CED

COMMUNICATIONS ENGINEERING & DESIGN
THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS

Cable telephony: Coming into focus

MARCH 1996 CED Reliability Powering Network management

Here's How Cable Operators

Hang Ten Mbps. There's a tidal wave breaking in cyberspace. An ever increasing swell of millions of net surfers worldwide. This global community of surfers will look to ride on the cutting edge. To push the envelope and surf to the farthest frontiers of the internet in the blink of an eye. Now is the time for cable operators to channel the power of this on-line surge before it crests.

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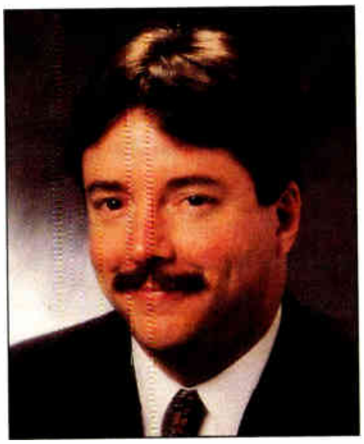
Money talks, but how fast can it speak?



After several long months of posturing and negotiation, federal legislators last month passed a sweeping telecom reform bill through Congress. The action, capped with a White House signing ceremony that gave the Clinton Administration way too much credit for the reform, was heralded in a number of quarters as "revolutionary" and other, similar terms. CEOs of every major communications and hardware company were seemingly elated at the news.

It is perhaps ironic now to realize that although the new law allows cable TV companies to get into the telephony business and telcos to offer video, neither scenario is immediately likely, except perhaps in some select markets. Instead, local exchange companies are busy working to cannibalize their brethren by jumping into the long distance market, while the interexchange carriers eye the local market the way a thirsty vampire views a pulsing jugular.

Cable MSOs, meanwhile, are clearly focused in the near-term on launching a pre-emptive strike against the telcos by deploying high-speed data modems. Seeking to capitalize on the burgeoning popularity of on-line services and Internet users, the MSOs hope to deploy such units nationwide. This, they hope, will allow them to lock up marketshare before the telcos can respond with ISDN and similar services.

While consumers may not yet be aware of the cable industry's plans, the operators are making sure the message isn't missed by the information technology crowd. In fact, the MSOs and CableLabs made a bit of a splash during last month's ComNet show in Washington in what could be described as something akin to a "coming out" party.

Clearly, there is no shortage of suitors for this debutante, judging from the hundreds of people who crowded into the CableLabs IT/Convergence forum, or gathered to hear a representative of Prodigy talk about how the cable companies can eliminate the telephony bottleneck that chokes information flow. And if that wasn't enough, officials from Digital Equipment Corp., Cisco and LANcity were on hand to talk about how they have already taken the plunge.

David Fellows of Continental Cablevision and Mario Vecchi of Time Warner provided overviews of their plans, which can be described as nothing short of aggressive. Fellows told the gathered audience about Continental's Project Agora that connects more than 5,000 Boston College students and faculty members to information at 10 megabits per second. He also talked of how equipment is already in place that allows doctors in Exeter, N.H. to review documents and patient information from the local hospital. Vecchi, on the other hand, explained how his company is structuring its planned "LineRunner" service around industry standards and a common set of protocols in order to ensure universal connectivity.

Unlike some recent industry announcements that were long on hype and short on reality, it's clear that data services won't die on the vine. There's already too much investment being made by the MSOs to turn back now. According to Fellows, Continental alone has budgeted $50 million in capital spending to prepare its network and roll out modems. Money talks. The cable industry hopes it speaks at 10 Mbps or faster.

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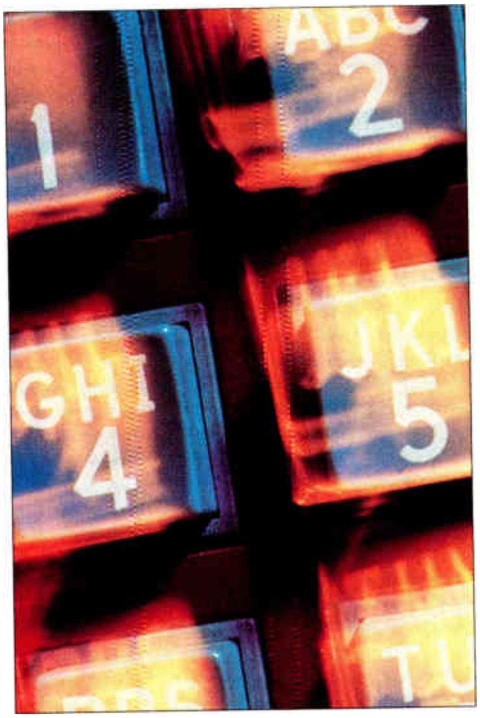

Photo by David McGlynn, FPG International

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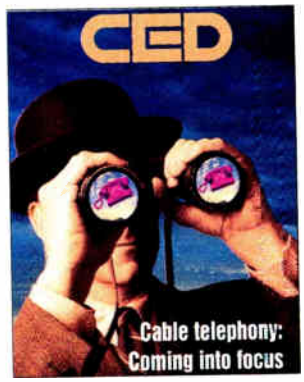

About the Cover

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Circle Reader Service No. 3

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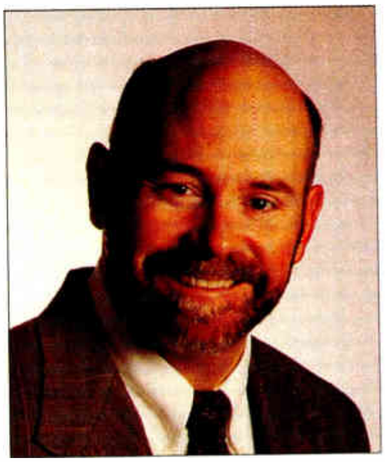

Chris Barnhouse

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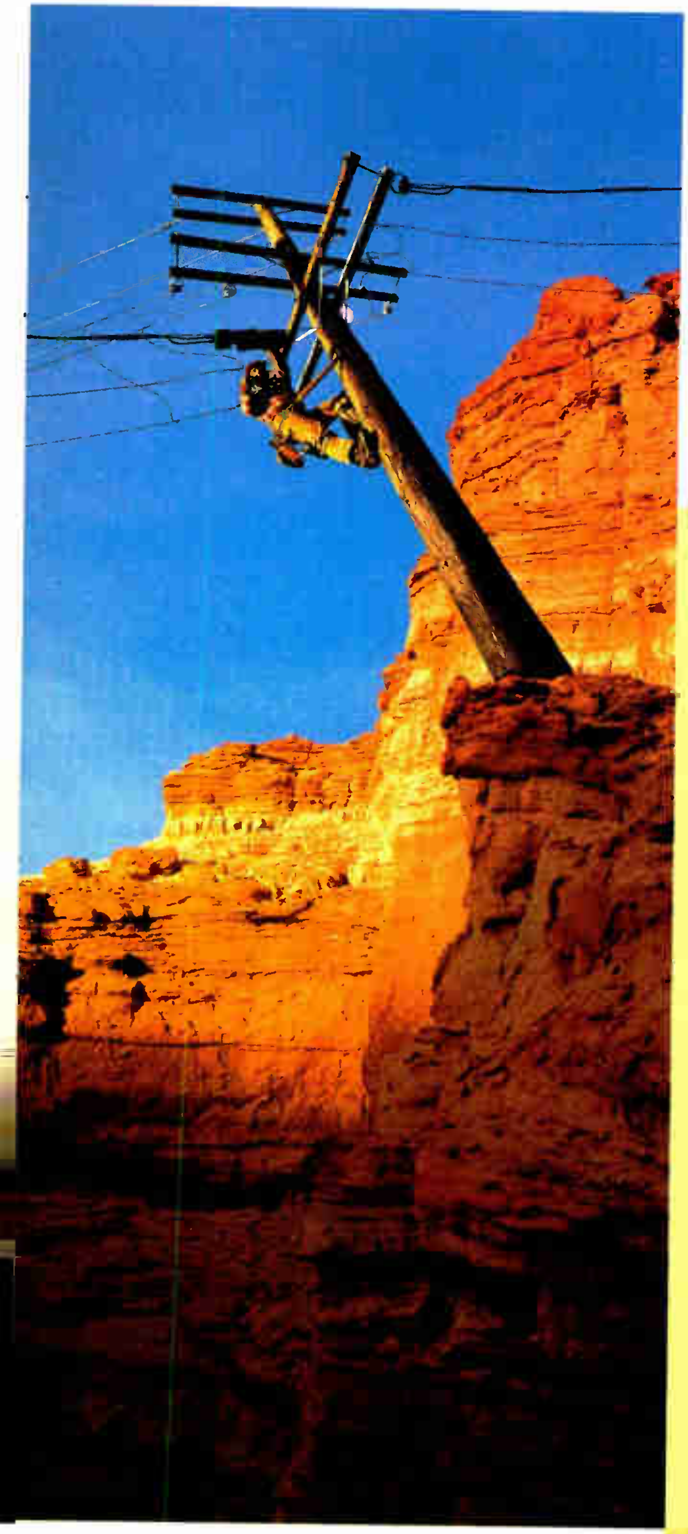

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O F L I G H T

Circle Reader Service No. 6

SNET pulls plug on Conn. VDT plans; pursues statewide cable franchise

It may not be dead yet, but video dialtone is bleeding profusely and barely breathing now that Southern New England Telephone Corp. has abandoned its VDT plans in favor of requesting a statewide cable TV franchise in Connecticut, it was announced in late January.

To pursue that goal, the company created a new subsidiary, SNET Personal Vision, to build I-SNET, the company's state-of-the-art hybrid fiber/coax network.

In fact, the construction of I-SNET is already well underway, according to Patrice Listfield, who has been named president of the new subsidiary. Pending regulatory approval, which SNET hopes to have in hand by this autumn, integrated video and voice services could be offered to as many as 22 percent of the homes in Connecticut by the end of 1997, and up to 36 percent in 1998, Listfield said during a conference call interview with reporters. By 2000, service is expected to be offered to 64 percent of Connecticut homes. The entire state will be served by 2009.

The 76-channel analog network, which will utilize a unique, 480-volt powering approach, will be ready to transport both voice and video signals over the plant beginning in 1997, according to SNET officials.

SNET decided to drop its VDT plans in favor of the traditional franchise model because of dissatisfaction over the Federal Communications Commission's slow approval process. "We just don't want to keep Connecticut consumers waiting," said Listfield in a statement.

SNET anticipates offering service to portions of Darien, Fairfield, Norwalk, Stamford, Weston, Westport, Farmington, New Britain and West Hartford within a few months of receiving regulatory approval. Other communities will be rolled out in an orderly fashion (see Table, left).

The company is already trialing the network to 350 West Hartford residents under VDT approval. That service will continue to be offered free of charge until that area becomes part of the cable franchise.

The announcement no doubt comes as good news to equipment suppliers that would benefit from the $4.5 billion network upgrade.

SNET Personal Vision deployment schedule
(By end of year 1998, assumes regulatory approval by 3Q '96)
Approximate percentage of homes and businesses in parentheses following town

Bethel	(100%)
Bloomfield	(100%)
Branford	(100%)
Bridgeport	(65%)
Bristol	(100%)
Danbury	(89%)
Darien	(100%)
East Haven	(100%)
Fairfield	(100%)
Farmington	(100%)
Hartford	(17%)
Meriden	(100%)
Milford	(100%)
New Britain	(100%)
New Haven	(70%)
North Haven	(79%)
Norwalk	(100%)
Old Greenwich	(100%)
Plymouth	(55%)
Stamford	(100%)
Stratford	(100%)
Trumbull	(16%)
Wallingford	(100%)
West Hartford	(100%)
West Haven	(98%)
Weston	(92%)
Westport	(100%)

CAA and Intel join to create media lab

Creative Artists Agency (CAA) and Intel Corporation plan to establish a multimedia lab as part of joint efforts to further the creation of new multimedia entertainment and information programming for home personal computers connected by high-speed communications.

CAA and Intel will work together to encourage, identify and accelerate the development of new entertainment media. The companies will create a multimedia lab at CAA equipped with a range of state-of-the-art PCs, multimedia tools and consumer applications where CAA clients and other content developers can gain exposure to PC capabilities. The companies will also assist early-stage media companies focusing on applications which take advantage of high-performance PCs and online networks.

"The powerful multimedia home PC represents the first major new medium since the creation of television," said Avram C. Miller, Intel vice president and director of business development. "We welcome the opportunity to work with CAA to expose the creative community to the power of this new medium and the business opportunities it represents."

Hassan Miah, recently appointed to head CAA's New Media Group, will have responsibility for the Intel relationship within CAA. Miller will be responsible for the relationship within Intel.

S-A begins work on Iridium units

Scientific-Atlanta Inc. has received an order valued at more than $17 million to produce the satellite communications terminals for Motorola's planned Iridium global communications system. Scheduled to become operational in 1998, the Iridium system would be the first wireless communications network designed to serve handheld telephones with a single number virtually anywhere in the world.

The order calls for production of 21 earth terminals which will be configured into seven communications gateways. Production will begin immediately, and delivery of the first units is scheduled for December. The contract contains options which allow Motorola to purchase an additional 20 communications terminals.

Back in 1994, S-A was named the exclusive supplier of satellite earth terminals for Iridium. Under terms of the original contract, two types of satellite communications stations are being built for Iridium: system control segment earth terminals and communications terminals.

Thus far, S-A has provided Motorola eight of 20 earth terminals, valued at $25 million. The terminals are used in telemetry tracking and command centers located in Canada, Hawaii and Iceland to monitor and control the Iridium constellation of satellites.

The new communications terminals will be installed throughout the world in a configuration of terrestrial gateways which will interface with the public switched telephone network. A typical gateway will consist of three earth terminals geographically dispersed to ensure continuous satellite communications service and high availability under various environmental conditions. Continuous global communications will be ensured through the use of a constellation of 66 satellites in low earth orbit networked together as a switched digital communications system.

Installation of the first Iridium gateways at strategic locations throughout the world is scheduled to begin in early 1997.

TV, utility control combined in Atlanta

Wireless Cable of Atlanta, Atlanta's wireless cable television system operator, will work with The Southern Investment & Development Group, a subsidiary of The Southern Company, to provide cable television services to a 303-unit apartment community located in metro Atlanta.

Wireless Cable will be responsible for the design, reception, installation and transmission of broadband telecommunications service to the community. Southern Investment & Development Group will provide remote electrical service metering and load management, access to long distance telephone service provided by a local telephone company or Southern Development in conjunction with DeltaCom, interactive energy management by The Southern Company, thermostat controls provided by Raytheon, interactive video provided by Source Media, an intrusion alarm system monitored by Southern Development, internet access provided by Mindspring Enterprises Inc., and the ability to bill all services with one monthly statement. First Pacific Networks Inc. is providing the technology that enables the infrastructure to operate as a full service network.

Together, these services make up the Georgia Power Co. Good Cents Premier Home. Chatelaine Park is the first and only multi-family community offering the Premier Home in the nation.

ISDN Forum formed to speed deployment

AT&T Network Systems, 3Com Corp., Ascend Communications Inc. and U.S. Robotics Inc. have announced that they have established the ISDN Forum, an industrywide group whose purpose is to make ISDN (Integrated Services Digital Network) more accessible to small businesses and consumers. The ISDN Forum will enhance interoperability between ISDN end-user equipment and the public network, and promote the market's use of ISDN for applications such as Internet access, telecommuting and videoconferencing. The Forum's first effort will be to make ISDN installations more transparent to the end user.

Forum participants will exchange technical information regarding ISDN; address ISDN user needs; and promote interoperability that allows faster and easier digital transmission of voice, images and data across copper telephone lines. After an initial organizational meeting, the companies will make further information on participation available to members of the industry, including customer premise equipment vendors, network infrastructure vendors, network service providers, information service providers and applications developers.

The initial focus of the Forum's work will be on automated ISDN configuration capabilities including automatic switch detection and automatic Service Profile Identifier (SPID) capabilities. ISDN users currently need to configure their systems for ISDN by entering information about their telephone switch and SPID. Forum participants will design automated ISDN configuration capabilities that will be transparent to the end user by the end of 1996.

"Our goal is for people to take home an ISDN terminal device, unpack it, plug it in and be able to use it," said Bernie Schneider, vice president of marketing at Ascend Communications, in a statement.

ADC makes jump into MMDS with acquisition

ADC Telecommunications Inc. has announced its entrance into the wireless cable market with its agreement to acquire ITS Corporation, a leading global manufacturer of television transmission products for the broadcast and wireless cable industry. ADC has agreed to purchase ITS in a stock transaction valued at approximately $34 million.

The addition of ITS' analog and digital broadband wireless transmitters to its product portfolio will be ADC's first step in serving an industry that some analysts believe could achieve a 25 percent penetration of all U.S. households by the year 2005. To complete its wireless cable offering, ADC intends to secure partners to provide home antennas, downconvertors and set-top boxes.

Because of advancing technology, lower investment costs and shorter deployment times, many network providers are strongly considering wireless cable as a viable alternative to wireline cable and direct broadcast satellite. Certain RBOCs, for example, view it as a potentially fast and economical first step in entering the video service delivery marketplace. Recent purchases of frequency assignment license holders by PacTel, Nynex and Bell Atlantic is evidence of the revenue potential anticipated for the wireless cable market.

The addition of wireless products will complement and expand ADC's broadband product portfolio. That family will now include a hybrid fiber/coax platform; a digital video transmission system; a network element manager system; MPEG-2 encoders and decoders; and now, ITS' digital modulator and wireless broadband transmitters. Additionally, ITS' low-power broadcast television transmitters provide a path for the move to digital television and HDTV.

