these compression techniques is to produce a bit stream which has a preponderance of "zeros" clustered together. This clustering allows additional compression to be achieved in two ways:

✔ Successive "zeros" are coded in total instead of individually
✔ Totals that occur frequently are assigned short codewords.

In the receiver, the reverse processes take place and if the entire system has been correctly designed and installed, a television picture can be produced that contains both the visual acuity and fidelity of the original.

To provide the viewer with a full-motion TV signal, the signal must be transmitted over a physical medium and restored at the subscriber's location. In the telephone industry the medium would be the phone cable. Asymmetric digital subscriber line (ADSL) is the name given to systems that can do this over the majority of local telephone loops, which consist of twisted-pair copper. A simplified diagram of an ADSL system in shown in Figure 2. The objectives of ADSL include:

✔The provision of an upstream channel as

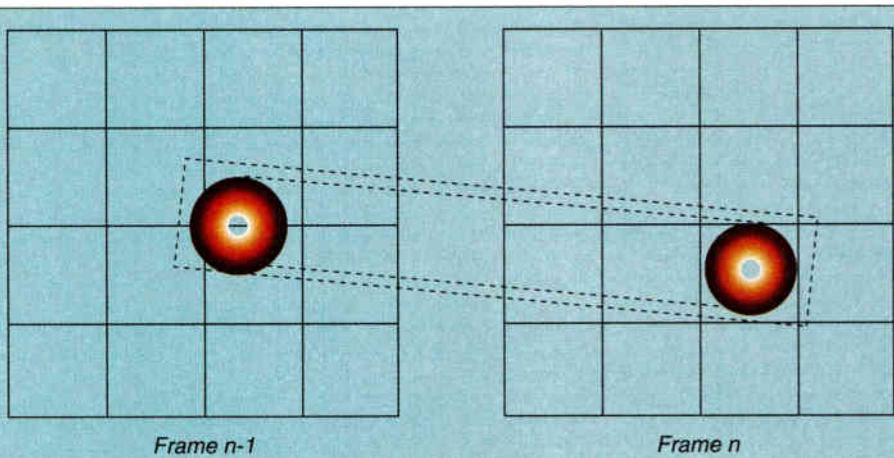

Figure 1: **Motion compensation – A block in frame n is best predicted by a small offset block in frame n-1. The encoder must send the offset and information about the difference between the predictor block and current block.**

well as downstream video
✔Coexistence with existing services including POTS and ISDN.

ADSL began as a Bellcore concept in 1988 but it was not until 1992 that it was considered a serious approach to providing multimedia over copper, explains Tom Starr, senior technical staff member at Ameritech. Starr chairs the ANSI (American National Standards Institute) T1E1.4 committee which has responsibility for digital subscriber line products. The major milestones in video-over-copper development are shown in Table 1.

ADSL transmission schemes use signals that can be confined to a discrete band, rather like a radio channel. This approach allows several different signals to be transmitted over the same pair of wires. As a result, transmission schemes were adopted that have similarities to those used in dial-up analog modems.

Carrierless AM/PM (CAP), and its predecessor, QAM (quaternary amplitude/phase modulation), are traditional transmission schemes that have been implemented in dial-up modems for many years. In 1992, AT&T Paradyne engineered a CAP transceiver that can be used directly on the loop to carry video channels at a T-1 (1.54 mbps) bit rate. This is fast enough to carry a compressed VCR-quality television picture.

Another approach, developed from a 1960s transmission scheme was announced last year by Amati Communications of Palo Alto, Calif. and Northern Telecom Inc. It is known as Discrete Multitone (DMT) and under laboratory conditions, it can transmit up to 6 Mbps over 12 kilofeet of 24-gauge non-loaded line. It performed well during the so-called "ADSL Olympics" held at Bellcore earlier this year, and is considered by many to have become the

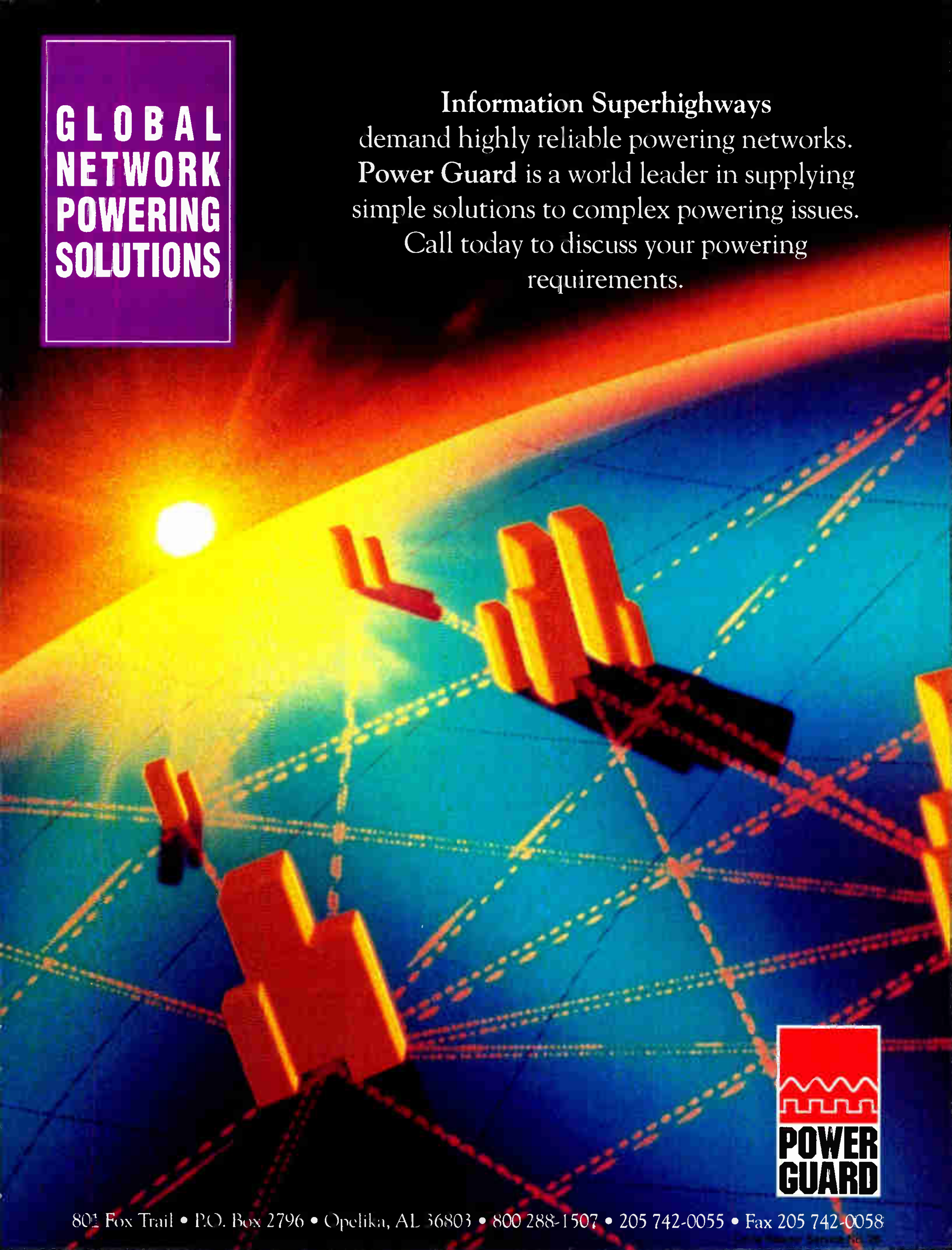
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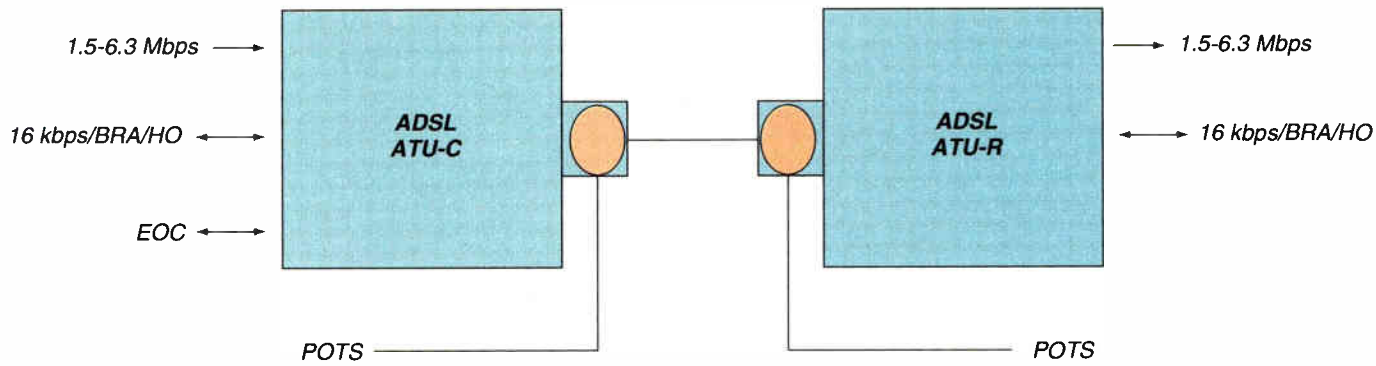
Figure 2: ***Basic ADSL diagram***



front runner for implementing ADSL.

Newbridge Networks, in collaboration with Aware Corp., is designing products based on yet another iteration of DMT developed by scientists at MIT. The chip sets for this are being designed by Analog Devices Inc.

Experts generally acknowledge that DMT and CAP should, when optimally engineered, provide the same performance over twisted pair copper outside plant cables, but it is by no means certain that this equivalency will be reflected in the final product. At present the answer to this question remains moot. The consensus of both Bellcore and ANSI is that a system using either approach must result in a reliable product that provides 6 Mbps ADSL simplex channel along with a full-duplex capability under a variety of conditions.

"The original (ADSL) architecture proposed 1.54 Mbps and this is now coming to be known as ADSL-1," says David L. Waring, director of high bit rate loop transmission at Bellcore. "There's another version of the architecture that would operate on Carrier Serving Area loops out to 12 kft. This would become ADSL-2. Then ADSL-3 would operate over the last mile at 6.16 Mbps.

"The choice of technology clearly matters if you're concerned about product interoperability," Waring notes. "A termination out in the residence becomes part of a consumer electronic device. If you have the consumer electronics industry building ADSL terminations–CD players, TV sets and PCs–then the telephone company has to match that termination on the network side."

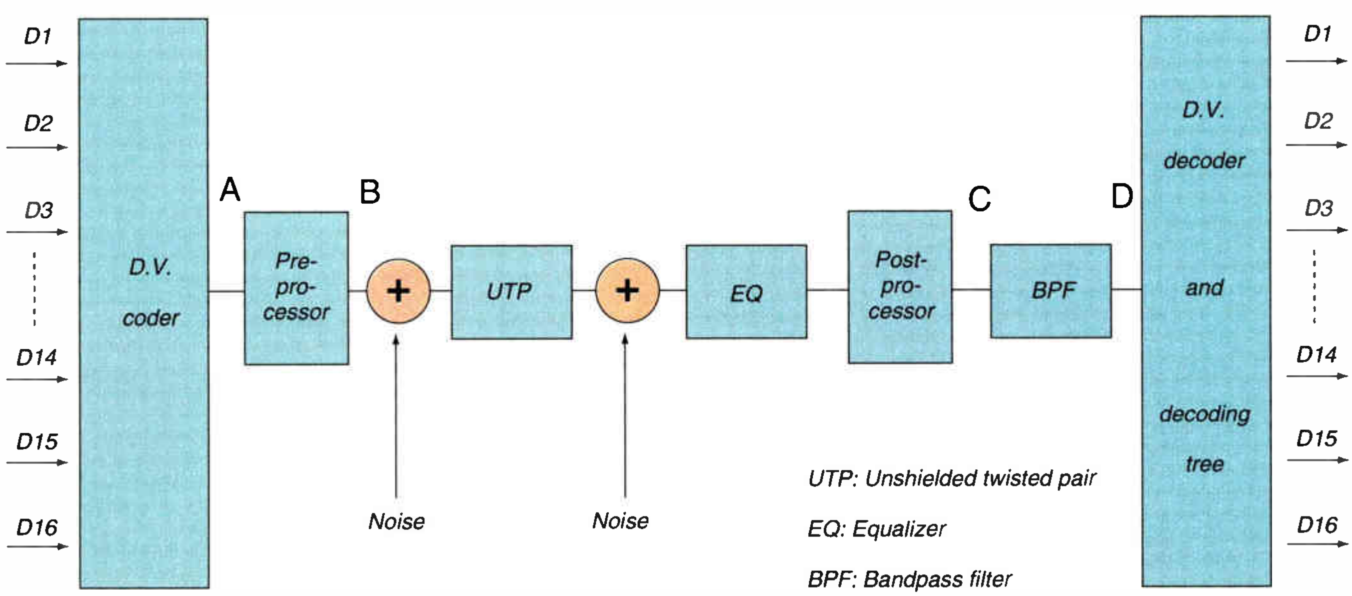
New York-based Digital Compression Technology (DcT) may have solved this problem. Working with the Advanced Telecommunications Institute at Stevens University, DcT has developed a technique which does not involve further compression of the TV signal during transmission. The original digital bit stream is transmitted in parallel format over an analog carrier. A sophisticated circuit at the subscriber end recovers the signal and converts it back into a serial bit stream. The virtue of this solution, claims DcT, is that it is more readily implementable in silicon than conventional ADSL because the network and subscriber terminals work independently (see Figure 3).

Bell Atlantic's ADSL trial

In June 1993, Bell Atlantic became the first RBOC to demonstrate the practical benefits ADSL by delivering movies-on-demand, network television shows, and other video services over its existing telephone network. Interactive Multimedia Television (IMTV), as it is called, will be brought to subscribers in three phases:

✔System installation, maintenance, and network and server technology finalization.This phase is underway with up to 100 Bell Atlantic employees participating.

Figure 3: ***Digital Transmission of Increased Capacity (DTIC) system (10 mbps downstream, 4 mbps upstream over 12kft 26 gauge)***



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operators to deliver local telephone services; the RBOCs themselves have found cable's core business, entertainment television, equally attractive in driving major investment.

Pacific Bell, for example, plans to invest $4 to $5 billion over the next seven years to completely overbuild its copper network with a broadband fiber optic/coaxial infrastructure; US West's Omaha project will test this RBOC's own broadband network capabilities. US West's investment in Time-Warner, the Cox-Southwestern Bell pact, and other telco-cable deals clearly suggest that the two industries could soon be partnering in some of the same markets, with the RBOCs aggressively competing against one another.

Cable television can certainly maintain a competitive advantage in the short-term since it already has a high-capacity broadband network in place. Unlike the RBOCs who need to completely rebuild, cable companies can get into the telephony business by extending fiber's reach and implementing network-compatible telephony equipment–once regulations permit cable's entry into the lucrative residential telephone service business.

To make the hybrid fiber optic/coaxial network ready to deliver telephony today, however, several key issues must be addressed. First, the provider must plan for initial capacity and long-term growth. The broadband network must be provisioned to balance bandwidth needs with peak load demand, especially when dealing with an essential service like telephony. An "all circuits are busy" notice simply won't be tolerated, especially in a local market where access to 911 or other emergency services is vital. For this reason, the initial network design must be provisioned with ample fiber to size service nodes appropriately.

Second, network redundancy is an important factor in delivering telephony services. Implementation of standby equipment and bi-directional rings between optical nodes will help to ensure the network reliability expected of telecommunication providers.

Third, powering becomes a key issue in delivering telephony, whether that powering is provided by the subscriber or through the broadband network. System powering does, however, present several hurdles to cable television systems, particularly in deciding whether to power over the drop or through a separate powering cable to the home.

Fourth, network status monitoring and operational support systems become even more important than they have been with traditional entertainment television. The bi-directional nature of telephony services, its need for switched services, and the efficient management of subscriber billing will all require attention from cable systems contemplating telephony as a new service offering.

Incremental network development

For today's cable television systems, the same infrastructure that can support telephony, data, and video services opens the door to new business opportunities, not just from residential telephony but from myriad other interactive services on the horizon. This will allow new service revenues to drive additional capital investment, so the network can be easily upgraded to accommodate increased demand.