Also, to add to its wireless cable solution, ADC has contracted with the David Sarnoff Research Center for systems engineering design of a two-way, interactive wireless broadcast architecture that could support fully interactive video, data and telephony, and potentially both MMDS and Local Multipoint Distribution Service (LMDS) frequencies. The David Sarnoff Research Center performs research, development and exploration of new technologies, including the development of potential and innovative products and systems in electronics and communications.

Bell Canada tests OC-192 gear in Ottawa

Bell Canada trialed new OC-192 technology from Nortel that promises to increase the capacity of its fiber optic network by four times and transmit 10 billion bits of information per second. This new transmission system will support voice and data calls, as well as applications like medical imaging, videoconferencing and Internet connections. The additional capacity will ensure Bell can meet the future needs of business and residential customers.

Using S/DMS TransportNode OC-192 equipment from Nortel, Bell became the first telephone company in Canada to carry voice and data traffic at the speed of 10 gigabits per second using this new technology.

The trial, over two fiber optic routes within Ottawa, delivered medical images between a Nortel research facility in Nepean and the University of Ottawa Heart Institute in Ottawa, and connected through Bell's switching center located on Bank Street.

Bell Canada officials said demand for telecommunications capacity on their network is exploding, with new information-intensive uses coming on-line every day. Internet traffic alone is doubling every four months, officials said.

In addition to medical applications, the OC-192 can support more than 1,300 channels of premium quality video simultaneously. The OC-192 also provides Asynchronous Transfer Mode (ATM) connectivity which allows large amounts of data to be transmitted for business and banking uses.

Fiber extends reach through N.Carolina

Construction is currently planned or underway statewide that will connect nearly nine out of 10 North Carolina cable subscribers to advanced fiber optic technology by 1998, according to an independent study completed by an economist at the University of North Carolina at Charlotte (UNC-C).

"Over the past 15 years, the North Carolina cable television industry has experienced three-fold growth," said UNC-C economist John Connaughton, who conducted the study commissioned by the N.C. Cable Telecommunications Association. "This growth has propelled the cable industry into a major role within the state's economy."

According to the study, 65 percent of N.C. cable subscribers are now served by fiber optic cable, and that number will grow to nearly 90 percent in just two years.

Fiber optic technology will not only improve the quality of television reception, but also, will enable cable companies to provide enhanced electronic information services to North Carolinians, such as telephone service and access to the Internet.

The UNC-C study showed that:

✔ The cable industry will have an estimated $657 million total impact on the N.C. economy in 1996.

✔ The total impact of new construction spending by the cable industry in the state will be more than $450 million in 1996.

✔ Employment from ongoing cable industry operations and new construction should total 6,561 jobs in 1996.

✔ When planned system conversions are completed, the N.C. cable industry will provide fiber optic technology to 87.2 percent of its subscribers, nearly nine out of 10 N.C. cable subscribers.

Besides providing the fiber optic connectivity, cable telecommunications services are now providing an important electronic link between students in N.C. public schools and global information resources.

Another independent study, commissioned by the N.C. Department of Public Instruction in 1995, shows that of the 1,963 K-12 public schools in the state, 80 percent have access to televised instruction provided by their local cable system.

The study, conducted by Lee Wing, a telecommunications consultant with Responsive Media Inc. in Durham, N.C., shows that many additional schools could be connected to cable immediately or after modernization of the school's internal wiring.

MCI wins DBS slots; TCI alters its plans

Given all the delays the telecommunications bill went through before its final approval on February 1, the recently completed FCC auction for coveted DBS orbital slots and related developments seemed a perfectly orchestrated prelude to the bill's passage and the dramatic changes it will bring.

After much hemming and hawing, suits and countersuits, as well as the gnashing of corporate teeth over the FCC's plan to auction 28 frequencies at 110 degrees W.L. and 24 frequencies at 148 degrees W.L., the auction finally took place in late January. The FCC established the auction last year when it denied TCI's attempt to buy the 110-degree frequencies from Advanced Communications Corp. after the FCC ruled Advanced had not met "due diligence" requirements to establish DBS service.

The momentous auction produced some stunning results with MCI Communications Corp. bounding into the DBS ring with a whopping $682.5 million bid for the much-sought-after frequencies (with their national, 50-state footprint) in the 110-degree slot. The 18-round auction, which began with an initial bid of just over $200 million, involved MCI and only two other bidders, TCI Technology Ventures Inc. and EchoStar DBS Corp. TCI dropped out after the seventh round, while EchoStar persisted into the 17th round, entering a $650 million bid. EchoStar later went on to win the 148-degree frequencies (which cover the U.S. except the Northeast) with a $52.3 million bid.

Soon after the auction, MCI announced it would wake-up its somnambulant $2 billion partnership with Rupert Murdoch's News Corp. to cash in on the newly-opened DBS gateway. The two companies said they planned to spend an additional $1 billion to get their DBS service up and running within 24 months.

As if cable and the RBOCs didn't have enough to worry about, the auction itself was preceded by yet another dramatic development: AT&T's $137.5 million investment in DirecTv. With approximately 1.25 million subscribers, DirecTv will get a big boost when AT&T begins an aggressive marketing campaign for the service among its 90 million customers by mid-1996. Depending on AT&T success in signing up new subscribers, it can exercise options to buy up to 30 percent of DirecTv over the next five years.

After being thwarted in the DBS auctions, TCI announced the formation of a new satellite business unit to join together TCI's satellite interests, including the company's investment in Primestar. Gary Howard, senior VP of mergers and acquisitions for TCI Communications Inc. and president of Primestar by TCI, has been appointed to lead the as yet unnamed satellite unit, reporting directly to Brendan Clouston, president and CEO of TCI Communications Inc.

Immediately after the auctions were held, Primestar Partners announced it is deferring a planned capital expense of $500 million to upgrade the service to high-power satellites. Primestar will instead continue to offer medium-power service.

Clarification

Due to a printer error, the credit for the graphic on page 68 of the January '96 issue of *CED* was inadvertently dropped. The artwork was provided courtesy of Motorola Inc.–Multimedia Group.

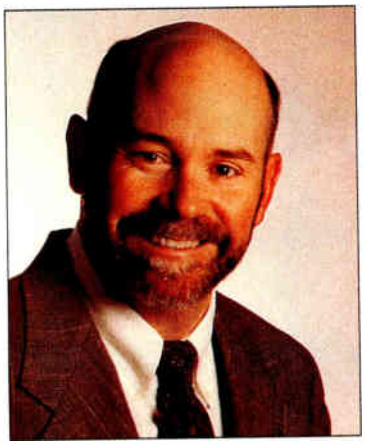
Jottings

TCI has awarded a digital ad insertion hardware and software contract worth more than $6 million to **SeaChange Technology**. TCI will use the equipment in five systems to insert commercials on more than 600 channels covering 40-plus zones. The equipment will be used in Dallas, Miami, South Bend, Ind., northern New Jersey and Pittsburgh . . . Ever heard of the word "lucent?" You will, for that's the new name **AT&T** has chosen for its new systems and technology company, which was formed by AT&T's intent to restructure into three separate companies. The new **Lucent Technologies** name was touted as simple and memorable and having a "technological feel." Lucent businesses will include Bell Labs, network systems, business communications systems, consumer products, microelectronics and multimedia ventures and technologies. . . **Hewlett-Packard** has chosen **Wind River Systems'** VxWorks real-time operating system to run its "QuickBurst" high-speed data-over-cable modem . . . **Fujitsu Limited** will merge the operations of its two U.S. switching and transmission subsidiaries in order to be more responsive to customers who are seeking an integrated fiber optic and broadband switching solution, according to company officials. Fujitsu Network Transmission Systems will merge with Fujitsu Network Switching of America and will be headquartered in Richardson, Texas, where the transmission and switching systems will be manufactured. The Network Switching facilities in Raleigh, N.C. will operate as a switching development center . . . . CED

Solving problems in the real world

Every day for six months, Chris Barnhouse boarded a bus that took him past a sleepy zoo, up to the side of a mountain, through a set of blast doors set in the mountain, and through a tunnel that was drilled a quarter mile through solid rock, back into the heart of Cheyenne Mountain and NORAD.

Looking back on those days in the late 1970s, Barnhouse, who is now Time Warner Communications' vice president–technology, remembers the excitement—and the stress—that went along with managing long-haul communications for the military command post. That was back in the days of the DEW (Distant Early Warning) line radar system, which kept watch over the top of the Arctic Circle for incoming Soviet missiles. Every once and awhile, NORAD would lose communications contact with one of those remote sites, and Barnhouse and company would start scrambling to determine if it really was a communications problem—or if a missile had just taken out a radar site. "If we didn't isolate it in a certain amount of time," he explains, "then we'd start to go on alert."



Chris Barnhouse

After about six months' worth of NORAD, Barnhouse, who began his career in the Air Force, decided to chill out for awhile, making the trek down to Florida where he worked, among other "odd jobs," as a forest ranger. He then headed back to Minnesota, his home state, where he hooked up with Norwest Banks as a data network specialist in the early '80s. After a stint working on a large, private network at another Minnesota-based corporation, Honeywell, Barnhouse signed on with US West, which had just formed an Advanced Technologies unit.

The big project for him there was working on a high-speed, metropolitan network, building a fiber optic backbone to link up two of 3M's facilities to a Minneapolis-based supercomputer center. The project was really the first of its kind. "It was the forerunner for a lot of high-speed networks," says Barnhouse. "Things like high-speed frame relay, and native LAN services that some of the carriers are [now] starting to offer [are the descendants of that project]."

Let your voice do the walking...

After making the move to Colorado and doing a stint with US West Marketing Resources, the company's $1 billion Yellow Pages subsidiary, where he helped to deploy a nationwide digital voice and data communications network, Barnhouse returned to the Advanced Technologies Group based in Boulder, Colo. His next job responsibilities would pave the way for his future entry into the cable telephony business: Barnhouse was charged with operational support systems planning to support new services. "My job was to work with service planners and figure out what kinds of changes we needed to make to the OSS to do things like network management, monitoring, billing and provisioning," he says.

One project he worked on was a voice dialing service, which used a speech recognition system to enable customers to store "voice-activated dialing patterns like 'Dial Pizza Hut'," Barnhouse adds.

A crazy assignment

Either because they shrewdly assessed the extent of Barnhouse's talents, or possibly because they had a long-standing fondness for pizza, execs at US West Cable pulled him over to do some work for them when US West started initial talks with Time Warner about partnerships. Barnhouse was offered a high-risk assignment to provide technical support for the venture.

"It was a lone assignment, with no guarantee of a job," he remembers. "I had to tell my boss that I wanted to take off on a crazy, secret assignment. And I had to convince him to let me come back if it didn't work out."

Fortunately, it did. That was three-and-a-half years ago, and since that time, Barnhouse has been figuring out how to architect the transmission networks for cable telephony, as well as how to make use of Sonet and digital switching. He has also spent lots of time evaluating and negotiating with suppliers.

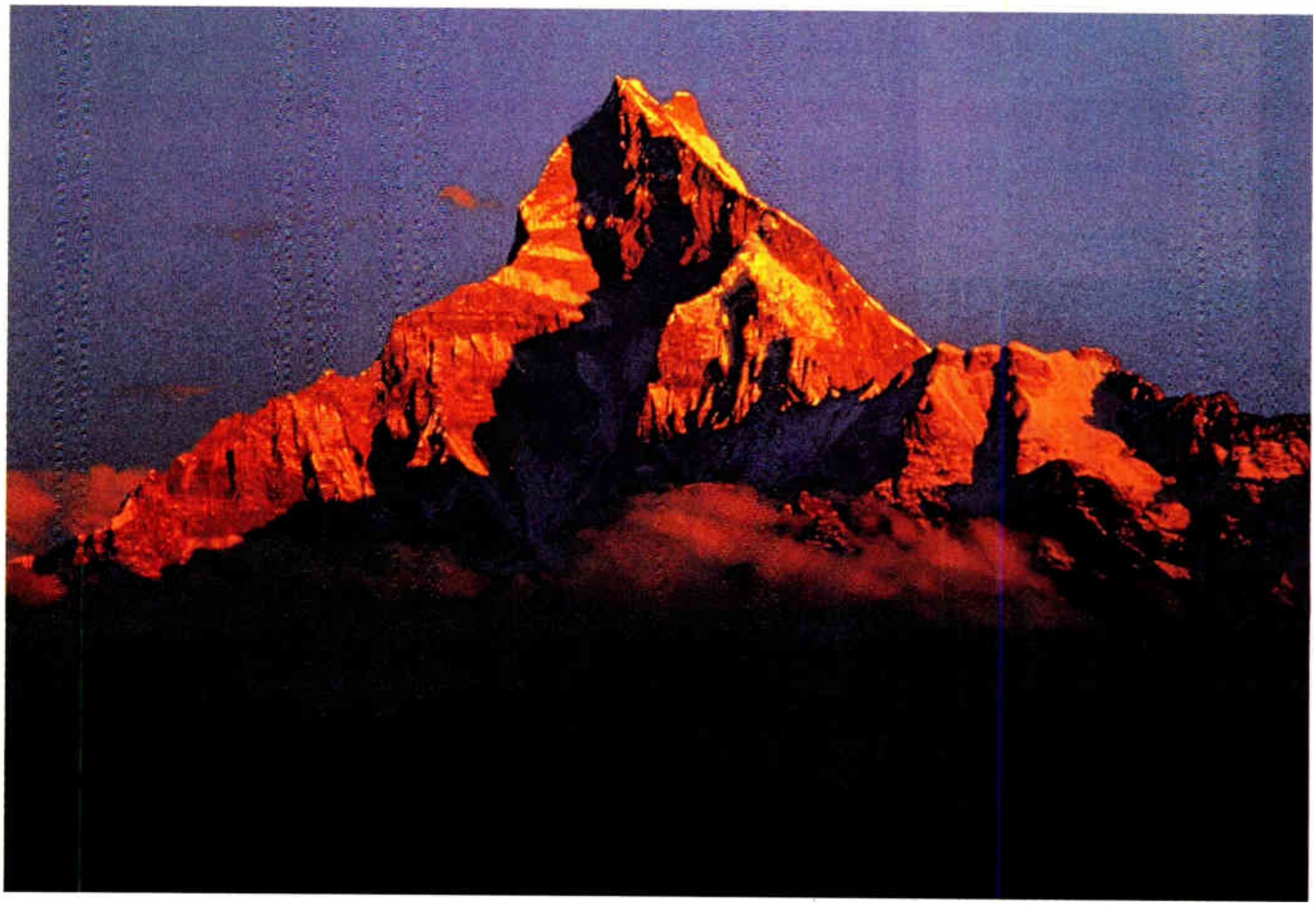
"I have the responsibility of making sure we can obtain whatever network technology we need to allow us to be in whatever line of business we decide to be in," he explains. His group is also running the telephony trials that Time Warner Communications is currently conducting in Rochester, N.Y.

Some kind of rodent

When he's not working, Barnhouse enjoys skiing, dirt bike racing and hanging out with his wife, Cindy, plus three dogs, four cats, a couple of rabbits and "some kind of rodent," that rounds out the list of his pets. As an amateur astronomer, he also spends a good deal of time gazing at the stars from his perch in the mountains of Colorado, and is working to establish astronomy classes for his local community, as well as putting together a proposal to obtain funding for the construction of a large telescope, also to benefit his neighbors.

Professionally, the latest turn in Barnhouse's career path seems to suit him. The contrast between his past life with a telco, and his current life in cable, has been quite striking. If anything, he has observed that while the telephony industry has "a tendency to solve every problem by studying, forming committees and task forces," the cable industry "solves problems by doing things. If it doesn't work, throw it away. If it does, put it into production."

–Dana Cervenka



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The bill is signed; now the work begins

By Wendell Bailey, VP of Science and Technology, NCTA

On Thursday, February 8, 1996, at approximately 11:45 a.m., The President of the United Stages signed into law the first major rewrite of the 1934 Communications Act.

While all of us in the cable television industry were working very hard to get the things that we need into this law, it is sometimes easy to forget that there were several other major industries that worked just as hard to get what they felt they needed as well. Some of them worked to get what they wanted at our expense; however, such is the way of politics in our Congress.

All in all, most observers feel that the changes that are about to occur are in the best interests of the average consumer of telecommunications services. Needless to say, this magnitude and type of change does not come about by accident or through serendipity. Hard work and long hours are the fuel and the fodder that are demanded in this field of endeavor.

In the case of the effort that the cable industry put forth, a lot of credit goes to the head of the NCTA and the incredible staff of the NCTA government relations staff. Having said that, I can tell you that those people will be the first to tell you "thanks," but will immediately insist that the leaders and workers in our industry put forth an unprecedented amount of personal and corporate effort to prove to the Congress that the cable television industry is dedicated to a new sense of responsiveness and customer service.

This commitment can be seen by the high level of involvement of so many system-level employees in the "Customer Service Campaign" that was launched last year and that has been renewed and rededicated this year.

Eighty new rulemakings

While there is much to be proud of and many people to thank for the opportunity to show what cable is capable of in the future, the fact is that the work is not finished just because the President of the United States signed a bill into law. The bill itself directs the FCC to conduct some 80 different rulemakings or inquiries.

These range from changing the network (broadcast)/cable cross ownership rules (eliminate the ban on cross ownership) to actions that will revise rules for aggregation of equipment costs. Some of these 80 actions have taken effect immediately. Most others will need to be put out on notice, commented upon, and replied to within periods of time ranging from 30 days to 30 months.

All (or most all) of this work will be dealt with by the legal staff of the NCTA in consultation and cooperation with the "Washington reps" of many of our companies.

Having gone through the extraordinary effort that was needed to deal with the FCC while it worked to implement its vision of the 23 FCC implemented statutes contained in the 1992 act (the one that slammed us), I shudder to think of the hours that will be put forth by the troops in this effort.