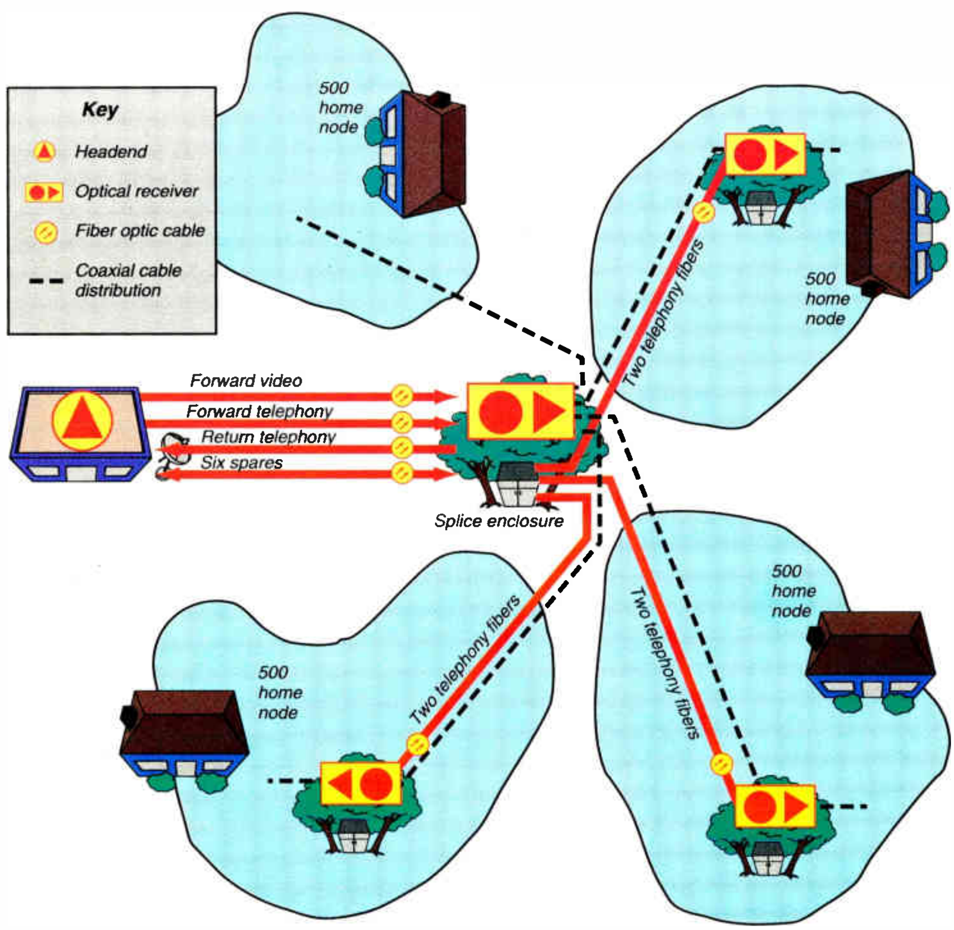
One system, developed by ANTEC in conjunction with AT&T, recommends initial node sizes of 2,000 homes, thereby allowing a maximum of 24 percent penetration rate for telephony services. Working within the system's spectrum utilization plan (25 MHz forward path/25 MHz return path), 2,000 home nodes allow 480 simultaneous telephone conversations within that node before demand outpaces capacity.

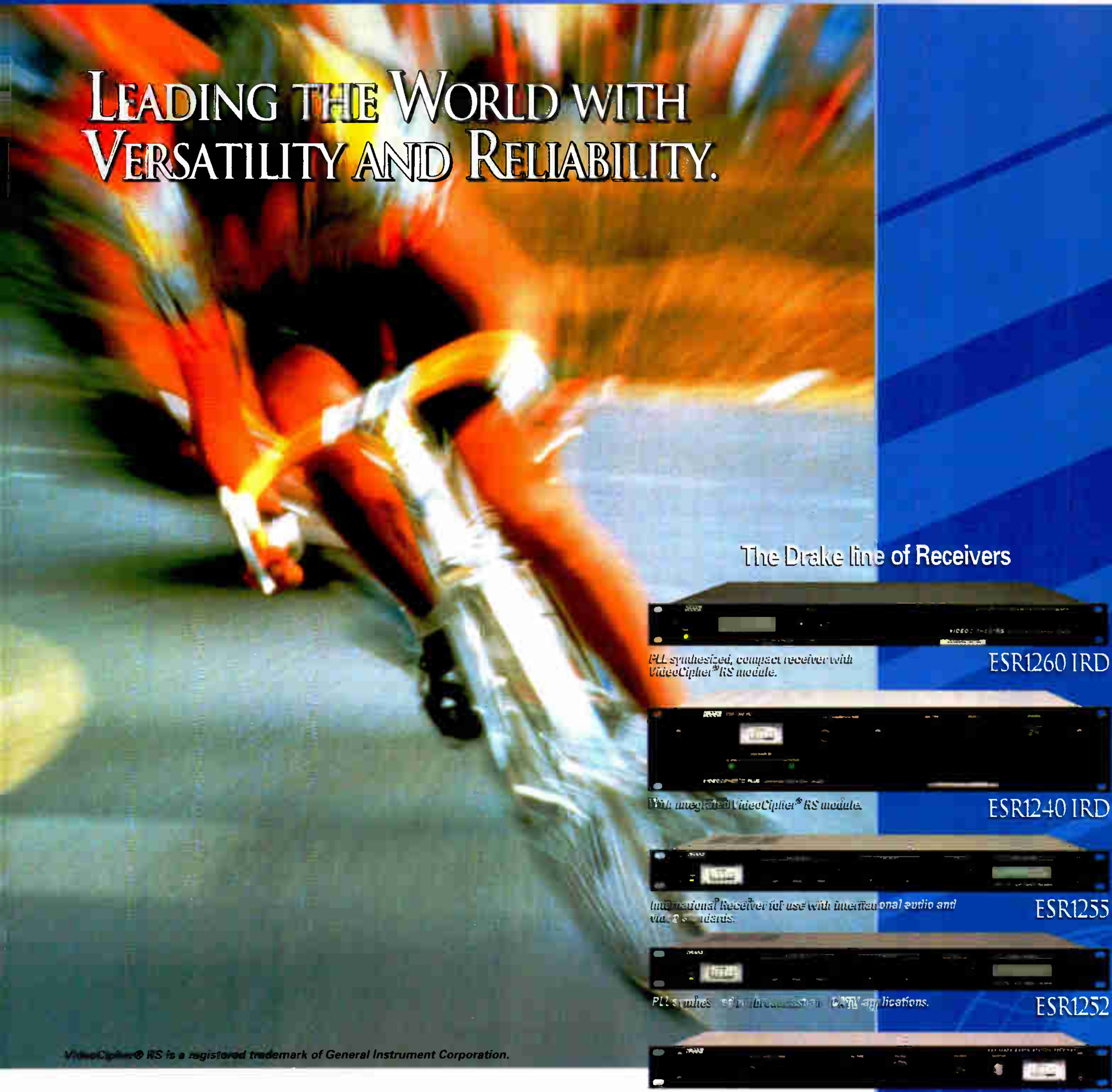
As more demand in each node is realized, pre-installed dark fiber can be extended, downsizing that single 2,000 home node to four nodes of 500 homes each. This requires the provisioning of at least eight telephony fibers to each 2,000 home node, two of which will be active and six (or more) which will remain dark until node downsizing is required.

As demand grows beyond 24 percent, service nodes can be downsized to 500 homes by extending the six dark fibers from the first optical receiver location to a second unit. Thus, nodes should be sized to 500 homes during the initial network design. This will allow each block of 25 MHz forward/return spectrum to be reused for incoming/outgoing subscriber telephone calls. Capacity then quadruples, allowing up to a 96 percent telephony penetration rate in each 500-home node.

The important point is that this downsizing can be accomplished only in specific serving areas where demand (read revenues) warrants this additional capacity. If demand remains at 24 percent or less in one area, 2,000-home nodes will suffice; if demand shoots up throughout the system, the entire network can be downsized to 500-home nodes or less, positioning the system for the bandwidth required

Figure 2: ***Cable Loop Carrier-500 network architecture***





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for a host of interactive services beyond telephony.

As shown in the Figure 1, the system headend unit interfaces directly to the public switched telephone network (PSTN). Incoming digital telephony signals from the PSTN are assigned a specific frequency and time slot based on the address of the telephone call. Telephony signals are allocated to a 25 MHz block of spectrum in the 500 MHz to 750 MHz range and are transmitted via fiber optic cable through a transmitter.

Traditional analog entertainment video signals are allocated in the 50 MHz to 500 MHz spectrum and are transmitted via an AM transmitter through a separate fiber. At an intermediate point, commonly called the hub divider, an optical receiver (gateway) converts the optical signals to RF, combines the signals, and transmits both over coaxial cable to the subscriber service area.

Should a second gateway unit be required to meet telephony demand beyond 24 percent, the primary gateway will continue to provide entertainment signals from the headend via the separate fiber. The second gateway is not required to house an additional optical receiver but simply passes the entertainment signals on to the smaller 500-home node through the coax input from the primary unit.

As Figure 1 indicates, new fiber links are established from the headend to the secondary gateway to provide for telephony service to the smaller service area. A filter at the secondary gateway eliminates telephony data traveling from the primary to the secondary units, and telephony signals are received and returned to the headend via the new fiber optic links.

Once entertainment/telephony signals arrive at the home, a directional coupler/splitter sends the signals to both the set-top convertor and the subscriber terminal. This latter unit, which operates like a modem, converts the downstream digital telephony signal derived from the coaxial cable input into an analog signal that can be recognized by a standard telephone set. Upstream, the subscriber terminal converts the analog telephony signal to RF in the 5 MHz to 30 MHz return path spectrum and transmits it back through coax to the gateway unit. There, upstream telephony signals are converted to digital signals for delivery via fiber back to the headend.