Technical rewrites

Of the 80 or so items, several deal with technical issues and will fall to a joint effort of the legal staff an the technical staff of the NCTA and their counterparts in member companies. Some of the technical items that are on tap are: a revision of the cable technical rules, adoption of rules for closed captioning of video programs, inquiry into video descriptions, new rules for scrambling of cable channels for non-subscribers, revised rules for equipment compatibility and a whole host of rules that relate to the rules needed for cable's interest in providing telephony.

Just in case you have noticed that this will not be enough to keep all of the high-energy staffs in Washington busy, let me also mention that there are lots of ongoing time-consuming battles that have yet to be resolved and that are of serious import for this industry. Specifically, we not only are still struggling with the home wiring issue, but the Commission, in what I think is a misguided effort to bend every physical law to the goal of competition, has released two new documents on this subject.

It seems that those who want to compete with cable find it easier to offer service if they can have the wiring that your company installed to serve an MDU. Never mind that in the next few months your company might wish to offer a service like Internet access to a former video customer. The wire that you could use if it was still yours will have been appropriated by your competitor.

It seems that if you want to restore service to that customer, you will just have to run another set of drop wires (the reason, by the way, that your competitor got your wires was that he said it was impossible to run additional wires in already occupied risers).

The question I can't get an answer to is, what happens when the next video supplier needs my NEW wire? How many of these things am I required to give up before I can reap the benefits that my capital and labor investments should have granted me?

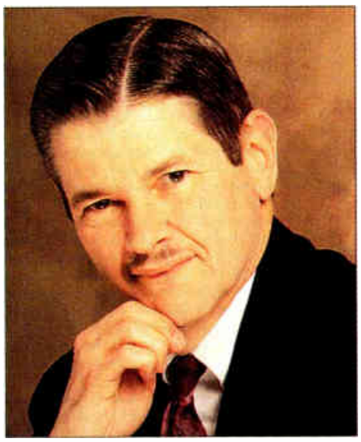
The only good lawyer...

It would seem that there is no end to the number of issues in the world of Washington, D.C. politics. I'm not complaining, mind you, it just sometimes makes me feel that if it weren't for lawyers and politicians, I'd have no fun at all.

What a life! CED

Have a comment?
Contact Wendell via e-mail at: naxt74a@prodigy.com

Tackling a complex beast: analyzers



By Jim Farmer, Chief Technical Officer, Antec Technology Center

Last month, this column introduced my friend Brunswick, who had written about his experience in teaching his headend technician to use a spectrum analyzer. Spectrum analyzers are complex enough that they cannot be described in a few words; however, this topic can be revisited at some point in the future. Hold on to this issue: the diagram won't reappear.

The diagram below shows the basics of a spectrum analyzer, which is really nothing more than a special purpose radio receiver with a piece of electronic graph paper (albeit, a really fancy radio).

This is a pretty generic block diagram, showing the key adjustments to make when using a spectrum analyzer. The implementation is pretty sophisticated today, but the principal shown is right. Starting in the upper left, the signal enters. An attenuator, AT1, reduces the amplitude of a strong signal so that it won't overload the mixer. After a low pass filter, which cuts off above the maximum frequency tuned, the signal goes to a mixer, where it is upconverted to some very high frequency. This is done for the same reason we upconvert signals in a set-top convertor: to avoid any images in the mixing process.

Because this frequency is so high, it is hard to do good bandpass shaping, so the frequency is knocked down to something pretty low, using several stages of frequency conversion. At the last IF, which might be a few megahertz, the analyzer does some careful bandpass filtering in F1, the width of which is selected by the user (or selected automatically). The bandwidth selected is called the "resolution," or some similar name.

After amplification, the signal passes through another user gain control, AT4. This control is usually called the "reference level," and determines the signal level at the top of the screen. Why two attenuators that do almost the same thing? Because it is very important to operate the first mixer in its linear region, while also setting the gain such that the top of the screen is the desired signal level. Next, the signal is detected using, in this case, a detector whose output is the logarithm of the input signal. Using a log detector, the vertical scale can be calibrated in decibels rather than in linear units. Alternatively, the signal may be detected in a linear detector, the type used for communications reception, then converted to a logarithm. Of course, the linear signal may also be applied to the CRT.

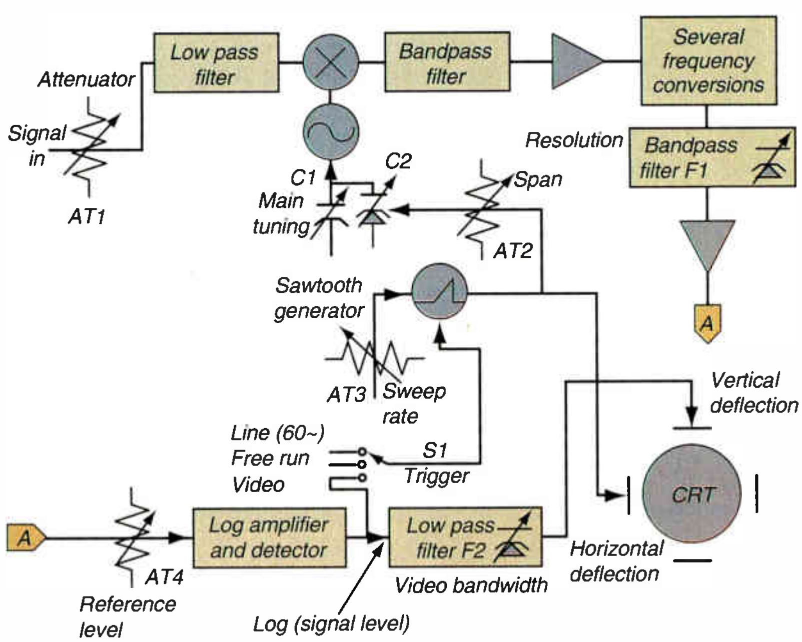
Operator control

The detected signal passes through a low pass filter, F2. This filter is adjustable by the user and is called the "video bandwidth" adjustment, or a similar name. Why the word "video," when the signal may have nothing to do with pictures? The answer is that many baseband (not modulated) signals are called "video" if the frequency range involved can exceed that of audio. It's a convention. After filtering, the signal is applied to the vertical axis of the CRT.

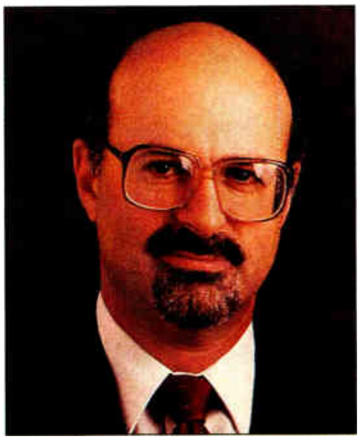
The horizontal axis of the CRT usually represents frequency. This is done by using a sawtooth oscillator (the output rises to maximum linearly, then falls to zero quickly). The sweep (rise) time of the oscillator is user controlled by AT3, which changes the speed of the ramp. The output of the oscillator is applied to varactor C2, which changes the frequency of the first oscillator, thus changing the instantaneous frequency at which a measurement is made. C1 is the user tuning adjustment. By adjusting the amplitude of the sawtooth waveform, done by changing AT2, the span, or the width of the spectrum displayed on the CRT is varied. The output of the sawtooth generator is also supplied to the CRT, so that it controls horizontal deflection of the electron beam.

The user also controls the triggering of the sawtooth generator. That is, he can control the time at which the waveform starts from rest and begins rising. The most common "trigger" is the AC line, so that the analyzer is tuned to the same frequency at the same point in the line voltage cycle. Alternatively the user may trigger the sweep when the video waveform reaches a preset point. Finally, the sawtooth generator may be free running, starting one sweep as soon as the previous one is finished. Triggering is selected by S1.

This is a quick tour of what is in a spectrum analyzer. Much more remains to be said about how to set all of these controls to make the intended measurement, but this remains for the future. Thanks to Rex Bullinger of Hewlett-Packard for his input. CED



Inside wiring: The next FCC attack



By Jeffrey Krauss, wiring wizard and President of Telecommunications and Technology Policy

The FCC is about to devote its resources to a decidedly low-tech subject, home wiring. Not electrical wiring, of course, but cable TV and telephone wiring. The advertised reason for this FCC proceeding is to harmonize the different regulations that apply to cable TV wiring as compared to telephone wiring. But the real reason is to establish technical standards for cable wiring and connectors, like the Part 68 rules that apply to telephone wires, in order to change cable TV business practices and promote the FCC's industrial policy goal of customer ownership of set-top boxes.

Part 68

Part 68 of the FCC Rules contains detailed technical rules that were adopted to limit hazardous voltages that might be produced by customer-owned telephones, in order to protect the health and safety of telephone company employees. But it was quickly expanded at the request of telephone companies to prevent customers from bypassing the telephone network billing systems.

Because these provisions are part of the Code of Federal Regulations, amending them requires a rulemaking proceeding to comply with the Administrative Procedures Act. It typically takes the FCC about two years or so to adopt rule changes from the time a Petition for Rulemaking is filed.

This combination of detailed technical specifications and the administrative difficulty of making changes has constrained the introduction of beneficial new technologies into the telephone network. For example, many new private telephone switching systems use telephone sets that communicate with the switch using digital control channel signals; this permits a variety of new services, such as allowing a telephone set to change its identity so that a telephone number can follow an employee as he moves through the building. But these digital telephone sets cannot be connected directly to the telephone network, because their digital signals do not conform to Part 68. The private switch filters out the control channel and other digital signals before any calls are connected into the public telephone network.

Part 68 has prevented residential subscribers from using these new digital phones, because we don't have switches to filter out the digital signals. But the FCC prefers to believe that Part 68 has brought nothing but benefits to telephone subscribers, in the form of increased competition in the supply of telephone sets. The FCC intends to impose a similar regime on the cable industry.

The FCC's goal is to promote customer ownership of cable boxes, and one way to do this is to assure "portability." This means a set-top box that works in one cable system must also work if the subscriber moves to another city. The cable industry does use one standard connector, and it does use one standard channel plan (three of them, actually, but that's close enough for government work). But a cable box that works in one city won't work in another city because the security and system designs—scrambling methods, channel capacities and control channel specifications—are different.

Descrambler authorization messages, channel tuning data and other commands and messages are transmitted from the headend to set-top boxes over a control channel. The frequency, bandwidth, modulation, data rate and internal structure of the control channel vary from manufacturer to manufacturer, and from one model to another from the same manufacturer.

To thwart cable pirates, the structure of the data within the control channel is a closely held secret. Set-top box portability would require a standardized control channel, and the data structure of the channel would have to be published in Part 68 or its cable TV equivalent. This would simplify the pirate's attacks on the security of addressable cable systems.

The FCC evidently wants more than just set-top portability, it wants a competitive supply of set-top boxes. This means no more proprietary boxes for services like the Sega Channel. A generic game box would have to be used. And I guess we will wind up with a single, generic, program guide service. Too bad, StarSight.

Signal leakage

Customer ownership of set-top boxes and inside wiring will lead to more signal leakage problems. Today, the cable operator is responsible for eliminating leakage, even if the customer uses a lamp cord to carry the video signal from one room to another. The operator must, as a last resort, disconnect the subscriber from the network, if that's what it takes to eliminate a leak.

The FCC does recognize that telephone companies will soon be installing broadband networks that could create new leakage problems. Until now, telephone networks have not used frequencies that would cause interference if they leaked. Satellite master antenna systems have operated on critical frequencies, and informal information in the cable industry suggests that SMATV systems have been responsible for serious signal leaks. But the FCC has never considered SMATVs to be enough of a problem to impose the same stringent standards that cable systems must meet.

Cable signal leakage can be a serious threat if it interferes with aeronautical communications. For this reason, the FCC would be expected to impose the same leakage rules on telco broadband systems that now apply to cable. But there is no indication that the FCC has thought about the signal leakage implications of customer ownership of set-top boxes. Maybe someone will point this out. Or maybe we should rely on Circuit City to send a crew around to track down leaks.

The FCC is pursuing an industrial policy to change cable TV business practices. But it's trying to fix something that isn't broken.

Have a comment?
Contact Jeff via e-mail at:
jkrauss@cpcug.org

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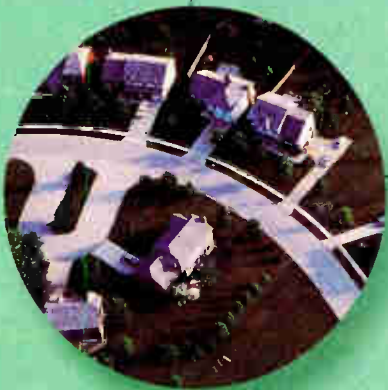

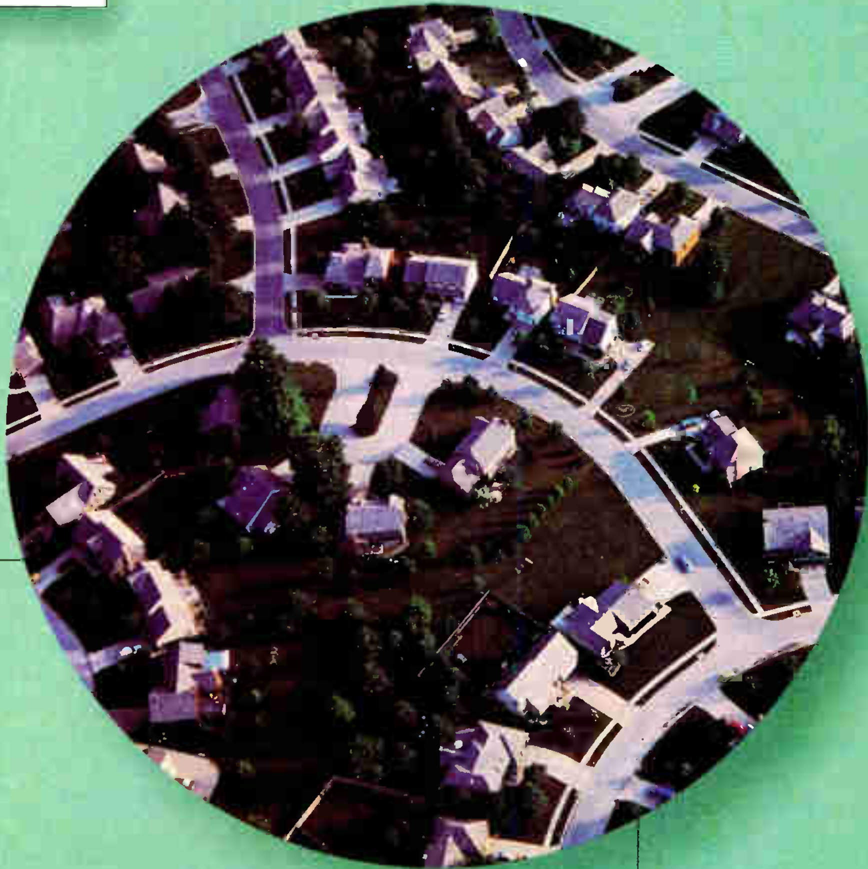

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Power (and telecom) to the people

By Thomas G. Robinson, Director of Regulatory Affairs and Technology Development, River Oaks Communications Corp.

Power to the people! It is a phrase that has meant a lot of different things to a lot of different people. It certainly evokes a number of memories for me, such as the time as an impressionable young teenager I participated in a junior high school sit-in. There I was, a true young man of contrast, fist raised and placard in hand, staring down the Establishment . . . in a lime green shirt and orange bell-bottoms.

For many across this country, power to the people has meant the provision of public power. In fact, there are over 2,000 public power systems in operation today. Because some of these are currently expanding, modifying or upgrading their infrastructures to provide telecommunications services, and many more are taking a hard look at such developments, one day soon, public telecommunications in some form may be as commonplace as public power.

The reasons for the current high level of interest in public telecommunications are myriad. To begin with, there has been an increasing requirement to develop better internal communications networks for applications such as customer service operations, automated meter reading and SCADA (Supervisory Control And Data Acquisition).

As internal communications are developed that require a fair amount of telecommunications infrastructure, it is then natural to look at providing services ancillary to the provision of power, such as load management systems, especially for large industrial clients. Such systems also help facilitate the development of time-of-day or "real-time" pricing structures, reducing the customer's cost because pricing can reflect more efficiently distributed demand.

Once the infrastructure is in place, it makes sense to pursue other types of telecom applications that are usually in high demand by large organizations. This includes everything from the lease of dark fiber to the provision of high-speed voice, data and video communications. For example, large power customers, such as manufacturers, hospitals and universities, may have both campus and off-site connectivity requirements that can be easily handled with the addition of fiber along power routes. This type of targeted investment makes inherent sense for the public owners of the system because it has limited risk, and it can work in tandem with applications ancillary to the core power business. Certainly from a cost and diversity of service point-of-view, it has equally significant benefits for the business and institutional community.

This is especially true in smaller jurisdictions where the availability of advanced services or a choice of competing providers may be minimal. Lusk, Wyo., for example, decided that public power system provision of a fiber infrastructure was its best option to ensure that advanced services would be available to its business, institutional and residential community. Recently, it has activated a fiber network ultimately designed to serve all 1,000 electric customers. At this point, the network already provides data communications connectivity for the public schools, and municipal energy load control for a variety of facilities and equipment, including street lights and water pumping sites. Lusk's next step is to begin residential service trials.

When you consider that advanced telecommunications infrastructure allows telecom-intensive services such as telemarketing and customer service operations to be performed from just about anywhere, these types of fiber deployments can be boons to the economic development of smaller communities. Because there is already a natural synergy between the local government and the publicly-owned utility, communities like Lusk demonstrate that there are significant opportunities for the enhancement of government services. Fiber infrastructure deployed along power routes can facilitate the development of Sonet applications and broadband Ethernets for government facilities, distance learning and electronic classroom services for schools, and outlets for government outreach communications in malls and libraries.