Redundancy

Telephony services require a network that will survive failures. Redundancy can be built into the network three ways. First, duplicate equipment can be installed at the headend to allow technicians to switch downstream traffic should a headend transmitter failure occur.

Second, diverse fiber routes can be implemented to allow the network to re-route traffic to survive a fiber break. In other words, fiber should be routed into an optical receiver location from two different directions.

Third, optical components should have built-in redundancy features that provide a back-up to all primary units. In the event of a network failure or fiber cut, the node could automatically switch traffic from the primary to back-up modules.

Powering the subscriber terminal

Telephony also makes powering a critical issue. Some subscriber terminals are powered by the subscriber, thereby saving cable systems on network powering costs and simplifying installation. These unist also contain an internal battery that provides up to four hours of uninterrupted service in the event of a power outage. Future designs, specifically a domestic, 24 channel T-1 residential telephony system, will incorporate both in-home, subscriber-powered and outside-the-home, network powered capabilities.

Network powering allows designers to easily increase the actual standby time of a node during a power failure. Depending on the design of the existing plant, cable systems will either need to increase the current-carrying capacity of existing power supplies or add more standby power supplies feeding a single node. One system standby battery would replace several subscriber batteries, thereby reducing maintenance costs since the need to replace subscriber unit batteries would be eliminated. Yet, network powering will substantially increase electricity costs to cable systems and present other key challenges.

Two options currently exist to system power the in-home subscriber terminals. Cable systems may elect to implement network powering either through the RF coaxial cable or through parallel powering cables at each subscriber home.

Powering through the coax does impact RF signal performance. In this instance, power-passing taps will be required with components that will help to minimize signal distortion, maintain insertion loss budgets, and reduce undesirable frequency response signatures due to the additive impact of several taps in series.

The second approach, parallel powering, utilizes a separate power tap or power extractor next to the subscriber RF tap. In this case, a parallel power pair attached to the coaxial drop cable would be used for routing power independently of the RF coaxial drop. This approach should ultimately be more reliable since more robust connectors may be used for the power-passing circuits. Standard low-cost taps could also be used, and overall RF performance should be subject to less degradation since fewer RF points would be disturbed.

The fourth key issue lies in operational support. System controllers can provide network maintenance for the system at the headend. A PC-based controller–which could ultimately be linked with the cable system's overall operational support system–monitors the status of the network and its components, and watches for alarms. The controller provides the interface needed to provision the network, with instant access to the condition and provisioning of each network component. From this single interface, more than 120,000 subscriber terminals can be monitored; the unit itself prevents duplicate provisioning of any network component and provides constant communication between the headend terminal and the subscriber terminal to allow technicians to monitor network performance.

Delay characteristics are inherent in the cable television plant since subscribers reside various distances from the headend and the network's active components. For this reason, the system incorporates an auto-ranging capability that records the distances from the headend terminal to the subscriber to prevent an overlap of signals from multiple users.

In addition, the 25 MHz upstream/downstream frequency allocation of the headend terminal and its associated subscriber terminals may be set through the controller, and password protection is available to preclude other technicians from provisioning telephony service in a spectrum already being utilized for another service.

Operations will also depend on who provides the telephony switching capabilities. Depending on how the telephony business begins, switching may be accomplished through the local telephone company or a long-distance provider. The switches utilized would provide subscriber billing information; however, fees will be charged for using this service.

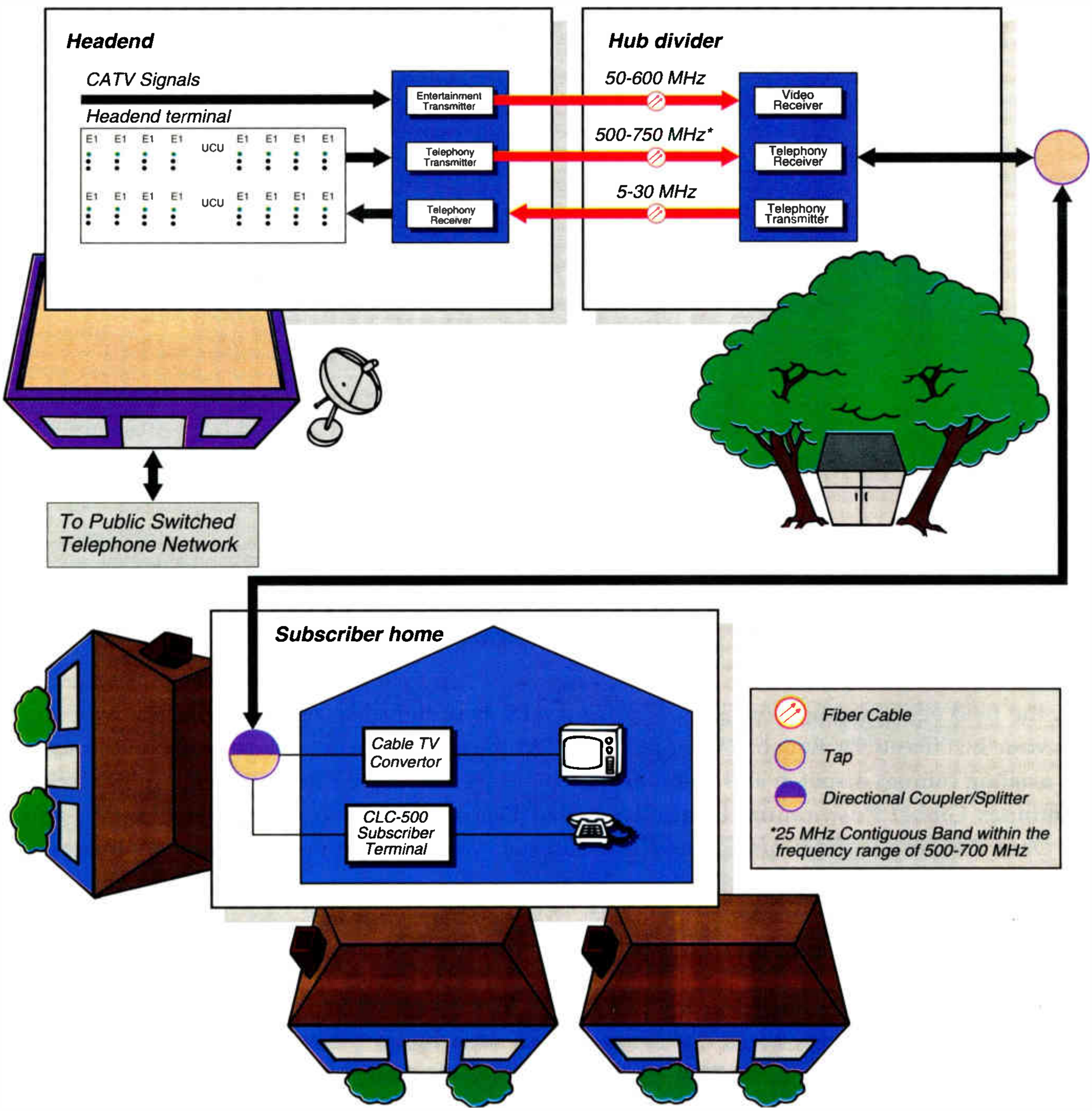
As the cable system's telephony business grows, a headend switch could be implemented that would aggregate traffic at the headend and switch accordingly. Calls could be 1) routed back into the cable system, 2) routed to telephone users in the local telephone company or 3) routed to a long-distance provider. In this case, the cable system's switch would tabulate usage charges accordingly and would then need to be incorporated into the overall operational support system, including monthly subscriber bills. CED

Telephony via cable: Competing in a new business

One method it can be implemented

The cable industry faces a promising new revenue stream that may, assuming regulatory relief, bring great change to today's cable operations: residential telephony. Exact figures vary, but experts suggest that local telephone services generate upwards of $60 billion in annual revenues for the Regional Bell Operating Companies. MCI recently announced its intention to bypass the $5 billion in annual access fees it pays to the RBOCs by making deals with local cable

Figure 1: **Cable Loop Carrier-500 network design**



Expanded glossary of basic telephony terms

From ADSL to X.25; acronyms to definitions

Editor's note: As cable operators move more into the realm of telecommunications, we though it would be helpful to provide a partial summary of commonly used telephony terms and acronyms.

ADSL

Asymmetrical Digital Subscriber Line. A method developed by the telco industry to deliver video to the home over twisted pair copper wire. It is a one-way video transmission technology with control signals returning from the home at 16 kilobits per second. Derivatives of the technology include High bit rate Digital Subscriber Line (HDSL), which puts bi-directional T-1 on unshielded twisted pair (primarily for business use), and VHDSL (very high DSL), which allows for 10 mbps to 40 mbps signal transmission speeds.

Asynchronous transmission

Recently, the term "asynchronous," at least when referring to broadband ISDN, has tended to mean the use of statistical multiplexing and packet switching technology to transmit a discontinuous steam of data.

Traditionally, asynchronous transmission has been a digital transmission method where the individual characters are encapsulated by "start" and "stop" control bits that identify the beginning and ending of each character. It features lower data throughput than synchronous transmission methods, but doesn't need to maintain precise timing relationships between transmitter and receiver.

Conversely, synchronous transmission, in the B-ISDN sense, has tended to mean the transmission of a constant stream of data, using time division multiplexing and circuit switching.

ATM

Asynchronous transfer mode, or ATM, is an international packet switching standard established by the Consultative Committee for International Telegraph and Telephone (CCITT), in which the network routing instructions and control information are part of the message itself.

ATM will operate at speeds up to 2 Gbps and features the transmission of uniform cells of 53 bytes length each. Of that total, 48 bytes represent the payload while five bytes represent the header.

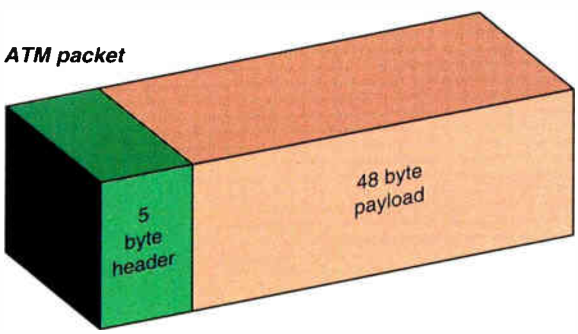
The header portion of the message unit identifies the owner of the transmitted information. ATM headers also identify the circuit number to which the message is sent.

The header also contains error control information. Because each of the cells (which may be thought of as "packets") are of identical length, whether completely full of data or empty, they can be switched quickly through a network.

In part, that advantage arises because the work doesn't have to spend time examining each packet to read its address information and assess the length of the packet.

Cell relay systems, such as ATM, are desirable when transmitting video or voice messages because the time delay is of shorter duration, and more importantly, perhaps, of predictable duration, than frame relay-based systems which use variable-length messages.

ATM packet



B-ISDN

Broadband ISDN is a high-bandwidth version of ISDN intended to support applications such as full-motion video and image. It uses a basic signaling rate of 150 Mbps and is expected to support additional bandwidth in increments of about 50 Mbps, up to about 600 Mbps.

CDMA, TDMA, FDMA

Code Division Multiple Access is a spread spectrum technology that has been developed to increase capacity over analog technologies and allow more efficient use of the spectrum. Essentially, the technology works by spreading signals across the broad frequency spectrum and assigning a unique code to each. Receivers then pluck the properly coded signals out of the mix.

The same concept of "frequency re-use" can be achieved through Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA). TDMA works by assigning each caller a unique timeslot and then sends packets of data during that slot. FDMA carves up telephone channels by frequency, instead of time and assigns specific frequencies for each user.

Cell relay

A packet switching technique that uses cells of uniform length. Such techniques are well suited for video or voice transmissions in contrast to frame relay techniques, which are better optimized for bursty data communications. Asynchronous transfer mode is a form of cell relay. So is the IEEE 802.6 standard and SMDS.

Central office

The central office, or CO, is a telecommunications facility where telephone calls are switched. In the local exchange, a central office generally represents a 10,000-access line service area.

A long-distance carrier's central office represents an access point to pick up and drop off traffic bound for, or originating from, a local exchange area (LATA).

Circuit switching

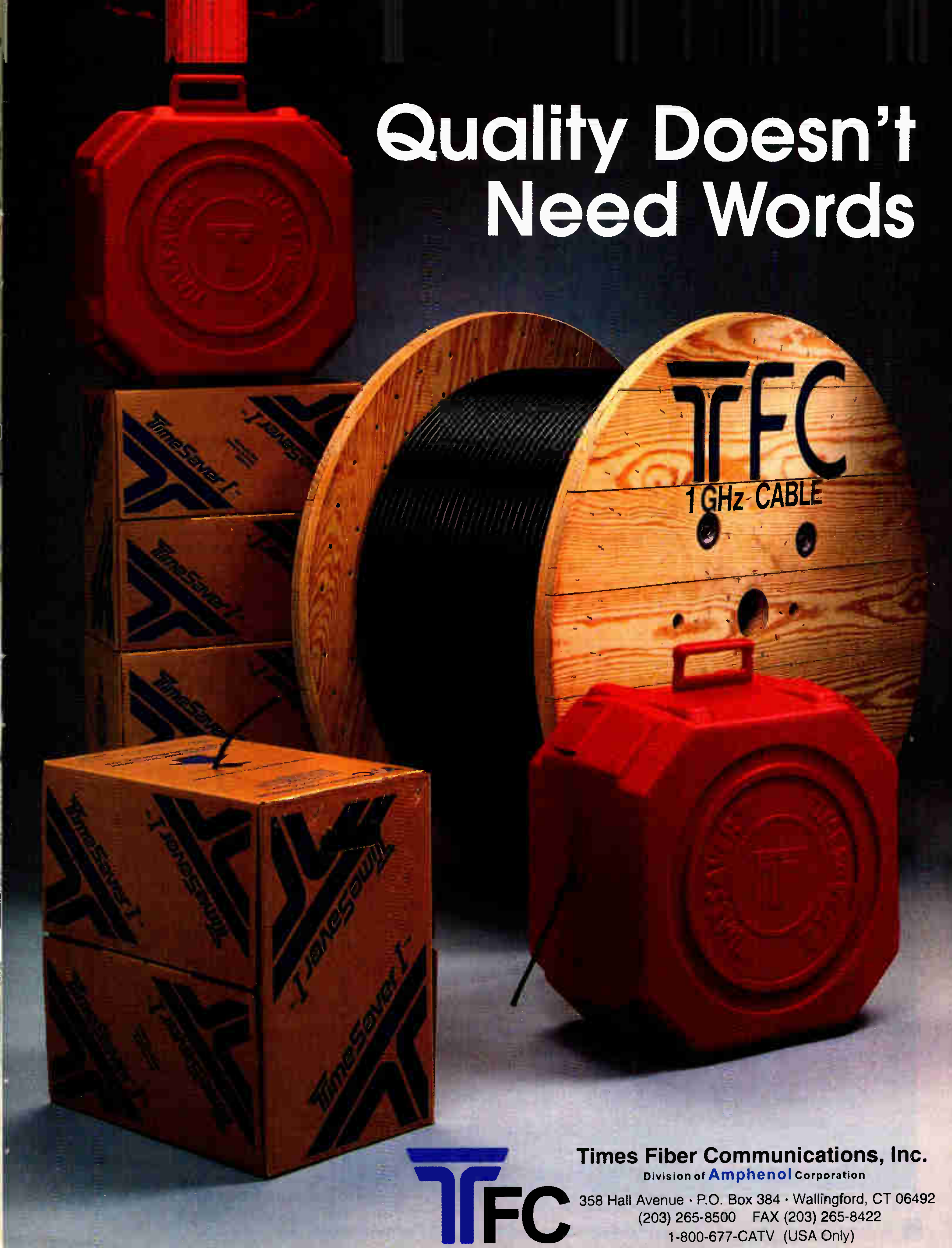
A type of switching system, historically used to establish voice connections between two or more speakers, using a dedicated physical circuit path between the callers for the duration of the call or session.

CPE

Customer premises equipment includes terminating equipment,such as telephones, facsimile machines, modems or other equipment owned by the customer and attached to the telephone network.

CSU

A channel service unit is a digital interface



Circle Reader Service No. 36

developed in 1977, outlines a seven-layer, modular method of breaking up activities required to establish and maintain a communications link between computers and computing devices, even when the machines are of different types and made by different companies.

Each of the seven layers performs a distinct part of the interaction, allowing the internal operations of each layer to be changed or modified without affecting the operation of the other layers.

The physical layer defines electrical and mechanical properties of interfaces, especially the detection of electrical voltage levels and the pin structure of interfaces.

The data link layer performs error detection and is responsible for determining when a transmission block begins and ends. It structures the received bitstream for reading by the network layer.

The network layer performs switching functions by routing packets among different pathways. Its job is to create a virtual circuit that is transparent to the other layers.