Partnerships with telecom providers

A public power provider which has proceeded this far in the development of telecom networks may next look at the feasibility of partnerships to provide or assist in providing a wide range of telecommunications services. This could include agreements with existing or new telecom providers for the lease of excess conduit capacity, the lease of dark or activated fiber or reciprocal facilities use. There are several advantages to these types of partnerships, including provision of a greater diversity of advanced telecom services and less disturbance to the public right-of-way related to system construction.

In conjunction with, or as an alternative to, such partnerships, the public power provider can also become a full service telecom provider. Only a few public power systems have embarked on this course, but those that have are passionate about the current results and the future potential of their telecommunications infrastructure. For example, the Glasgow, Ky. Electric Plant Board believes strongly that its infrastructure provides both a platform for cost-effective and advanced public telecommunications and, in partnership with private providers, a platform for commercial service development. Consistent with this focus, the Board provides such services as cable television, telephony and data communications to the business and residential community, traffic signal control for the municipality and, in concert with a commercial provider, high-speed Internet access.

Whatever the right answer is for any particular public power community, it's clear that every such community will benefit from some level of public telecom infrastructure development. In those communities, I think you will see the rallying cry, "Telecommunications to the People" continue to grow. And I say, "Right on!" CED

Have a comment?
Contact Tom via e-mail at:
tomgrob@teleriver.com

Rare misses of the wise and famous

To the Editor:

Archer Taylor's recent article about his "rare miss" prompts me to note another "rare miss"–this one by one of the foremost technological visionaries of our time: Arthur C. Clarke. Clarke missed an entire industry–the cable television industry!

The story begins in 1945, during the closing months of World War II. At the time, Clarke was an officer in Britain's Royal Air Force and a member of the British Interplanetary Society. In February of that year, *Wireless World*, a British technical journal, published a letter written by Clarke under the heading "V2 for Ionosphere Research?" This letter suggested the possibility of using rockets, such as the German V2 rockets falling on London at that very moment, for post-war research into the upper atmosphere.

This letter also contained the following words:

" . . .I would like to close by mentioning a possibility of the more remote future–perhaps half a century ahead. An 'artificial satellite' at the correct distance from the earth would. . .remain stationary above the same spot and would be within optical range of nearly half the earth's surface. Three repeater stations, 120 degrees apart in the correct orbit, could give television and microwave coverage to the entire planet."[1]

And so it was that Arthur C. Clarke predicted in 1945 that by 1995 the inhabitants of planet Earth would have deployed three communications satellites in geostationary orbit.

Expanded idea

Clarke subsequently expanded this idea in an article titled "Extra-terrestrial Relays," published in the October 1945 issue of *Wireless World.* This article developed the idea fully, with rigorous technical analyses of the orbital geometry and the radio communications links. Clarke again suggested that three satellites would be required and even provided specific locations: 30°E, 150°E and 90°W.

Clarke's justification for the use of geostationary satellites was economic: he believed that satellites could be used to distribute television signals at lower cost than ground-based networks. Two excerpts highlight this idea:

"The service area of a television station, even on a very good site, is only about a hundred miles across. To cover a small country such as Great Britain would require a network of transmitters, connected by coaxial lines, waveguides, or VHF relay links. . . . A system of this kind would provide television coverage, at very considerable cost, over the whole of a small country. It would be out of the question to provide a large continent with such a service, and only the main centres (sic) of population could be included in the network.

"In view of these facts, it appears hardly worthwhile to expend much effort on the building of long-distance relay chains. Even the local networks which will soon be under construction may have a working life of only 20-30 years."[2]

The year 1995 has come and gone. Clarke's grand vision has come true: we, the inhabitants of planet Earth, have indeed deployed communications satellites in geostationary orbit.

But here in the United States, it didn't happen the way Clarke envisioned it.

Long before the launch of the first communications satellite, the broadcast industry was providing television service to what is certainly "a large continent," and had provided the financial incentive for the construction of microwave "long-distance relay chains" extending from coast-to-coast. Meanwhile, the cable television industry was already extending the broadcasters' television services well beyond the "main centres of population."

Vision becomes reality

In the early 1970s, Clarke's grand vision was becoming a reality. The feasibility of distributing video programming by satellite had been proven, and governments around the world began launching satellites for domestic television distribution. Satellites appeared at numerous locations throughout the geostationary arc; the number quickly grew beyond the three Clarke originally suggested. By the end of 1975, Clarke himself, from his home in Sri Lanka, was able to watch educational programming provided by the government of India–just 30 years after his famous *Wireless World* article, not "half a century," as he had originally predicted.

Here in the United States, broadcast networks already had land-based distribution networks, so they didn't see any reason to switch to satellite. But for the cable television industry, the satellite was a dream come true: the cable industry wanted unique programming, and the satellite was the obvious way to distribute it. HBO was the first to make the leap, in 1975; Ted Turner's WTCG (now WTBS) and Pat Robertson's Christian Broadcasting Network (now The Family Channel) followed shortly thereafter. By the end of 1976, satellites were well established as the best means for distributing video programming to cable television headends.

In the years since, satellite-delivered programming has been the driving force that has enabled the cable industry to grow to be one of the largest communications industries in the world. Indeed, it could be argued that we all owe our livelihoods to satellite-delivered programming–and to the geostationary communications satellite predicted 51 years ago by Arthur C. Clarke.

With that in mind, I think we can forgive him for missing our industry back in 1945!

Neal McLain
Project Manager
Communication Technologies Inc.

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1310 nm amps move closer to reality

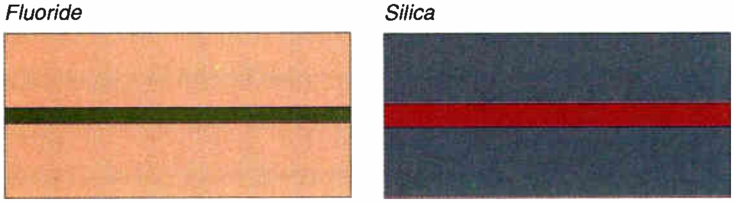
Breaking down physical barriers

By Donald L. Sipes, Vice President of Technology, ATx Telecom Systems Inc.; and Todd Truex, Engineer, Electro-Optics Components, Galileo Electro-Optics

While the world of telecommunications has embraced fiber optics as the backbone of its terrestrial networks, further optimization continues to take place in incremental steps as electro-optical scientists and engineers find ways around seemingly basic physical barriers. One of the most significant barriers has finally been broken down: the commercialization of a practical fiber optic signal amplification at 1310 nanometers.

Optical fiber was first introduced to the industry in the mid-1970s, when it was considered a potential alternative to the bandwidth limitations of copper.

Figure 1: *Differences to overcome*



Fluoride: Melting temperature = 350° C; Numerical aperture = 0.39; Core = 1.7 microns

Silica: Melting temperature = 1900° C; Numerical aperture = 0.14; Core = 5 microns

But it wasn't until singlemode fiber was coupled with advances in opto-electronics in the early 1980s that such benefits as higher information capacity, with superior signal quality, lighter weight and smaller size, could be realized. Since then, in not much more than a decade, billions of dollars have been invested in the installation of some tens of millions of miles of optical fiber worldwide. With the vast majority of this fiber operating at 1.3 microns (1310 nanometers), this has become the literal backbone of terrestrial telecommunications, serving the needs of voice, data, computer and entertainment communications everywhere.

1310 nm became the standard

Mass produced silica fiber supports optical transmission in bands centered at 870 nm, 1310 nm and 1550 nm. In these frequency bands, it is not only the characteristics of the fiber, but also the performance of light sources and light detectors that determine the throughput characteristics of the channel. In order to maximize bandwidth and transmission distance, the telecommunications industry focused on the 1310 nm window, where silica fiber offers minimum signal dispersion. Although 1550 nm transmission offers lower attenuation, signal dispersion is greater. Because of the maturity of the technology at the time, and the low cost of material, the 1310 nm bandwidth became the standard, with regeneration to compensate for signal attenuation in the silica fiber. The opto-electronic regenerators currently in use combine both optical and solid-state technology. The incoming fiber optic signal is converted to an electronic signal. That signal is, in turn, reshaped and retimed if appropriate, amplified and then converted to an optical signal to drive a new length of fiber.

While these regenerators make fiber optic transmission feasible for the distribution of telecommunications signals, they add to the cost. They require power sources and environmental protection.

Further, by their nature, they detract from the inherent broad bandwidth capability of fiber and must be designed to operate at specific data rates or within narrow frequency bands. For fiber optic systems that take advantage of the wider bandwidth capability of the fiber, multiple repeaters must be used, each tuned to a particular sub-band. This makes maintenance, service and upgrades more complex and more costly. Optical scientists and engineers have sought a better solution–the ability to perform any necessary optical signal amplification in the optical domain.

A milestone

About 10 years ago, a major breakthrough was made. Researchers at the University of Southampton (UK), developed an erbium doped fiber amplifier (EDFA) that worked effectively, but in the 1550 nm window. Optical amplifiers were built and sold to boost the power of 1550 nm signals. They work by exciting a length of erbium doped fiber with the signal from a pumped laser. The signal to be amplified is simultaneously present in the doped fiber, and picks up energy from the excited erbium ions. This silica fiber is relatively easy to make, easy to work with and can be treated in similar fashion to standard telecommunications fiber.

Figure 2: *TEC silica taper*

Numerical aperture 0.39
Mode field diameter — *Mode field diameter*

However, despite these advantages, the problem of optical dispersion still remains an issue at 1550 nm, and much of the already installed base of fiber optic telecommunications equipment is currently at 1310 nm. Dispersion shifted fibers can compensate for the fluctuation, but because of their costs, practical application is

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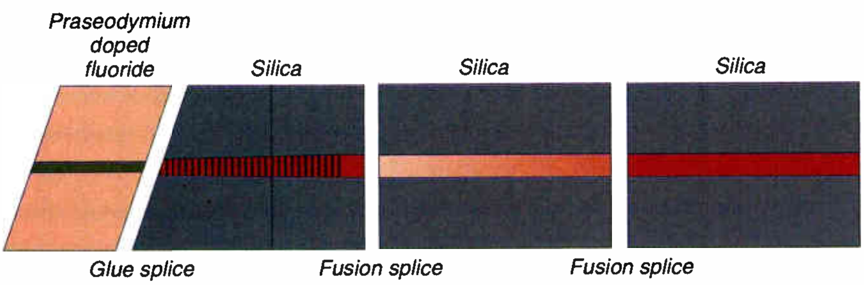
limited. Also, because almost all major metropolitan networks operate at 1310 nm, the task of correcting the 1550 nm dispersion problem was economically unsound. The search for an approach to optical amplification at 1310 nm intensified.

In the early 1990s, researchers at British Telecommunications (BT) successfully demonstrated the results of their research. Using a single praseodymium doped fluoride fiber amplifier (PDFFA), they generated 16 dB of amplification in the optical domain and transmitted a 5 Gbps data stream at 1310 nm over 100 km of silica cable. While BT's experimental results demonstrated a technical solution, providing the telecommunications industry with a practical PDFFA required more creative research and engineering.

Figure 3: *The critical angled splice*



Some major issues had to be overcome. The first was to develop a reproducible manufacturing process to make low-loss fluoride fiber. In addition, this fiber, which is inherently weaker and less chemically stable than silica, had to be made more durable. After a number of years and at significant cost, these obstacles were overcome. The result was a singlemode fluoride fiber with 50 dB/km loss, a bending radius of 2 mm, and the ability to survive hundreds of hours immersed in water.

Having developed a suitable fluoride fiber, the next obstacle was developing a means to provide this fiber in a package compatible with silica fiber. This was not an easy task, considering that fluoride and silica fibers have such dissimilar characteristics. The key issues are illustrated in Figure 1. For amplification purposes, the fibers need to be spliced in a way that supports optical transmission in both the 1310 nm band and in the band of the pump frequency.

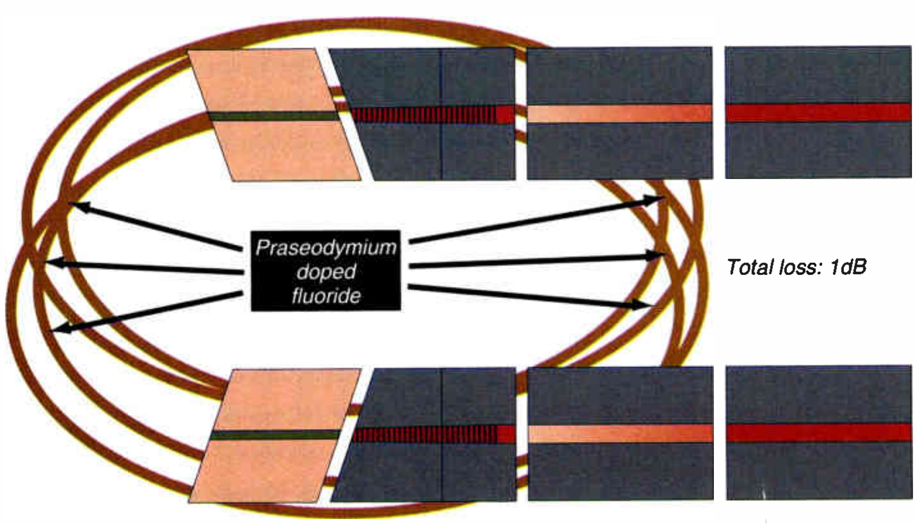
One approach was to build a connecting link between the fluoride and silica that had technical characteristics somewhere in the middle of the range. This approach was abandoned when it was realized that it would still have technical performance limitations and wouldn't alleviate the connection problem caused by the difference in melting temperature of the two fibers and the characteristic of fluoride fiber that it crystallizes when heated. A creative alternative was considered.

A more sophisticated connection was created that utilized a specially designed fiber that matches the characteristics of the Pr-doped fluoride fiber at one end, and the specifications of silica fiber at the other. Figure 2 illustrates this silica taper approach. The thermally expanded core (TEC) is created through a carefully controlled heating process. The result is an increase in the effective core diameter. By exercising precise control of the process, a linear taper is achieved.

The angled splice

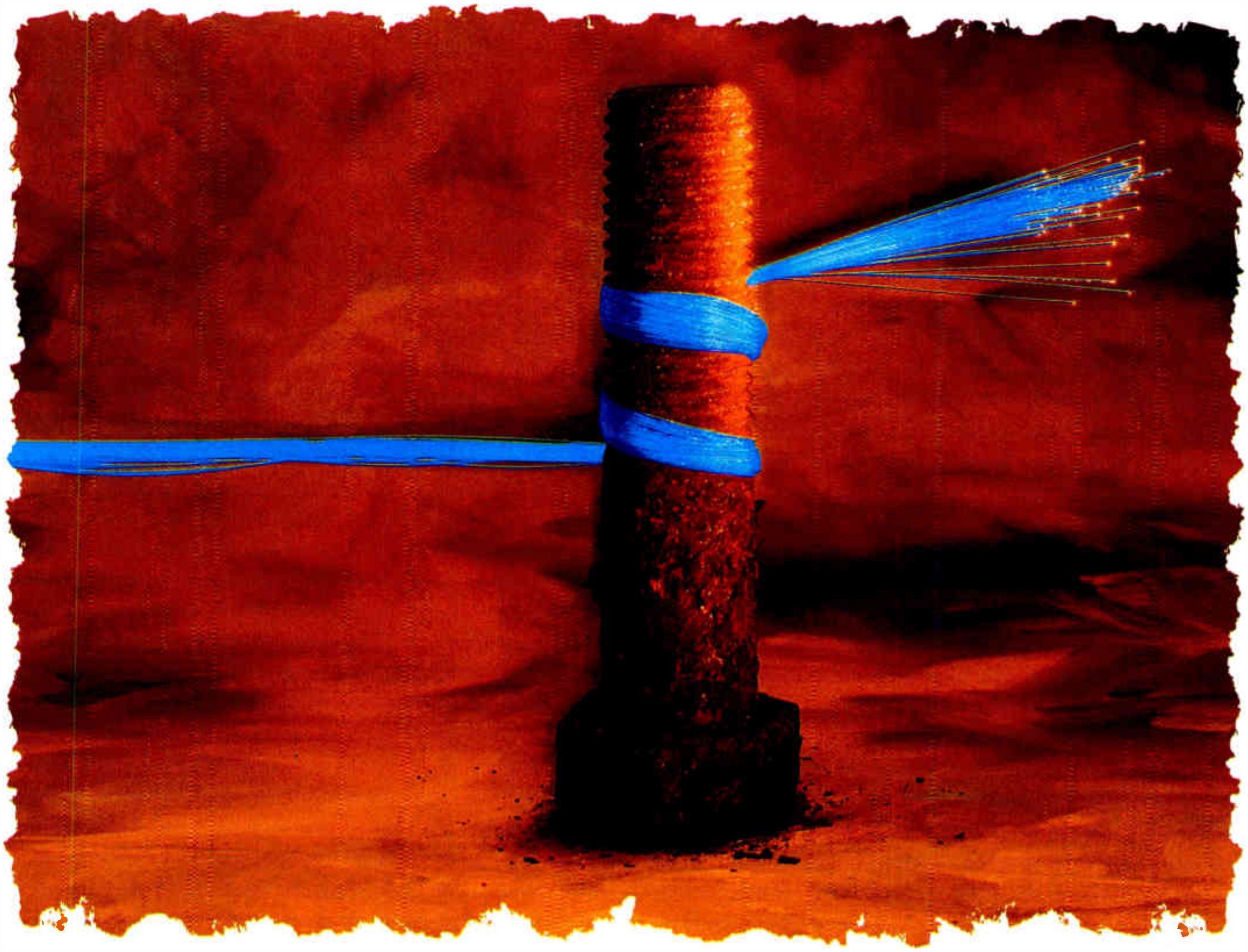
The remaining issue of splicing the fibers is illustrated in Figure 3. While the TEC silica taper offered an improved match to the fluoride fiber, a splicing technique that would minimize guided back reflection was still required. An angled splice did the job, resulting in a return loss of -60 dB. The Pr-doped fluoride fiber and the matching end of the silica taper are cleaned, polished and joined at an angle using an adhesive selected for its strength and transparency at 1310 nm. The remaining splices are made with standard fusion techniques.