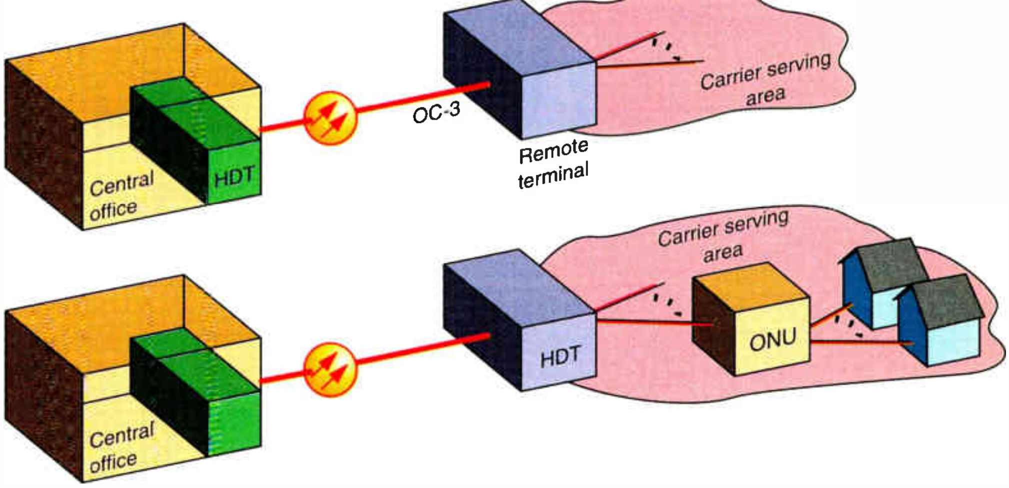
The transport layer handles those details related to moving data between one network and another. Multiplexing and error correction, for example, are handled at this layer.

The session layer establishes and maintains half-duplex or full-duplex connections as needed, and provides data flow control operations.

A half-duplex connection uses one channel to connect two speakers, allowing only sequential transmissions (in one direction at a time only).

The presentation layer handles syntax issues, rules for representing data. The application layer is the communications interface to those portions of an end-user program concerned with file management, printing operations and virtual terminal emulation.

Remote terminal



PCM

Pulse code modulation is the traditional process by which an analog signal is converted to digital form for transmission over a digital telephone network.

The sampling process involves sampling of analog voice signals 8,000 times a second. The sampled amplitudes are represented by discrete eight-bit words, leading to the standard 64,000 bits per second (64 kbps) digital signaling standard for voice.

POP

A POP, or point of presence, is a switching facility owned by a long-distance (interexchange carrier) and used to pick up and deliver traffic from one LATA to another.

RBOC

There are seven regional Bell operating companies that were created by the AT&T system breakup as holding companies for local telephone companies within their service regions. The "seven sisters" include Ameritech, Bell Atlantic, Bellsouth, NYNEX, Pacific Telesis, Southwestern Bell and US West.

Remote terminal

The subscriber plant end of a digital loop carrier transmission line, typically containing opto-electronics equipment (for optical loop carrier systems), multiplexing and demultiplexing equipment and cross-connect func-

"[People] betting on an early slam dunk in multimedia may be disappointed."

Motorola's version of the PowerPC.

Fast start for Oracle

Oracle has gotten off to a flying start in the chase for networked multimedia business, prompting even developers with strong ties to Oracle competitors to accommodate interoperability. General Instrument Corp. is a case in point, saying it is "working with" Oracle to ensure compatibility between the Oracle Media Server system and GI's LinX computerized set-top module.

The widely shared model for network distribution of multimedia assumes at least two and, often, three tiers of storage to accommodate levels of demand for various types of services. The most demanding level concerns the top 10 or so movies which 80 percent of video-on-demand customers are likely to order at any one time, according to Ben Linder, director of technical marketing for Oracle Media Server software. These movies will be stored in main server memory.

A second tier of some 200 movies or so will be stored on some 1,000 hard storage disks inside the server. The third tier uses 8 millimeter digital tape cassettes, each with a single title, numbering in the thousands. To support thousands of simultaneous viewings from a single recording, as might be required for the top 10 movies, developers employ a technique known as "memory striping," which distributes the same tiny segment of a given movie to several memory disks at one time, allowing independent access by a small cluster of users from each disk.

Advances in CD-ROM

The whole array supports an extremely high capacity electronic video store, at costs which some feel will permit telcos and cable companies to draw customers. But, with the early iterations of the client/server systems taxed to achieve this level of capability, it remains to be seen whether the platform can also support customers' access to the huge range of titles entering the market from the CD-ROM multimedia side.

Moreover, because the latter are designed for playback on progressive scan computer screens, efforts to translate them to NTSC interlaced TV formats add to the costs and consume valuable processing time. "You pay a real premium in functionality when you try to take advantage of the embedded TV base as a platform for digital media," notes Larry Fennell, an advanced display system researcher at Xerox.

As network operators wrestle with the problem of getting first-generation platforms off the ground that can support what amounts to a largely movies-on-demand business, the multimedia systems developers

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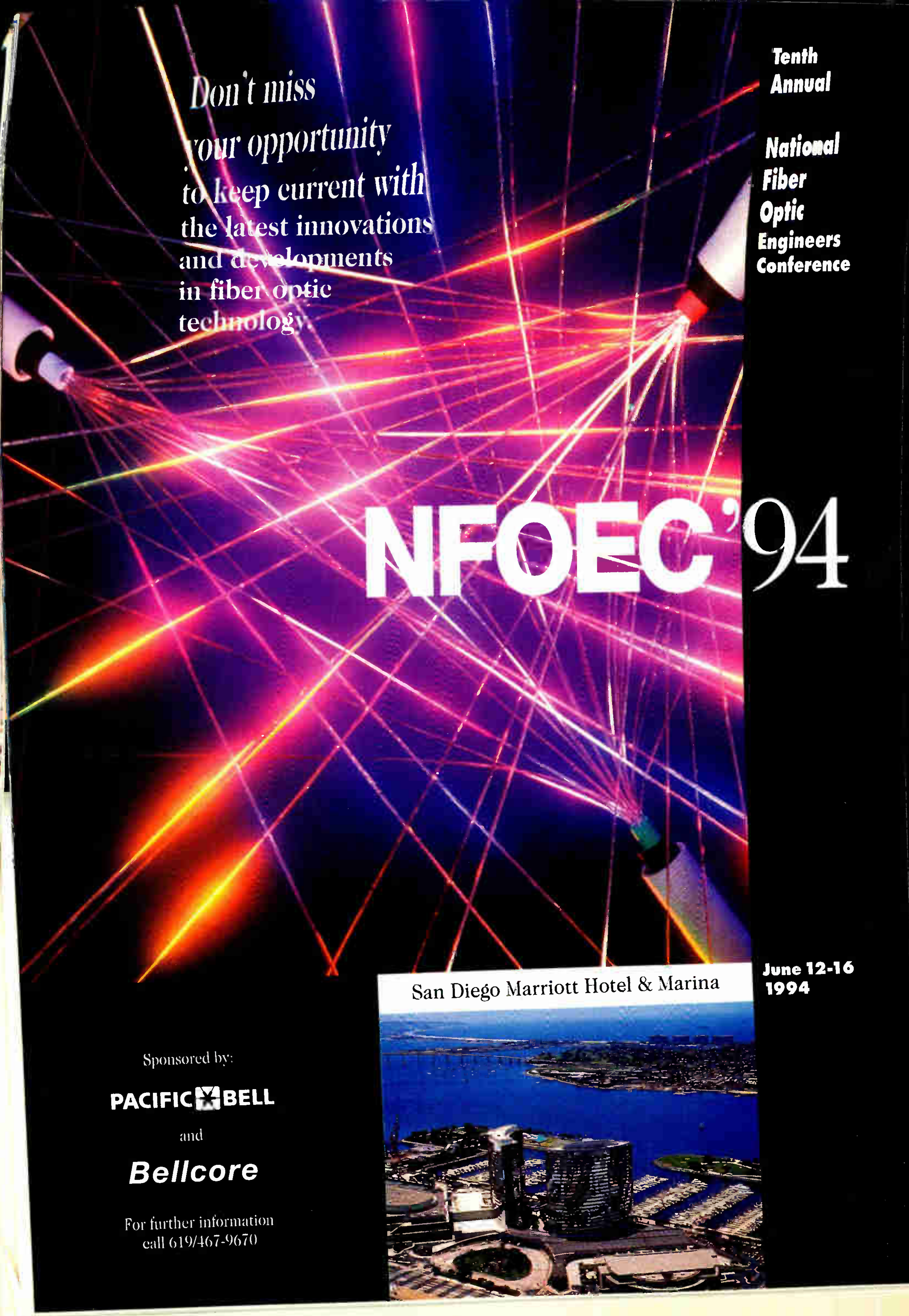
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Learning from each other

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

Without warning or premonition, as I was writing this column, TCI and Bell Atlantic walked out of the church, unmarried. Metaphors about a new 1849-style gold rush and the franchise feeding frenzy of the 1980s suddenly seemed inappropriate. Maybe, though, we are not quite back to square one. Perhaps, in the coming together since last fall, both telco and cable interests have had opportunity to reflect on their undeniable interdependence. Exciting new vistas have been opening, more in the context of the circumstances that gave birth to the TCI/BA merger than as a direct consequence of the now abandoned deal.