Figure 4: *1310 nm fiber optic amplification module*



A conceptual illustration of the Pr-doped fluoride fiber amplifier module is shown in Figure 4. The palm-sized package is compact enough to be incorporated into existing equipment designs. What was conceivably a 4 dB or greater loss because of dissimilarities in the materials has been reduced to only 1 dB in the manufactured module. When integrated into a full optical power amplifier by licensed OEMs utilizing high power 1 micron pump technology (up to 2 watts, CW), power outputs of 16 dBm to 22 dBm will be available.

This module allows telecommunications providers to retain the existing installed 1310 nm fiber backbone, while eliminating capacity constraints associated with solid-state optical regenerators.



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How Time Warner is winning over Rochester

Making a splash with customers

By Roger Brown

With the passage last month of the telecom reform bill, many are now predicting all-out war between cable MSOs, long distance carriers, local exchange carriers and every other communications provider as they skirmish to beat one another at their own game.

In fact, battlelines are beginning to take shape in several locations, especially between the telcos themselves. AT&T and MCImetro were talking about working together to enter the local loop in competition with the LECs. Bell Atlantic wants to provide long distance service.

Oddly, there are few head-to-head fights underway, however. Jones Intercable spent millions to fend off impending competition from Bell Atlantic, and BA backed down. US West is reportedly doing well in Omaha, but has pulled back its plans to build broadband networks throughout the West. Pacific Bell has been stringing cable, but can't get authorization from the Federal Communications Commission to offer service. Southern New England Telephone got so tired of waiting for the FCC to act, it decided to go for a statewide cable franchise.

All of this has led some industry observers to note that competition will actually occur in unlikely places insidiously rather than by revolution. That's not a far-fetched notion; and one need look no further than Rochester, N.Y. This upstate community of 250,000 people, nestled neatly near the shores of Lake Ontario, is leading the competitive pack, offering the nation's first integrated package of voice and video services over a single, hybrid fiber/coax network. Soon, high-speed data will also come on-line, too.

For Time Warner, the decision to enter the residential and commercial telephony business was made after it concluded that a cable system, after being segmented into nodes with fiber optics, makes an excellent platform to provide other services.

PHOTO BY DAVID McGLYNN, FPG INTERNATIONAL

Why Rochester?

But why did Time Warner zero in on Rochester? Why didn't the company focus on the New York metropolitan area, where it built the world's first 1-GHz cable system? The answer is actually a combination of several things. First, Rochester is completely dominated by the company, especially with the recent acquisition of properties formerly held by Cablevision Industries. The Rochester cable network now covers the entire Rochester advertising market, an 11-county area that includes almost all the cities and towns between Buffalo and Syracuse. That covers about 300,000 cable TV subscribers, served by nearly 3,000 miles of plant.

"Rochester is a perfect example of Time Warner's clustering strategy carried out successfully," says Jim Chiddix, senior VP of engineering and technology for the Connecticut-based company.

Strangely, however, not only is Time Warner competing with Frontier in Rochester, it's a partner of sorts as well. Even as Time Warner sales forces are out in the community attempting to steal customers and marketshare, it's also reselling Frontier's cellular service. Furthermore, the two companies continue to negotiate over interconnection, co-location of equipment, number portability and Time Warner's use of services such as directory and operator assistance in order to provide customers with seamless service.

"It's been going reasonably well," reports Ann Burr, president of Time Warner Communications in Rochester, in reference to the ongoing relationship with Frontier. While Burr declined to provide details about the negotiations, it's clear that it has gone better in Rochester than it has in Ohio, where Time Warner is in litigation over a variety of issues related to entering the telephony market.

Rochester is also a homogeneous community with plenty of well-educated customers, that boasts an attractive base of commercial customers, including several Fortune 500-sized firms. For example, Kodak, Xerox and Bausch & Lomb all call Rochester home and welcome the entrance of competitive telecommunications providers. After all, it gives them an opportunity to save anywhere from 10 percent to 30 percent on their telephone bills by going to a competitor.

Finally, the Rochester core system recently underwent a major upgrade that took it from a 330-MHz network (in some older pockets, the system only offered 270 MHz of bandwidth) to a state-of-the-art 750 MHz system that has been spaced for a full 1 GHz of service, according to Tom Foster, VP of network services and engineering in Rochester. Although the upgrade was driven by a franchise renewal, Time Warner chose to push fiber deeply into the system, making it an ideal candidate for new services such as telephony and high-speed data transport. In all, the Rochester system presently consists of about 800 fiber nodes, each of which passes an average of 412 homes.

Powering options

Being a newly rebuilt system with a large amount of fiber, the network would easily be considered reliable enough if all that was being offered was entertainment video, notes Chiddix. But in the telephony marketplace, where the benchmark is established by the incumbent and where a challenger must be as reliable, if not more so, Time Warner has to take significant–and expensive–steps to bulletproof its network.

The headend in Rochester is very much a work in progress.

In fact, Foster and his crew are mulling several different options related to power. Time Warner has already implemented three-hour battery back-up units and in some cases uses natural gas generators that kick in when commercial power is lost. But generators are best used in a "centralized" powering scheme, which mandates the use of 90-volt power supplies. If


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Central operations in Rochester monitors the video feeds and provides dispatch functions.

the system shifts to 90 volts, there appears to be an issue with amplifiers and hum modulation that may force a swapout of amps.

One unusual option that appears to be promising is a deal with Rochester Gas and Electric, the local utility, to develop a redundant power scheme where each major power node would actually be served by two separate substations. This would dramatically improve network reliability, according to Foster, because except in the case of catastrophic failure, it's extremely rare that two substations would go dark. In addition, such an arrangement removes power from Time Warner's operating responsibility and puts it back on the experts–the power company.

"We prefer not to be in the power business," notes Steve Pearse, senior VP of engineering, operations and information systems at Time Warner Communications, "but if we have to be, we will."

Perhaps the most daunting task was finding ways to make the modem equipment work in the hostile return path environment, says Chiddix. Time Warner wanted a solution that did not rely on high-pass filters or bridger switching that helps isolate noise and ingress from individual homes. Instead, Chiddix wanted hardware that could stand on its own two legs and reside in the real world. Therefore, the vendors had to be creative. Solutions include dynamic frequency agility and forward error correction, but, according to Chiddix, the effort has paid off. "We have very high reliability service," he is proud to report.

Time Warner is using Tellabs telephony modems in Rochester.

And Time Warner can prove it; the system has extensive diagnostic electronics that report both locally and via frame relay to the company's national operations center in Denver. In fact, even the network interface unit located on the side the house has intelligence, allowing engineers to monitor network performance all the way to the home.

In a couple of nodes, they're even monitoring the return lasers in the amplifiers. "We're overkilling on purpose," notes Pearse. "That way we can determine just where we have to monitor in the future."

A success story

So, just how is Time Warner doing in Rochester? Well enough to upgrade its 9,600-line switch to support a total of 52,000 lines and 17,000 trunks. While Time Warner officials refuse to disclose exactly how many residential and commercial customers are hooked up until a "magic number" is reached, those close to the project report there are already nearly 1,000 paying customers.

Like many service start-ups, one of the keys to winning converts is to get them to try the service. For Time Warner, that typically means offering free telephone service, complete with advanced calling features like call waiting, call forwarding, caller ID and voice mail messaging for a month or so to allay consumer reservations about the quality of the service. According to Foster, the conversion rate from free service to paid customers is running at about 95 percent–a phenomenal success story.

As for business customers, "they simply want to know how quickly they can hook up," reports Mark Lipford, a former telephone company employee who is now the VP of business services in Rochester.

Of course, it helps that the cable company–formerly known as Greater Rochester Cable–has been vigilant in its effort to build good plant, establish good rapport with its customers and be a good corporate citizen within the community. "There is no anti-cable stigma here," says Lipford, which goes a long way toward getting a foot in the door with commercial accounts.

Why are the local businesses so eager to switch providers? Lipford says it's the person selling the service and the after-sale support that's extremely important to the business customer. "It's been my experience that companies buy the salesperson, not the provider," notes Lipford. "So, it's important to steal good sales people" from the incumbent telephony provider. "But

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the key to keeping them as customers is the post sales support."

To address that, Time Warner has a "customer advocate" within the company who is charged with looking out for the business customer. After a customer signs on, the advocate gets in touch with the new account, helps them through the cutover to Time Warner and continually follows up to make sure there are no open, unaddressed issues or questions.

"In the end, the technology will even out," says Lipford. "What will separate us is our people."

Training and education

Preparing Time Warner employees for the transition from "cable TV" personnel to "communications" personnel fell to Greg Hunt, VP of operations and customer service. He started by analyzing the way a cable system operates and comparing it to the way a telephone company operates. He found a lot of overlap. "Essentially, we both take orders and provision service," he says. But telephone networks are inherently more complex, and the customer service reps had to understand basic telephony, tariff structures and the different products and services in order to handle customer inquiries, problems and complaints.

Time Warner gives its seasoned CSRs an additional week of telephony classroom training, followed by another week of on-the-job training before letting them loose on customers. So far, half the Rochester CSRs have completed the training, and half the technicians have also.

"There was some apprehension at first," reports Hunt, "but then everyone took to it like ducks to water."

Employees–and for that matter, the Rochester community at large–had to be retrained to think of the company as a provider of integrated communication services, not just entertainment video. Hence the name change to Time Warner Communications and a media blitz that included direct mail pieces, billboard and electronic advertising and other high-profile marketing efforts.

In retrospect, would Hunt do anything differently? "I think I'd emphasize the fact that there's going to be constant change. We have had to change directions based on new technologies that are coming on line, new architectures and new policies. It has caused havoc, but I think our personnel adapted to the changes quite well."

That's remarkable, given that Time Warner is doing what many think could be impossible–melding two separate cultures into one. But it says a lot about the employees that they're taking to it well.

"You have to find people who fit into this culture," says Lipford. "Look for people who are already in a competitive environment, like at a vendor or an interexchange carrier, or people who feel stifled at the telephone company."

Even with that, there are those who will be stunned at the differences in the way cable companies operate versus the way the local telephone company works. "We have one technical manager here who is shocked at how much gets done here in a short time," says Hunt.

Lipford concurs. "This (kind of pioneering work) would never have worked at a telco," he says. "They work too slow, study things for too long, have way too many meetings regarding policies and procedures–and still don't get anything done. We meet in the hall, make high-level policy on the fly and then let the CSRs make decisions from there." CED

Building cablephone systems piece by piece

Manufacturers provide an update

By Dana Cervenka

Cablephone may not be ringing yet, but with the passage of the Telecom Act of '96, the service is a lot closer to reality. "The gun literally went off when they passed that Bill," says Jim Phillips, corporate vice president, Motorola Inc., whose company manufactures a cablephone platform. "People who were futzing around with telephony are suddenly very serious." And in general, manufacturers have become much more tight-lipped about the trials they are conducting since this article appeared last year (see *CED*, March '95, p. 32).

Since last year's roundup, at least one manufacturer has put its cable telephony products on the back burner for the present; however, most are still forging ahead with trials and deployment schedules. What follows is a brief update on pricing, trials, equipment modifications and roll-out schedules.

ADC Telecommunications

ADC is one of a handful of manufacturers which is using OFDMA (Orthogonal Frequency Division Multiple Access) technology to manage the upstream, and OFDM to manage the downstream paths. That allows them the ability to pack DS-0s, or voice circuits, much more densely into a 6 MHz-channel, says Todd Schieffert, program manager, Access Platforms Systems Division, ADC, for a total of 240 DS-0s per 6 MHz in a fully symmetrical system. Release 1 of ADC's Homeworx platform, which was actually QPSK-based, was tested by Time Warner Communications in its Rochester, N.Y. trial. Release 3, the OFDMA version, is the technology which ADC is targeting for volume production. While the company had initially predicted that its Homeworx platform for cable telephony (as well as data, video and PCS) would be ready for full-scale roll-out by the fall of last year, that date has since been changed to this summer. "We have enhanced our platform, and that has caused some of the movement in the schedule," notes Schieffert. The company has also been conducting trials domestically with two major MSOs at undisclosed locations. In terms of actual orders, Optus Vision of Australia is going "full bore" toward implementing the Homeworx system this summer, says Scheiffert.

ADC will also be getting into the wireless side of telephony, as the manufacturer recently signed an agreeement with PCS Wireless Inc. of Vancouver, B.C. to form a 50/50 joint venture company called PCS Solutions LLC, which will be based in the U.S. ADC has also inked an agreement with Nokia Telecommunications which will provide ADC with access to interfaces for ESTI standard countries, and thus, the ability to manufacture and market the Homeworx platform worldwide.

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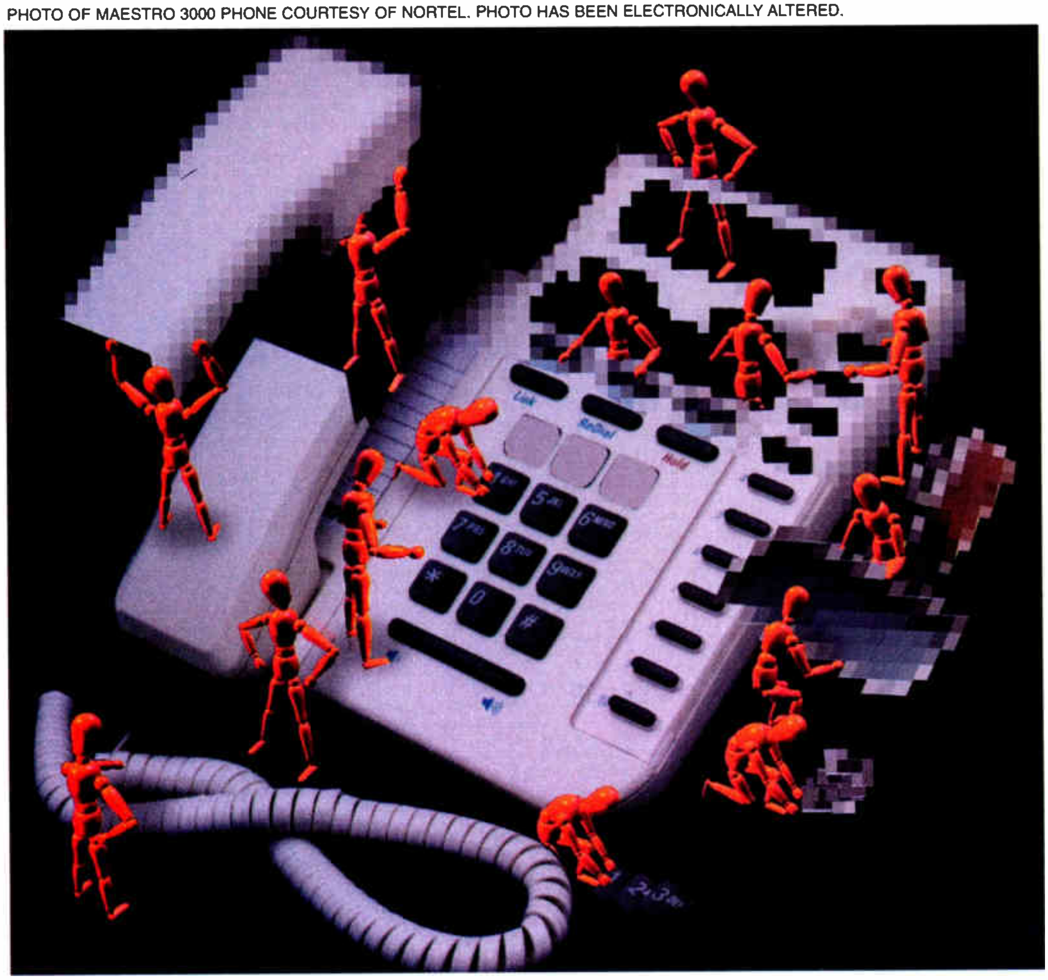
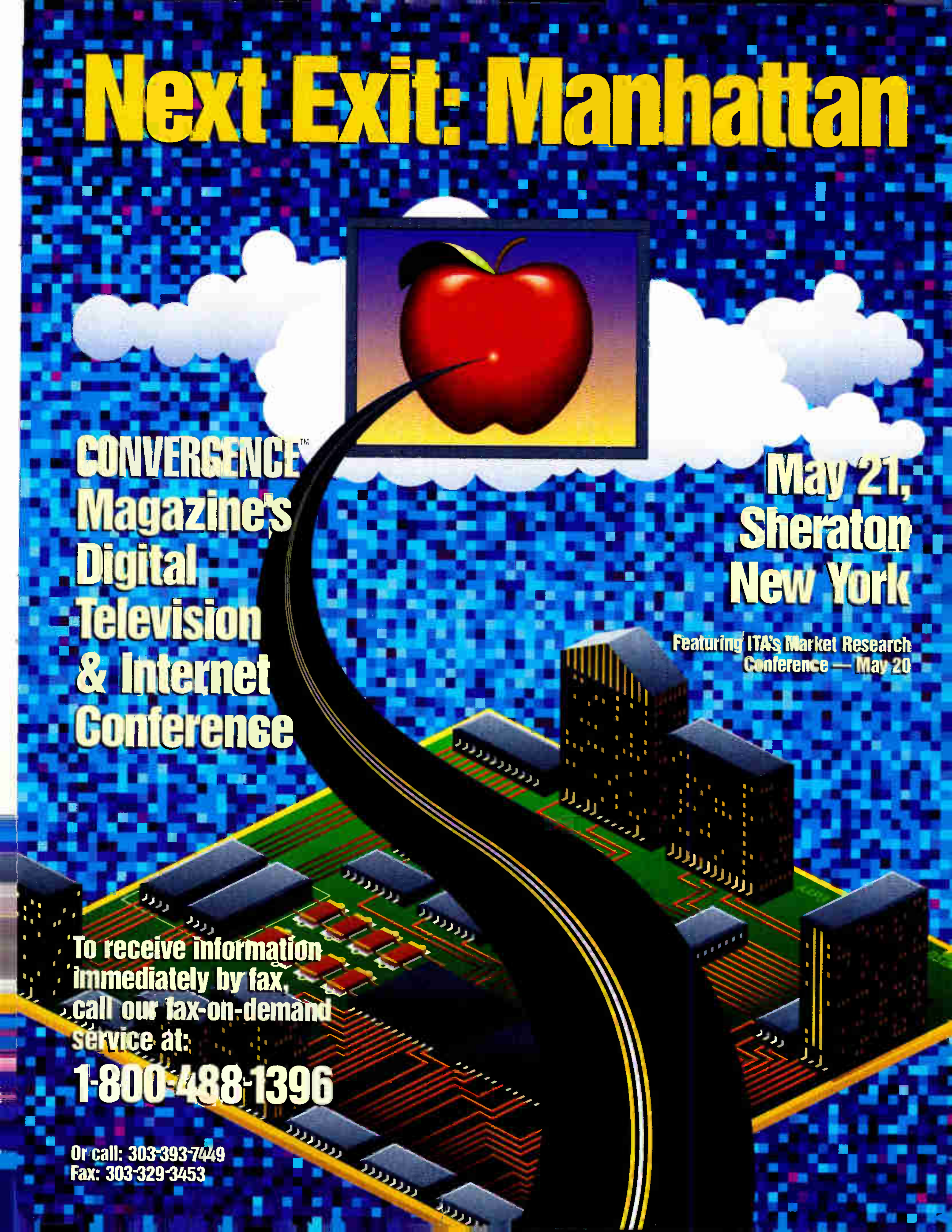


Lucent Technologies

At last year's Western Show, Lucent Technologies (AT&T Network Systems) announced some enhancements to its HFC-2000 Broadband Access System with MSOs in mind. Those modifications are geared toward helping cable operators scale up incrementally for telephony, as they allow MSOs to implement a system even with low penetration of telephony services. The "MSO-centric" version of the technology, as Marty Glapa, distinguished member technical staff, Bell Labs, calls it, will provide coverage of up to 64 fiber nodes, as opposed to about four nodes in the previous version.

Lucent's HFC-2000 Broadband Access System, a family of products that encompasses an HDT, distribution hub optics, fiber nodes, network inter-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face units, amplifiers, power-passing taps and an element management system, is already being deployed by carriers Pacific Bell and Southern New England Telephone (SNET). There are other differences between the telco version of the platform and the cable-centric version, including a redesigned NIU, says Glapa, which will "accommodate different input levels, and also, accommodate amplification, if it's required." And although the system is designed to be network powered, there are three different versions of that as well: 90 volts, one hertz; 90 volts, 60 hertz; and 60 volts, 60 hertz.

The enhanced platform utilizes 6 MHz-wide channel slots between 702-750 MHz in the downstream direction, and in the upstream, it utilizes 1.8 MHz-wide channels between 5-40 MHz. The use of QPSK modulation in both directions allows the transmission of 96 DS-0s within one 6 MHz slot downstream, and 20 DS-0s per each 1.8 MHz channel in the return. To manage the ingress-plagued return path, Bell Laboratories has developed some specific algorithms that maximize TDMA (Time Division Multiple Access), which are currently under patent submission. In the case of excessive ingress noise, dynamic channel assignment comes into play: the system constantly monitors noise thresholds, and once acceptable levels are exceeded, it moves the entire 1.8 MHz-wide channel to a cleaner portion of the spectrum.

AT&T predicts that the system will be available for general deployment sometime in the fourth quarter of 1996.

FPN

First Pacific Networks (FPN) comes to cable telephony from a different angle; the company has leveraged its RF technology by introducing telephony-over-cable applications. Its energy management system and telephony platform are targeting both the U.S. and international markets. "Our core competency is in RF transport," notes Jim Dougherty, director of marketing for FPN. "We have successfully deployed two applications that exploit that technology and plan to introduce others in the near future. These applications will share bandwidth within the digital domain."

Southern Company, a utility based in the southeastern United States, recently announced that it is deploying both FPN's telephony product and its energy management solution. FPN has also deployed predecessor systems to its FPN1000 at Canby Telephone and the San Diego Naval Air Station. Internationally, the company is conducting trials in Japan and the Philippines, and Dougherty notes that 300,000 of FPN's subscriber units will be deployed over time in a system in Russia; 300 units are in use in Australia; and a private phone system in the Netherlands is also deploying the cable-phone technology.

The frequency spread the system is assigned to is designed for either a 300 MHz system, or a 600 MHz system: the former utilizes the 294-342 MHz range, while the latter operates between 542-642 MHz. The system occupies a single, 6-MHz wide channel and utilizes AM/PSK modulation downstream, QPSK upstream. In the return, the FPN1000 operates between 12 and 30 MHz, and utilizes sheer, brute force—high power—to overcome ingress and impulse noise.

While FPN has deployed the technology, it is not yet in volume production, says Dougherty, who reports that "it doesn't appear that they [MSOs] are going into full-scale deployment" at present.

As for powering options, FPN is currently producing subscriber units that are locally powered, with eight hours of battery backup. Though FPN has a prototype for a network-powered system, it will "make one when we need one," notes Dougherty.

General Instrument

Known as "Mediaspan," General Instrument's cable telephony offering utilizes a frequency agile modem to send transmissions in 6-MHz wide slices of bandwidth in the 50-750 MHz range for the downstream, and in the 5-42 MHz band for the upstream. Up to 120 simultaneous voice channels (or DS-0s) can be packed into a 6 MHz RF band in the upstream, and in another for the downstream, according to Ami Miron, vice president of engineering, Telecommunications SBU, GI Communications Division of General Instrument.

The cablephone solution consists of three main components, and includes a headend unit, known as the Central Unit (CU), which automatically handles subscriber access, allocates bandwidth-on-demand and provides interfaces to the PSTN and PDN (Public Data Networks).

Although GI had previously announced that initial field trials would take place last summer, that schedule has been altered, with dates for trials yet to be announced. Miron notes that the manufacturer is "not rushing to put out a system" before it has characterized the network, and in that vein, GI is currently providing channel characterization services to cable operators as they plan their plant upgrades.

About two years ago, GI teamed up with telephony equipment supplier DSC Communications to augment its strengths in broadband technology with DSC's strengths on the telephony side. At present, GI officials say that there has been no change in the relationship with DSC.

Hughes Network Systems

Announced at the European Cable Communications '95 show, the Cable Telephony Transport System from Hughes Network Systems has been used in a trial by TeleWest Ltd. in its Newcastle franchise, northeast of London, and has now been deployed by the operator (see *MCN*, 10/95). But the manufacturer has plans that are broader in scope for the product line, as it plans to market the cablephone system to operators in the U.S. as well.

The system, which utilizes QPSK modulation in both directions, operates above 400 MHz in the downstream, and, for cable's purposes, in the 12-40 MHz band in the upstream, in combination with TDM (down) and FDM (up). The two main components of the system are the Headend Unit and the Remote Node.

Motorola

Motorola seems to be on the fast track to deploying cablephone products, as the manufacturer says it will be shipping its CableComm system in commercial quantities by the end of March, or beginning of April this year. The quick ramp up to production is due, in part, to an order from TCI Telephony Services Inc. for up to 220,000 CableComm subscriber units, as well as associated infrastructure, during the first year of a five-year agreement. TCI has been testing the technology, in conjunction with Teleport Communications Group (TCG), in the Chicago suburb of Arlington Heights for the Sprint Telecommunications Venture.

Motorola's Phillips reports that his company has received CableComm orders from three cable companies in the U.S. (including TCI) and from one RBOC as well. Because his customers http://www.tellabs.com

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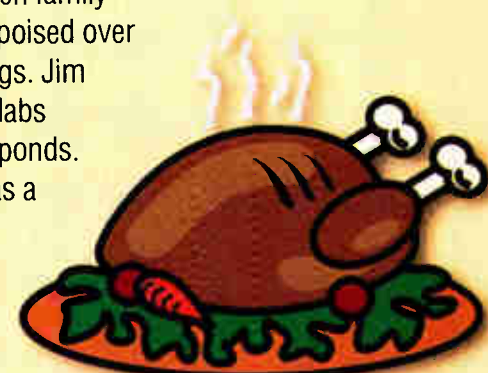

Thanksgiving Day, U.S.A., 3 p.m. A dozen family members present. The carving knife is poised over the bird. A telephone rings. Jim Lauretig, director of Tellabs Customer Services, responds. A Canadian customer has a competitor's digital cross-connect which is down. They urgently need critical hardware that the competitor can't supply. "Can we provide it?", the Tellabs account manager wants to know. Seven hours later, Lauretig returns home, to reflect on the blessings in his life and the satisfaction of this day's work. The equipment is on its way. A customer is happy. Lauretig contentedly bites into a cold sandwich, his first taste of turkey that day.

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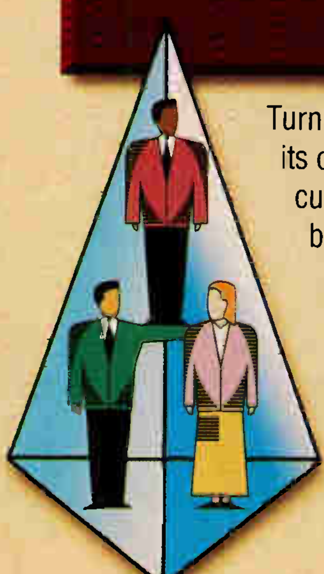

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don't wish to tip their hand to their competitors, Phillips is keeping their plans under wraps, but he does say that Motorola is currently doing mapping for 13 U.S. cities for an unnamed MSO in preparation for roll-out, and for one RBOC for three cities. When will cablephone really be ringing? "I think it will be this summer before you see...big ads in the marketplace, for both voice and data," concludes Phillips.

The manufacturer, which has a rich history in RF products such as two-way radios, pagers and cellular phones, has borrowed a technique from its cellular products to "trunk" its RF channels; subscribers have access to a pool of timeslots on RF carriers. Motorola has also taken into account the ingress-plagued return path in its design of the CableComm system: once the error floor comes up to a specified level in the upstream, an error mitigation algorithm compensates for errors up to a certain level, and then CableComm searches for another available carrier to leap to. Using these 600 kHz carriers, Motorola's CableComm system can support 5,500 to 6,500 subscribers.

Nortel

There have been many changes at Nortel since this article appeared last year. For one, the company's cablephone platform, Cornerstone Voice, is is now under the control of the yet-to-be-named joint venture between Nortel and Antec: further, Antec is the cable distribution arm for the product; Nortel is the telco arm. The product is still on schedule for volume production sometime this summer, according to Stan Brovont, general manager, Cornerstone Products, who adds that the joint venture currently is running five field trials of Cornerstone Voice, including trials with Cablevision Lightpath, Time Warner and TCI. And though he would not release specifics, Brovont reports that "we are currently in the final stages of contract negotiations with several customers, and actually have a few orders on the books."

The cablephone system, which uses a proprietary, frequency agility scheme to manage the return path, has three powering options: nework powering down the coax; network power off a Siamese drop; and local power with battery backup. The product, which is configurable in 2 MHz bands, operates in the 350-750 MHz range in the downstream; 5-42 up. Brovont adds that the development team "has leveraged about five years of development work from Northern Telecom in building the headend platform," with the end result that the manufacturer is delivering, from day-one, a TR-303 interface capability, which allows operators to manage concentration based on traffic requirements.

Philips

Philips Broadband Networks has formed an alliance with telco vendor RELTEC to augment its cable telephony platform. RELTEC provides the digital switch interface components–TR-08 and TR-303–to Philips' Broadband Communications Gateway.

Jay Staiger, group product manager, Broadband Communications Gateway Group, reports that the system could be available for actual deployment by the fourth quarter of this year. "If we get a commitment from [an unnamed] major telephone company, we *have* to deliver in the fourth quarter," adds Staiger.

Philips has been working with a Syracuse-area cable company to test its BCG technology, while there's another trial planned with Century Communications.

Staiger estimates that the system would

range from about $250 to $500 per line for MSOs, depending, of course, on the implementation. He adds that the company's subscriber gateway unit is "unique" in that it contains protection for "subscriber-originated noise" (Philips has applied for a patent on the technology). The system operates from 300-750 MHz in the downstream; and 10-42 MHz up, and utilizes 1.5 MHz-wide carriers.

Scientific-Atlanta

About this time last year, Scientific-Atlanta announced that it would be teaming up with Siemens Public Communications Network Group in a joint venture for the development and marketing of cable telephony products. Siemens would provide access to the international market, as well as its telephony line card technology, while S-A would contribute cable-based technology, including that behind its CoAxiom products for cable telephony, which the manufacturer originally introduced in 1993. "No one is trying to do this alone in the marketplace," elaborates Rob Avery, CoAxiom product marketing manager, S-A. "We have some good strengths with cable networks; we understand them well. But we are not a telco-[based company], whereas Siemens is."

The pairing has born fruit, as today, the two are conducting a multi-phase trial of CoAxiom in Belgium in conjunction with Electrabel, a Belgium power company, and its cable TV partner, IVEKA. That trial is utilizing hardware that is very close to the configuration in use in the United States, in conjunction with different software which adapts the CoAxiom system to the telephony interfaces in use in Europe. S-A also successfully concluded a technology trial of its cablephone system with Jones Intercable and MCI in Alexandria, Va.

The CoAxiom system utilizes a broad range, from 120-750 MHz, in the downstream, says Avery, to facilitate the creation of a "hands-off" technology that can be produced in large volumes: "You can design a filter and have it go through the production line, and know it's going to work without tuning," he elaborates. In the return path, the system utilizes a single channel per carrier system (SCPC) in the 5-65 MHz band, transmitting calls in 50 kHz-wide chunks of bandwidth. "If that 50 kHz channel is not available," says Avery, "we can hop to a new frequency. By having a small carrier, you can be very flexible as to how that occurs." Avery adds that CoAxiom is the only cablephone system which is utilizing SCPC technology, and that the company holds an international patent for it, though it awaits a U.S. patent ruling.

Because of the extremes of noise and ingress which characterize the cable TV return path, the single channels, says S-A, are "less prone to disruption than wider TDMA channels. The loss of a single carrier can easily be averted, unlike that for multiple channels, which can lead to audible detection or multiple dropped calls."

S-A's production schedule calls for volume deployment sometime in mid-'96, with additional trials to be conducted before that time.

Tellabs

Tellabs Operations Inc. has made significant strides in trials of its Cablespan cable telephony product portfolio, adding tests with Viacom Cable in Castro Valley, Calif.; Adelphia Cable Communications in several eastern franchises; TeleWest in the U.K.; and Time Warner

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Figure 1. Cablephone equipment at a glance

Company	System name	Available (in volume)	Trials	Price (est.)*	Powering	Bandwidth & Modulation
ADC Telecommunications	Homeworx	Summer '96	2 MSOs	NA	Network; local 60/60, 90/60	Down: 400-750 MHz, OFDM; Up: 5-42 MHz, OFDMA
Lucent Technologies (formerly AT&T Network Systems)	HFC-2000	4th Q '96	Comcast, DPL: PacBell; SNET	NA	Network; 90 V, 1 Hz; 90/60; 60/60	Down: 702-750 MHz; Up: 5-40 MHz; QPSK for both
FPN	FPN1000	Now	See text	$250-600/ line	Local powering; 8 hrs backup DTU=net.powering	Down: 294-342 MHz, 542-642 MHz, AM/PSK; Up: 12-30 MHz, QPSK
General Instrument	Mediaspan	NA	None	$200-400/line; MDU-$150	Network; local	Down: 50-750 MHz; Up: 5-42
Hughes Network Systems Ltd.	Cable Telephony Transport System	Summer '96	DPL: TeleWest	$150-200/line (residential)	Network; local	Down: >400 MHz, TDM/QPSK; Up: 12-40 MHz, FDM/QPSK
Motorola	CableComm	End of 3/96	DPL: TCI	$350-550/line	Siamese; coax	Down: 50-750 MHz, TDM; Up: 5-40 MHz, TDM
Antec/Nortel JV	Cornerstone Voice	Summer '96	5; see text	NA	Local; 2 network	Down: 350-750; Up: 5-42 MHz; QPSK for both
Philips	Broadband Communication Gateway	4th Q '96	Syracuse-area co.; Century Comm.	$250-500/line	90 volts network; 120/220 sub	QPSK; Down: 300-750 MHz; Up: 10-42 MHz
Scientific-Atlanta	CoAxiom	Mid '96	Electrabel; Jones/MCI	$350-400/line	Siamese; coax; inhome	Down: 120-750, TDMA/QPR; Up: 5-65, FDMA/QPSK
Tellabs	Cablespan 2300	MDU=5/95; RSU=5/96	4; see text	$300-350/line	Network (Siamese; coax 90 V, 60 Hz; 60 V, 60 Hz); local	Down: 470-750, TDM/OQPSK; Up: 5-40, TDMA/QPSK
West End Systems	WestBound 9600 Broadband Access Platform	Now	8; see text	$700-800/line in trial; DPL=$300	Network; local	Down: 54-750 MHz, OFDM; Up: 5-42 MHz, OFDM

Key
*All pricing information is based on rough estimates. Actual pricing will depend on factors including architecture, system configuration, pre-existing equipment and volume production. NA = Information not available at this time. DPL=Deployments.

Communications in Rochester, N.Y., in addition to the previously-announced trial with Time Warner (formerly NewChannels).