Telcos once believed they would be uniquely capable of providing "true" video-on-demand, including the pause and fast forward/reverse functions of the VCR, by adapting to video the historic telephony architecture utilizing central office switching and dedicated subscriber lines. Cable TV can't do that; can it?

Well, yes; as a matter of fact, cable *can* do it and has actually been leading the way with two important developments. The linear laser, first reported in 1987 by Jack Koscinski of Irving Kahn's General Optronics, permits simultaneous fiber optic transmission of analog and digital signals on RF carriers. Telephone experts scoffed, secure in the notion that the essential nonlinear characteristics of lasers could be effective only with digital signals. As the feasibility of the AM fiber has been clearly demonstrated by Jim Chiddix and others, AT&T and other telephone-based engineers have begun to take notice.

Then in June of 1990, the VideoCipher division of General Instrument, a cousin to Jerrold, the all-time leading supplier of CATV equipment, stunned the army of HDTV developers with its DigiCipher bombshell. In addition to compressing the digital signal at the source, DigiCipher proposed to use QAM (quadrature amplitude modulation) technology to squeeze the compressed digital signal into the available 6 MHz. Zenith's comparable competing 16 VSB technology has now been approved and certified by the FCC.

These two technologies, AM fiber and high bits-per Hertz modulation efficiency developed by CATV, form the foundation stones for local area distribution of video and probably voice and interactive data as well. Interconnecting local areas is more likely to follow the telco developed SONET (synchronous optical network) type protocols based on time division multiplexed PCM (pulse code modulation) technology.

First Pacific Network (FPN)

The first serious architecture integrating POTS (plain old telephone service) and CATV on the same network was introduced by First Pacific Network in 1989. Duplex voice (and data) signals would be modulated on RF carriers for transmission on three or more pairs of 6 MHz channels over networks with no more than about 1,000 homes passed per optical node. This arrangement superimposes the voice and data traffic on existing CATV tree-and-branch networks, connected at the headend to the PSTN (public switched telephone network) or long distance POP (point of presence).

FPN states that three 6-MHz channel pairs would support up to 1,380 voice users at P.01 grade of service; i.e. the probability would be less than one percent that a user could not complete a call in the busiest hour of the busiest season. Incremental costs added to an existing CATV plant, are estimated at about $400 each. This arrangement overlays POTS on existing cable TV networks.

On the other hand, the BBT architecture superimposes digital video on existing telephone plant, upgraded with fiber-to-the-curb. Voice and data are switched at the central office (CO) but video is switched at remote terminals (RT) in controlled environment vaults (CEV) for every 250 or so households. A total of 16 time division multiplexed (TDM) DS-3 channels per fiber, each carrying up to six MPEG-2 compressed video signals, are transported to the RT switches. There, the program selected at the user's keypad is switched to one of the 24 TDM DS-3s transmitted to ONUs, (optical networks units) each with 8 video ports. The proper DS-3 is demultiplexed at the ONU and transmitted on coaxial service drop to the subscriber premises.

Thus, up to six separate programs can be switched on request to each subscriber. The BBT architecture is quite expensive, providing enhanced POTS (fiber-to-the-curb), off premises switched video and interactive information services. The BBT architecture is not compatible with cable-ready TV sets, because it delivers only one channel at a time to the TV or VCR antenna port.

Learning together

Cable has a lot to learn about the POTS business, especially about switching for ready access all over the world. We have not yet fully addressed the issues of outage prevention, service and public relations in a manner comparable to telephone company practice. Of course, there is a difference: telcos are reasonably assured a "cost plus" pricing, while cable TV is being beaten bloody by congressionally mandated unjustified rate regulations.

Telcos are just beginning to learn that the classical architecture that has been successful for narrowband voice and interactive information services may not be the proper solution for video distribution. The vehemence of the public anger over wired video's incompatibility with "cable-ready" TV sets and VCRs is beginning to spill over on to video dialtone. The notorious breakup of the TCI-BA merger is not likely to relax the learning process, on either side. CED

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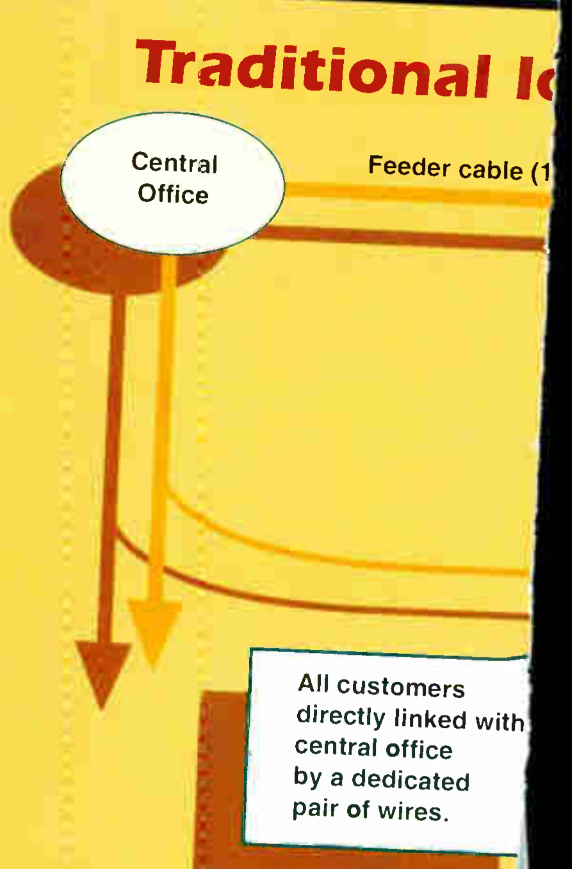
The evolving local loop

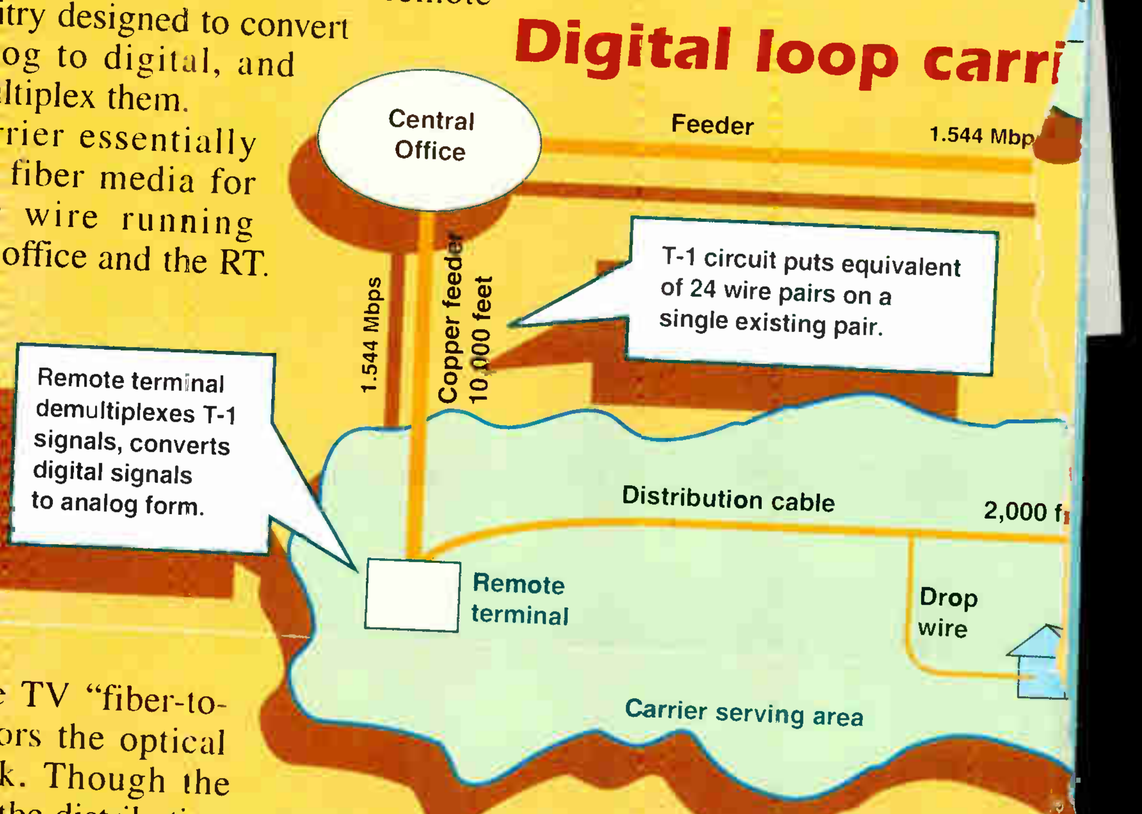
The traditional local portion of the telephone network involved stretching a dedicated set of wires from a central office or wire center out to each customer's premise. By the late 1970s, though, telephone network designers had begun to use a new concept, that of the "serving area," to reduce the amount of capital investment required in a new-growth area. The idea was to plan, in advance, for network resources sufficient to serve an area containing several hundred to 3,000 homes, but to defer actual installation of plant until new housing construction created an immediate demand.