In addition, the Illinois-based manufacturer will be announcing "a couple more very significant relationships that are being formed [with] several other key MSOs," according to Wayne Partington, group product manager. Of Tellabs' existing trials, Partington says that Time Warner's test is the furthest along, and predicts that the MSO will be the first to roll out service in the U.S. to single family homes.

Added to that is the fact that the manufacturer has been in full-scale production of its Multiple Dwelling Unit since May 1995, and currently counts approximately 1,000 telephony subscribers on-line in the U.S. through its system for commercial service. Tellabs, which is currently trialing its residential units, plans to go into production with those units next month.

While the system currently supports the TR-08 switch interface, the manufacturer has plans to introduce TR-303 in the second half of this year. As for other specs, Cablespan uses frequency agility in both the upstream and the downstream to handle ingress and other impairments that could enter cable systems, and employs QPSK modulation.

West End Systems

The WestBound 9600 Broadband Access Platform is one of the few cable telephony systems which utilizes OFDM (Orthogonal Frequency Division Multiplexing) modulation. The platform's manufacturer, West End Systems, reports that OFDM is particularly well-suited to overcoming ingress in the return path, as "such a modulation scheme allows individual tones to be jammed without bringing the entire link down," according to company literature. OFDM also tends to "filter out" short bursts of ingress. An additional benefit: the technology allows frequencies to be packed tightly together. Each access platform supplies voice and data services for as many as 360 simultaneous calls (up to 2,000 subs) in one 6-MHz NTSC cable channel, or 480 simultaneous calls (2,600 subs) in an 8-MHz PAL channel.

West End, which is partly owned by Newbridge Networks Corp., will be able to produce its cablephone platform "in quantities of tens of thousands" by this summer, according to Roger Magoon, vice president of marketing and business development. Newbridge brings some traditional strengths in telephony to the relationship, including experience with a variety of telephony interfaces, adds Magoon.

All totaled, West End will have close to eight trials in progress by the time this appears in print, mostly composed of cable companies, and one telco. The locations of those trials include the U.S., the U.K., Argentina, and a couple in Europe, outside the U.K. As for cost, Magoon says that the price per line will drop to somewhere below $300; however, the trial configuration is probably closer to $700-800 per line.

West End's system supports both network and local powering configurations, including battery backup. CED

Asking key questions, seeking low-cost solutions

Improving powering, MTTR and training key to success

By Michael Lafferty

While the first blush of cable's rosy interactive television future has finally faded into obscurity, more attainable two-way services (at least in the relative near-term) have begun to blossom in a variety of cable systems around North America. Trials in cable telephony and data communications are sprouting up everywhere and generating a whole new crop of vital information and data on how operators can improve their system's reliability/availability without causing a major infestation of budgetary woes.

In fact, during the recently completed Conference on Emerging Technologies, held in early January in San Francisco, six presentations dealing with network availability issues led off the conference in its first session. One of the first presenters, David Large, principal with the consulting firm Media Connections Group, believes the basic building blocks for improving network reliability/availability, i.e., outage/failure rate data, are often in short supply.

Reliable data: is it a failure or not?

"There is no organized effort to formalize and train personnel to gather accurate reliability data," says Large. "When there's an outage, the technician's primary concern is to get on site and get the problem fixed, hopefully, so that it doesn't happen again for a long time." But the data problem doesn't stop there, says Large. There is also the question of exactly what data should be collected. Large believes reliable data involves more than total subscribers affected and for how long they were without service. In fact, even how one calculates outage/failure time can be a problem.

"A lot depends on how you configure your time," states Large. "How do you measure how long it took to fix it? Is it from the time you dispatched someone to fix it? Is it from the time the first subscriber called? Or is it when it actually went out or when someone actually arrived on the scene to fix it?

"The subtleties of how you count it, of how you calculate it, and what you count and calculate are amazing," he says. "I did an analysis on a system...and the guy showed me this wonderful, wonderful reliability data. But his reliability data didn't include anything that was power related, or anything that was headend related, or anything that was (caused) by his own technicians. All that was included was field equipment failures. And, of course, if you look at it on that basis, it's much better because that's not the dominant cause of outages."

Exceptions to the rule?

Yet, some individual systems have been able to gather the data they've needed to forge ahead.

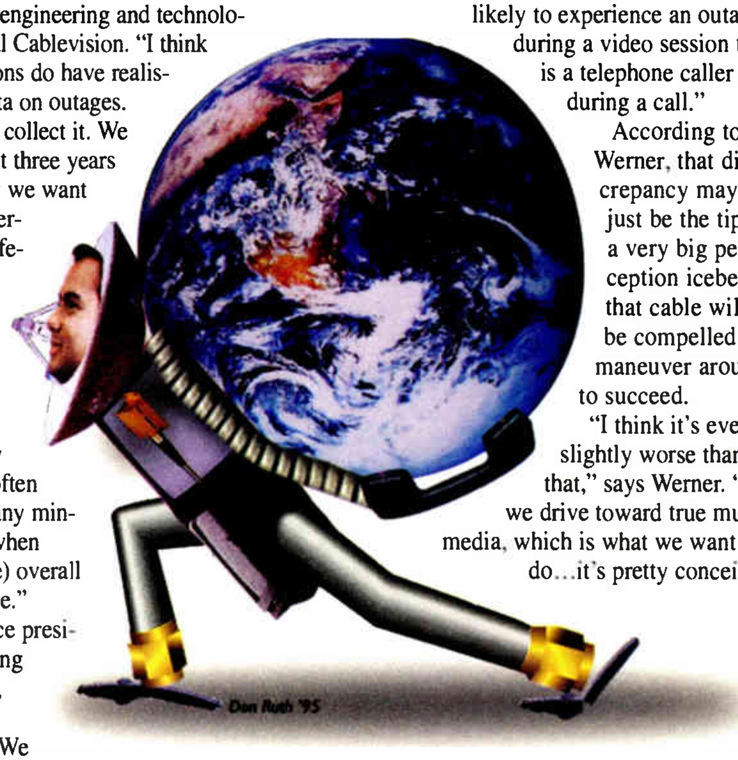
"I agree there is a dire need (for)...realistic, believable data," says David Fellows, senior vice president of engineering and technology for Continental Cablevision. "I think some of our regions do have realistic, believable data on outages. We are careful to collect it. We sort of figured out three years ago that someday we want to be offering a service that, if not lifeline, (it would be a service) people really cared about, or was competitive.... So, we think we have data on why things fail, how often they fail, how many minutes they're out when they fail, and (the) overall reliability we have."

Del Heller, vice president of engineering at Viacom Cable, says his experience is similar. "We have a few systems that have done a very admirable job of tracking failure histories on plant amplifiers, power outages, taps, you name it, on a PC basis for a number of years. We've just begun going through some of that data to really get a feel for whether component failure rates assigned by Bellcore are something we really experience."

The infamous Bellcore availability standard has received a great deal of attention at Tele-Communications Inc. (TCI). Both Tony Werner, vice president of engineering, and Oleh Sniezko, director of transmission engineering, spent a good portion of their Emerging Technologies presentation assessing the much-discussed Bellcore objective of 99.99 percent network availability (or 53 minutes of annual network downtime).

Their conclusion? Werner and Sniezko's paper states, "We have been unable to find any evidence that the LECs unanimously or even substantially meet the 53-minute Bellcore objective." Yet the authors note that the public's perception of reliability, especially when phone and cable service go head-to-head, is extremely lopsided because of the very nature of the services and how they're utilized.

They and Bellcore itself point out the discrepancy exists because people try to compare a service that's used on average for just 30 minutes a day (telephones) and one that's viewed on average 7 to 7.5 hours per day (television). As a result, Bellcore states, "A video viewer is approximately 10 times more likely to experience an outage during a video session than is a telephone caller during a call."



According to Werner, that discrepancy may just be the tip of a very big perception iceberg that cable will be compelled to maneuver around to succeed.

"I think it's even slightly worse than that," says Werner. "As we drive toward true multimedia, which is what we want to do...it's pretty conceiv-

able that the 7.5 hours in some of these homes could go up to 14 or 15 hours. And the homes that go to that high-end (usage) are the good, high-paying customers that you're trying to impress the most. If you go to 15 hours, then all of a sudden you've got a 20-to-1 perceptive disadvantage in delivering a plain old telephone service."

It's powering, stupid!

Much like the oft quoted exhortation posted in the Clinton election headquarters in 1992 ("It's the economy, stupid!"), there's a constant reminder hanging over most cable engineers' desks that reliability/availability problems revolve around an issue that engineers have to address again and again: powering.

Like most complicated topics, the powering conundrum has plenty of other nagging issues tied to it. "I still don't know how I'm powering my telephone roll-outs," says Continental's Fellows. "Is it down the center conductor? Is it down a Siamese drop? Is it out of the home with batteries? Is it eight hours of batteries? Is it flywheels? Is it natural gas generators? Is it 60 volts or do I shift to 90 volts? There is no one clear answer."

A number of system operators, who have recently completed or are in the process of completing rebuilds, are approaching the powering problem with the added "baggage" of having spent considerable money on what Viacom's Heller calls "the conventional 60-volt approach." He notes that while, "some of the (new) equipment is capable of being powered from 90 volts, there's lots of inefficiencies in the power supplies that need to be worked out...So, even though you may have some 90-volt ready equipment in the system, it may not be an optimal design for 90-volt powering."

Other operators, like TCI, seem to have studied the research, are conducting trials and have already made some important decisions. Werner believes TCI has a pretty good understanding of the powering problem and considers it "the topic of the day as far as reliability goes." Bottom line, he says, "90 volts is...the key."

When it comes to powering and reliability, Werner explains, "It isn't that the powering isn't reliable, the problem is coming up with some sort of extended stand-by. If you look at 20,000 homes passed in doing a traditional 60-volt powering, you have an average of about 67 power supplies. To go to a 40 percent telephony penetration, you have to go up to about 135 power supplies. Yet if you go to 90 volts, you can reduce that to 17 locations. Those locations may have multiple 15 amp busses.

"Once you reduce the number of locations, you can afford to look at doing generators or other types of long-term solutions, or extended batteries with a maintenance scheme where you can dispatch generators. Or, you can look at feeding three, four or five of them off a centrally located generator using a high-power 480 volt AC distribution system to get over to them.... And we're moving to 90 volts head over heels strictly because of that."

Return path: it's not rocket science


Jim Chiddix


David Fellows


Tony Werner

The success of two-way cable services rests on the ability of operators to ensure the signal integrity of the upstream path as well. Surprisingly, those in the telephony trial trenches don't seem to be particularly losing sleep or busting their budgets over it.

While it's no cake walk, TCI's Werner doesn't believe it's a butt buster either. "I think upstream maintenance adds another element ...to the system," says Werner. "What we're starting to find out is that it does require management and attention. But it doesn't appear to be rocket science. We've got a number of trials up and running now...where we've got phones operating and operating well over plant that's nowhere nearly as good as what it's going to be when we get that system done."

Jim Chiddix, senior vice president of engineering and technology for Time Warner Cable, seems to concur. "We've had to learn to balance the return plant which is something that is new to most of our technicians," reports Chiddix. "And we've got equipment from two vendors...which through a combination of frequency agility and forward error correction seems to be able to deal very well with impulse noise, discrete carrier ingress and so forth. And we're not using high pass filters...(or) bridger switching. We have a reasonable CLI program to clean up leakage, but nothing extraordinary. And that really has to be the answer."

Investing in quality pays off

Another recurring theme in reliability/availability discussions is the importance of quality assurance programs, both in hardware acquisition and installation practices.

The Werner/Sniezko paper at the ET conference and others stress the value gained and the downtime eliminated by investing in quality products/parts and improving installation techniques, such as fusing practices. In fact, Werner/Snieszko noted one of the three systems they studied posted a "much higher reliability...mainly (as) a result of careful component selection combined with the preventive maintenance program."

Viacom's Heller reports his company's two-decade old commitment to quality control is paying off in their effort to boost their system's reliability/availability. "I think one of the things we have done well, actually for more than 20 years now," says Heller, "is we have an in-house group of people who do hardware evaluations for us. They look at everything that comes along on the market, both new and existing, from connectors to taps, to amplifiers, to headend equipment, or whatever.

"We try to screen out and choose the most reliable and best quality equipment that we can before we put them into the system. That's a key...picking the best quality products before you even talk about price actually is how we approach it...(and) it pays off in the long term."

Heller explains that Viacom's quality controls don't stop in the purchasing department. "We use a lot of contractors to do our rebuild programs, as most companies do," says Heller. "And we have in-house...quality assurance inspectors that are out on the job with the contract crews day in and day out. They not only do our end-of-line proofs...they actually go back and take things apart like connectors, just to look at the workmanship of things that are hidden...With contractors knowing that we're following their every step, we're insuring that we're getting our money's worth and the best quality. We're very aggressive on that."

The summer solution & improved MTTR

In comparing the outage/failure rate data of three, well-documented systems in their ET paper, authors Werner and Sniezko found a fascinating, recurring "blip" in the data they think could lead to considerable improvement in system availability.

"Some of the opportunities we found in the data," explains Werner, "are that in most of the systems, especially any of them that occupy the Midwest and the areas that go through a fairly intense climatic change, just about all of them show a much higher failure rate that repeats itself (June through August), year after year, and correlates with meteorological data that would typically relate to heat. I'm not sure heat is the failure mechanism. In fact, I think it's electrical in nature.

"We think these seasonal peaks are a gigantic opportunity...to reduce network failure fairly significantly by analyzing the causes of that particular cycle of increased failures. If we can figure those out, we can probably enhance the network availability far more in the future."

Werner, Sniezko and others say another vital key to successful two-way cable systems, one that doesn't necessarily have to break the bank, is an operator commitment to improve Mean Time To Repair (MTTR) rates. In fact, says Werner, cable operators already have an advantage over LECs in this area.

"One of the big advantages in network availability that the HFC networks have over conventional telephony is the MTTR is so much faster," explains Werner. "We can splice a coax cable, bringing up all 300 customers, in a very short period of time. In fact, most of the time is drive time. But you get a cut 400- or 500-pair cable, and it's a fairly significant amount of time to repair. Eighteen to 20 hours is not out of the question."

Also key to any improvement of MTTR rates is the ability to monitor system outages and equipment failures. "The benefit, in particular on the telephony interface devices," says Heller, "is that you now end up with having a fairly smart device on the side of the house that has some telemetry or status monitoring capability of its own. We're going to end up getting a lot earlier warnings on failing, if not failed, portions of the network than we have in the past just relying on customers. That's going to be a big benefit.

"I think that is going to help our preventive maintenance programs to be able to zero in on developing problem areas. That, in conjunction with the status monitoring on the power supplies, will certainly give us early warning of power failures where we have to go out and put generators after a certain number of hours."

While cable professionals spend a great deal of their time discussing the intricacies of all kinds of parts and equipment, many still realize their future success in improving and expanding service really comes down to people. The effort to improve MTTR and overall system reliability/availability is no different.

"If you really go into an RBOC, a suspicion based on having been one once," says Fellows, "I think the real, primary cause of outages in a well-run system is human error. You pulled the wrong card; you switched the wrong switch. Or you went in to do an upgrade and the new software load failed and brought the whole switch down...In the data world you've suddenly lost every call that was on that fiber node. You've caused every data modem to come down and have to reboot... . The digital world is an ugly world because everything works perfectly until it fails disastrously.

"So training all of our people–the technicians, the installers, the CSRs, everybody really–that this is a live, living network is absolutely crucial." CED

Reliability effects of choices in network powering

New services demand better quality

By David Large, Principal, Media Connections Group

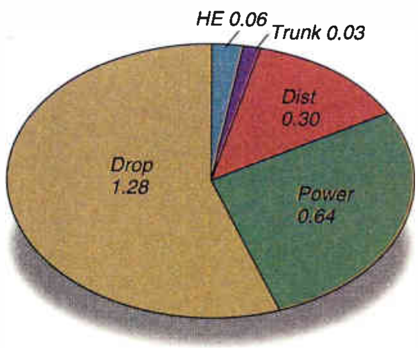
Broadband network operators moving beyond traditional cable television services are being faced with new requirements for increased reliability:

✔ Customers who order per-event programming, such as movies or concerts, are understandably less tolerant of outages than viewers of broadcast television.

✔ Provision of telephony services requires a high, documented level of network availability.

✔ Very brief interruptions of signal delivery that may appear on a normal NTSC television receiver as no more than a missing line or two of video may cause a digital receiver to "lock up," with recovery taking a second or more.

Figure 1: *Video perceived outage hours; Relative contributions*



Faced with the need to formalize the modeling of network reliability, CableLabs' Outage Reduction Task Force, in 1992, published *Outage Reduction*, along with software for characterizing networks.[1] That work was extended by Rogers in 1994[2] and by the author in 1994 and 1995.[3] Media Connections Group has developed the System Outage And Reliability (SOAR) program for analysis of complex networks. This program was used in this study.

Powering is central to the reliability issue. As the CableLabs publication accurately observed, the reliability of commercial utility power varies widely even over the distance of a few blocks.

While many cable television systems have been built with non-standby power supplies, most new systems use some form of standby supplies in the field, and at least a backup generator in the headend. This article will examine the effects of choices in both field and headend powering in a typical real-world situation.

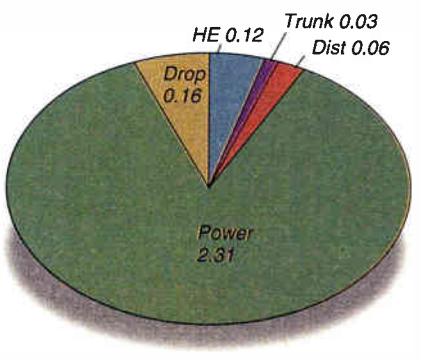
Prototype architecture

New design and construction in urban and suburban systems typically utilizes 500-home nodes and 750 MHz upper forward frequency limit. When complete rebuilds or newbuilds are involved, it is common to power the entire node from a single power supply.