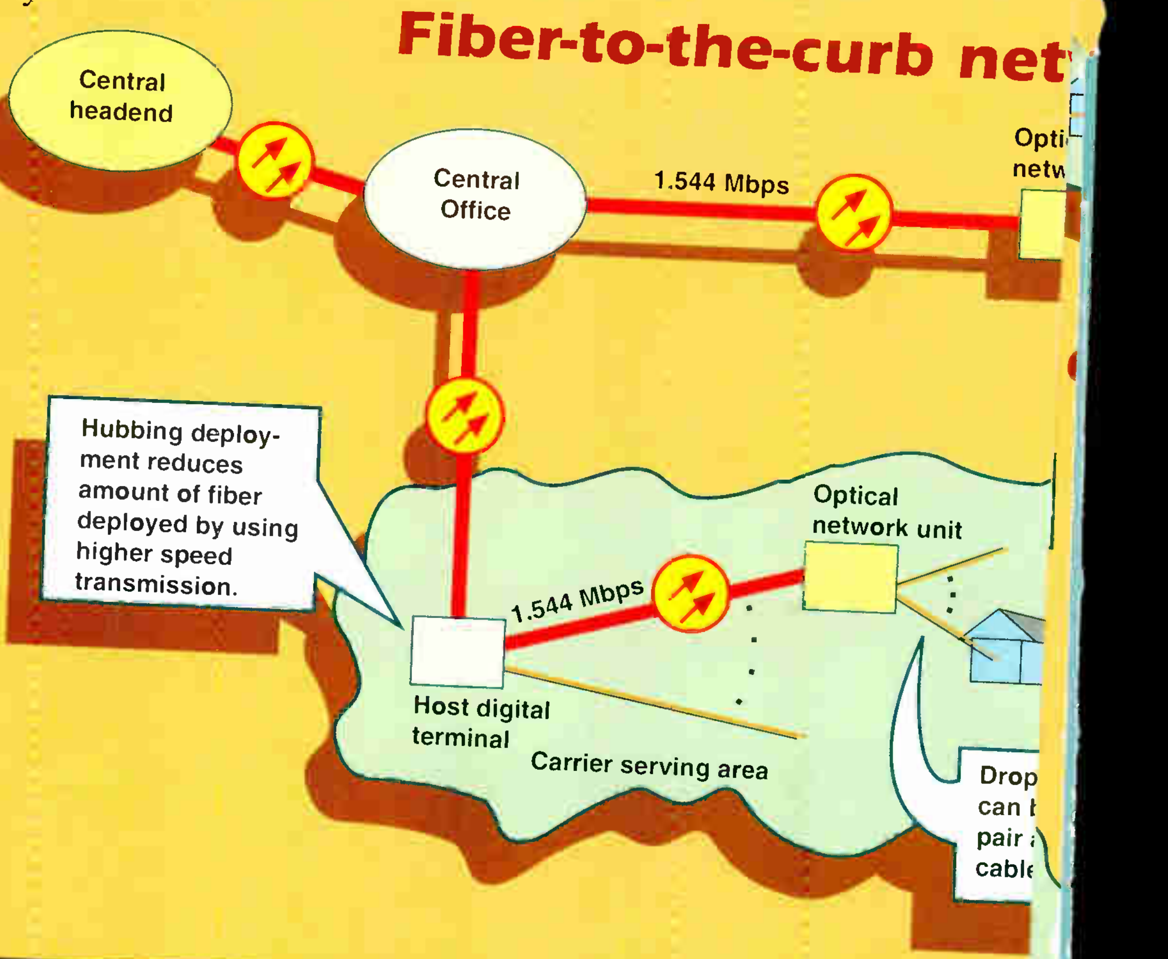
The "carrier serving area" was further developed with the advent of digital loop carrier, a method of gaining more channel capacity without adding new wiring to the existing plant. This type of upgrade involves the use of digital transmission at 1.544 Mbps on a single pair of wires that formerly could carry only a single voice conversation. Such capacity represents 24 voice circuits. A DLC network replaces the serving area interface with a remote terminal with circuitry designed to convert signals from analog to digital, and multiplex and demultiplex them.

Optical loop carrier essentially substitutes optical fiber media for the older copper wire running between the central office and the RT. The future fiber-to-customer network will move fiber closer to the customer location, to the curbside in some cases, to neighborhoods of a few hundred homes in other cases.

Note that the cable TV "fiber-to-feeder" design mirrors the optical loop carrier network. Though the physical topology of the distribution network (cable TV feeder) may be different, the logical topology of both networks can be identical.







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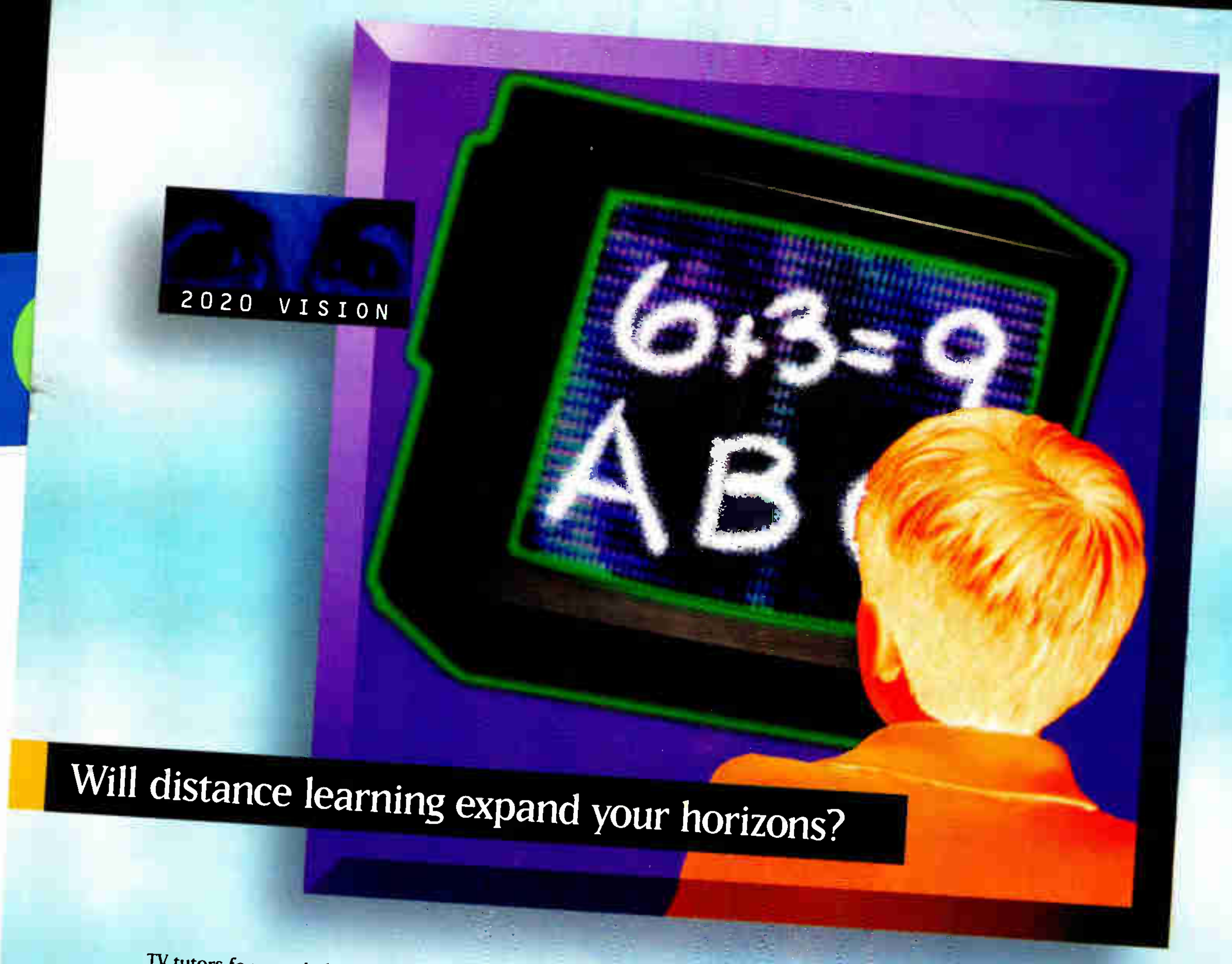

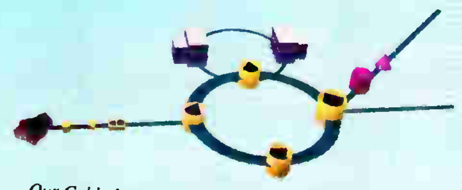

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