Most upgrades earlier than 1994, however, were to more modest specifications, and operators are understandably anxious to avoid major additional construction in order to offer new two-way services. Thus, the architecture chosen for this study is based on an actual 550 MHz upgraded plant with 2,000-home node serving areas. Three field power supplies and 44 amplifiers were required per serving area, on average. The cascade is limited to four active devices beyond the node; however, the total tap cascade exceeds 20 in places.

The plant is fed from a regional master headend with "home-run" fibers directly from the headend to each node. Field power supplies are non-standby, but the headend has an automatic standby generator which comes on-line within 30 seconds of a commercial power outage. The headend serves plant which passes a total of 150,000 dwellings with an average penetration of 70 percent.

Figure 2: *Video perceived outage rate; Relative contributions*



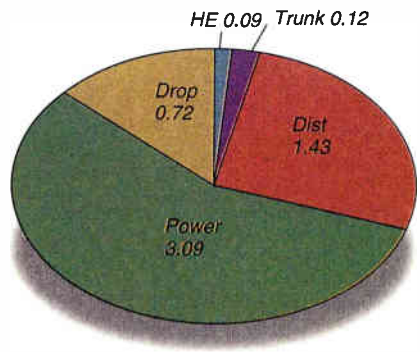
Based on recorded trouble call and outage data, the operator feels that this is an acceptably reliable system for delivery of cable services. As with most operators, however, the recorded outages do not include single subscriber outages, single-channel outages, or outages too brief to have caused significant subscriber calls or dispatched personnel (including most short power outages).

It is predicated that this operator desires to begin offering wired telephony and/or VOD/NVOD video services over this network. The configuration, the measurement standard and the reference point are all different for these services. The effect of powering options on each of these possible new service categories will be analyzed.

Video

Video is a product, and the evaluated chain must include everything from the program source within the headend to, and including, the descrambling convertor in the home. It is assumed that subscribers, in any one viewing session, significantly view 10 cable channels and, as a result, are exposed to failures of any one of about 30 pieces of equipment, plus three

Figure 3: *Telephone network unavailability: Relative contributions*



broadband amplifiers within the headend.

Based on CableLabs' work, the primary measure of quality for delivery of video services is the frequency of subscriber-perceived outages, even though outage hours and network availability are also important measures (e.g., it makes very little difference to a customer taping a movie whether an outage lasts for five minutes or an hour!). The Outage Reduction Task Force found that, for conventional cable services, subscribers would tolerate about one outage every other month. Based on a lower expected tolerance for purchasers

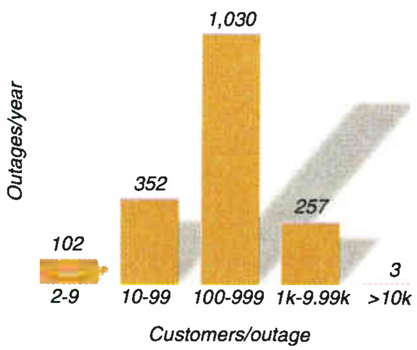
of on-demand programming, a goal of 0.5 user-experienced outages/year was set for on-demand video services in this study. This rate is based on average daily network usage of five hours.

Telephony

In the case of telephony, it is assumed that an external Network Interface Device (NID) is used at each dwelling, with reliability measured to the output of the NID. Because the NID is located before in-home video wiring, only two F-connectors and the drop wire are between it and the distribution network.

An important difference between the telephony and video services is that the network is assumed to monitor the NID's health, so that outages up to and including the NID will be detected and repaired when required, without the affected subscriber having to report the problem. In the case of video, failed inside wiring or the convertor will only be repaired when detected and reported by the customer.

Figure 4: Distribution of multi-subscriber outages by size



In the headend, reliability is measured from the output of the central office (CO) switch. Because telephony signals will be inserted on a per-node basis just before the fiber-optic transmitter, it is assumed that users are exposed only to a single amplifier plus three pieces of equipment between the transmitter and the switch.

The primary measure of telephone system performance is network availability, which is defined as the percentage of time that the network is available for use. Bellcore suggests that local telephone service should be available 99.99 percent of the time, equivalent to 53 minutes per year of downtime.

Finally, the operator wishes to achieve the required performance at minimal capital and operating cost. On the operating side, there are two costs to be minimized: the actual cost of repairing failed equipment and the cost of staffing CSR positions dedicated to answering trouble calls which, in turn, is driven by peak call volumes.

Existing system analysis

Assumptions. The failure rates, repair times and repair costs used for the analysis are based on a combination of CableLabs' recommendations, Rogers' analysis and the author's experience operating cable systems. The key values are listed in Table 2.

Commercial power is assumed to achieve about 99.99 percent availability at each field location, with three total interruptions per year for a total outage time of one hour. It is further assumed that crews will be dispatched once yearly to each location to provide generator backup for an extended outage.

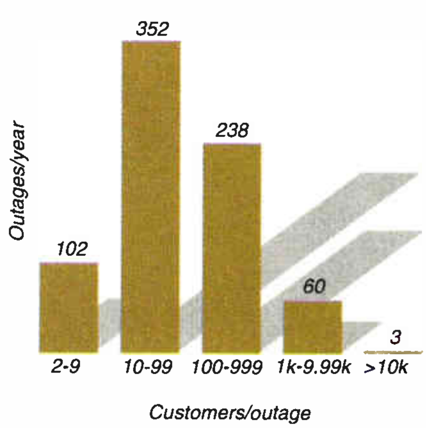
Power reliability at the headend location is assumed to be somewhat better with only two interruptions per year. Based on the actual distance between the headend and the node and between power supplies within each node service area, outages are assumed to be independent, rather than coincidental.

As explained above, specific locations could vary by a factor of ten better or worse than these assumed conditions, but they provide a starting point for analysis.

Performance

The availability of the video network to the most disadvantaged customer is 0.99929, corresponding to 6.21 hours per year of outage, of which the hypothetical 5-hour-per-day viewer will experience about 2.3 hours. As Figure 1 shows, drop and power-related failures dominate the causes. The relative slowness of response to drop problems and the lack of automated monitoring of convertor condition leads to the large drop contribution. The total number of outages/year is 12.4, of which the video customer will experience 2.7, or about one every 4.4 months. This is well within the CableLabs suggested guideline, but significantly short of the study's goal of 0.5/year. As Figure 2 shows, the subscriber-experienced outage rate is largely a function of power-related failures.

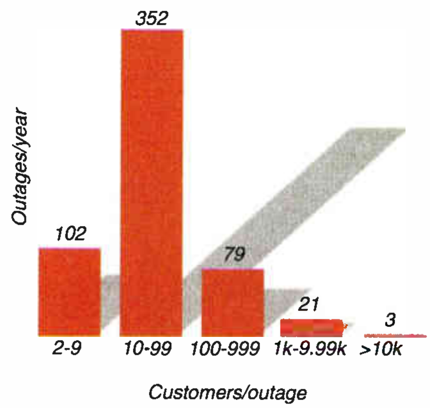
Figure 5: Improved outage size distribution with use of standby power



Evaluated as a telephony network, the performance is slightly better because of the reduced contributions of both headend and drop components. The key availability parameter is 0.99938. On the assumption that the average telephone user accesses the network approximately 0.5 hours/day, he will experience about one outage every four years with this availability.

As Figure 3 shows, the use of fewer and more reliable components reduces the relative contribution of the drop to overall unavailability for telephone customers.

Figure 6: Further reduction in outage size possible with status monitoring

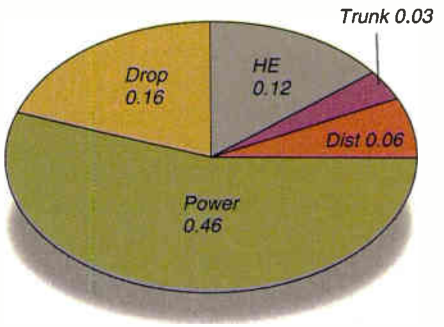


Finally, the video network is expected to experience 16,800 individual customer outages per year, while the telephony network will experience 9,450 such failures. These failures occur randomly. In the case of telephony failures, they will be automatically detected and repair crews dispatched. In the case of video, the pattern of subscriber calls can be predicted based on maximum viewing hours.

A greater problem is outages which affect many customers, causing peaks in incoming telephone calls to CSRs and which require operators to provide lines, equipment and staff to adequately respond. Although the HFC network has reduced the extremely large outages experienced by the former tree-and-branch all-coaxial network, the operator can still expect nearly three outages per day affecting more than 100 customers and about one outage per day affecting over 1,000 customers, as shown in Figure 4. Because many power outages are brief, this does not imply a corresponding trouble call volume but will give an indication of relative outage size and can be scaled with experience to predict resulting incoming trouble call rates.

Given that commercial power failures dominate both the outage rate experienced by video customers and the network availability for telephony customers, options for improved field supplies should be considered.

Figure 7: *Contributions to video perceived outage rate after status-monitored field supplies are installed*



Standby power supplies

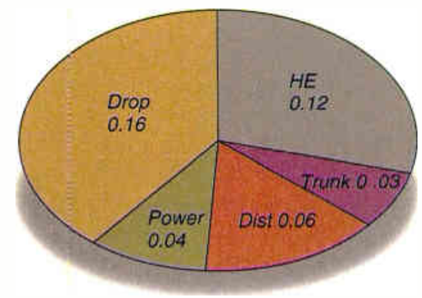
Standby power supplies include a charger, batteries and inverter which supply power in the event of AC power failure. A tradeoff in battery capacity must be made between cost (initial and ongoing servicing) and run time (relative to average power outage lengths). Generally two to four hours run time is provided.

All standby power supplies are not alike. Older designs used separate transformers for AC power and inverter operation, with a transfer relay on the output to switch between modes. With this design, a power interruption of typically 8-16 milliseconds on transfer is inevitable. Doug Welch has shown that, because of the interaction between amplifier power supplies, an interruption as short as 8 milliseconds will "grow" to as high as 70 mS as it propagates through several amplifiers.[4] This is long enough to be very noticeable on an analog television picture and to cause serious problems for digital convertors.

The problem can be avoided through the use of uninterruptible power supply (UPS) designs. Conventional UPS supplies "float" the battery between the charger and the inverter, which was in continuous use. This causes both inefficiency and reduced reliability because of the additional stages involved.

New designs are now available that provide the reliability and efficiency of single transformer designs, along with zero-time UPS transfer both directions between commercial and battery power. Transient avoidance on transfer, reliability and operating efficiency all clearly indicate that these should be used in new designs, particularly where transmission of digitally modulated signals is contemplated.

Figure 8: *Relative contribution to video outage rate*



To calculate the effect of using these supplies, the model was modified by:

✔ Replacing the non-standby field supplies in the model with 100,000 hour Mean Time Between Failure (MTBF) standby supplies.
✔ Assuming that there remains a 50 percent yearly probability of a power outage at each location which exceeds the battery capacity.
✔ Assuming that when an outage exceeds the battery capacity, system personnel respond in one hour with a backup generator.

These changes result in lowering video-subscriber-experienced outages by nearly 60 percent to 1.15 per year, while telephony network availability improves to 0.99954, a 25 percent decrease in outage hours.

As Figure 5 shows, the use of standby supplies also results in a dramatic shift to smaller subscriber outages with a 4:1 decrease in all calls affecting 100 or more subscribers.

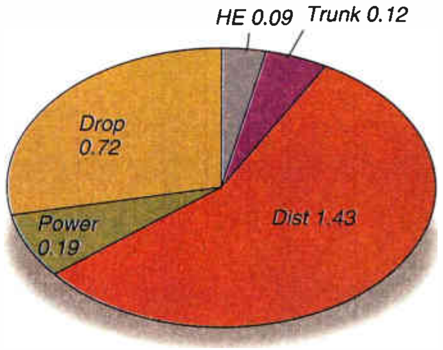
Addition of status monitoring

The remaining exposure to field commercial power outages can be eliminated by either adding battery capacity or by ensuring that system personnel are made aware of commercial power failures before the batteries are exhausted.

Other options are available to more granular systems (smaller node sizes) which are powered by a single power supply at each node location. The traditional telephone carriers have generally opted in that case to provide either eight hours of battery capacity or a standby generator plus UPS at every node location. Another solution was announced by SNET, which has stated that it intends to co-deploy 480 volt power along with fiber cables, so that nodes can be directly powered from the CO.[5] Both of these solutions involve significant additional capital cost.

Because the services contemplated in the analyzed system require a two-way network, the addition of status monitoring to power supply locations is the most economical solution for informing system maintenance personnel of the status of commercial power.

***Figure 9:** Relative contributions to telephone network unavailability*



To evaluate the effect of adding status monitoring, the labor cost of responding to outages was left in the model, but the outages themselves were removed. With this change,

***Table 1:** Attainable improvements*

	Original	Final
Telephone user perceived		
Availability	0.99938	0.99971
Unavailable minutes/year	6.6	3.0
Outages/year	0.25	0.02
Video subscriber perceived		
Unavailable hours/year	2.31	1.70
Outages/year	2.70	0.43
Total video network		
Sub outages	1,081,000	135,000
# of >100 sub outages/year	1,290	100

video-subscriber-experienced outages drop by another 27 percent to 0.84 per year, while telephony network availability improves to 0.99971, a decrease of over 36 percent in outage hours per year.

As Figure 6 shows, the yearly number of multi-subscriber outages in both the 100-999 and the 1,000-10,000 categories drops by another factor of three with this change.

Headend UPS

Figure 7 shows the relative contribution of various network components to the remaining video-customer-experienced outage rate after all the field powering upgrades are made (the telephony customer graph is similar).

Power-related problems still dominate outage numbers because, while the headend has an automatic backup generator, it takes half a minute to come on-line. Meanwhile, the entire customer base is without service, causing a massive outage (which has relatively little effect on availability because it is so short).

Elimination of these outages requires the use of a UPS at the headend. It must have sufficient peak capacity to handle all critical signal processing equipment, but only that equipment and only sufficient battery capacity to ensure that the generator will be on-line and stabilized before it transfers to that source.

When these headend outages are eliminated, the video-subscriber-experienced outages drop another factor of almost two to 0.43 per year, allowing the network to meet the study's goals for this category. As Figure 8 shows, the remaining outages are primarily determined by failures of headend video processing equipment and drop components (mostly set-top convertors).

Telephony network availability remains virtually unchanged at 0.99971 for the most affected customer, and 0.99977 for the average customer. Based on 0.5 hour average use, the most affected customer can expect to experience one failure every 50 years and 3 minutes per year of unavailability at this rate!

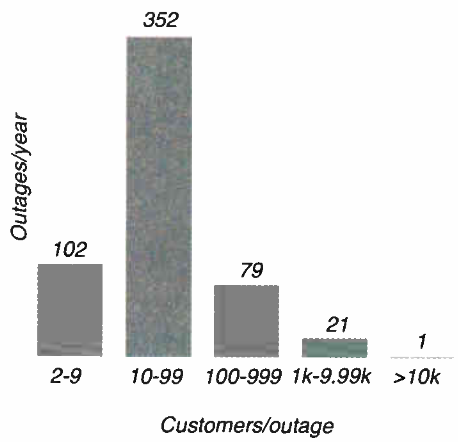
Figure 9 shows that the dominant cause of the remaining outage hours is failure of distribution system components. If it is required that the network achieve significantly greater availability, it will be necessary to either:
✔ Add nodes to shorten amplifier cascades;
✔ Add express feeder cables to eliminate cascaded strings of taps; or
✔ Improve the reliability of the NID.

The addition of the headend UPS changes the distribution of multi-customer outages (Figure 10) by one important detail: the number of outages affecting more than 10,000 subscribers drops from 2.6 per year to 0.6 year. That difference alone drops the total number of subscriber outages (=∑[outages * subscribers/outage]) from 345,000 to 135,000.

The evaluated powering upgrades all affect the capital cost of upgrading a system. The incremental cost of standby UPS field power supplies is approximately $1,100 compared with non-standby supplies, to which status monitoring adds another $165. Three such supplies are required for each of 80 nodes in the system evaluated. A large UPS with sufficient capacity to power all the critical equipment in a regional headend would cost approximately $10,000. While the total dollars involved are not insignificant, they represent only $2.13 per home passed, an increment of only about 1 percent of the total $200/home upgrade costs for this system.

The network analyzed is typical of plants

***Figure 10:** Distribution of subscriber outages by size after upgrading system powering*



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upgraded in the past few years. Before adding any of the suggested powering upgrades, it exceeded the CableLabs suggested outage rate guideline by a factor of two, while the trouble call rate from all causes was dramatically reduced from the level before the upgrade.

Despite that, additional improvement is needed before offering transactional video and residential telephony services. This analysis shows that, by using selective powering improvements, network unavailability can be further reduced by a factor of more than two, while the outage rate experienced by video customers can be reduced by a factor of over six for a total cost increment of just over one percent relative to the original upgrade cost. Table 1 summarizes the attainable improvements.

While other architectures and other commercial power situations will result in different degrees of improvement, the results of this study suggest that broadband network operators should seriously consider full field and headend UPS powering plus status monitoring as part of any upgrade or rebuild. CED

Acknowledgements

The author gratefully acknowledges the support of Alpha Technologies toward the preparation of this study and report.

Table 2: Failure rates

Element	Annual failure rate (%)
Fiber optic cable	0.06%/mile
Coaxial cable	0.12%/mile
Drop cable	1.5/drop
Hard cable connectors	0.2
F connectors	1
Amplifier w/o output module	3
Amplifier output module	3
Line passives	0.3
House passives	1.5
Non-standby power supplies	5
Standby power supplies	8.8
Fiber optic transmitters	7
Node, including fiber optic receiver	7
Set-top convertor	7
Telephony NID	4
Headend equipment	5 ea
Headend amplifier	3

End notes

1. *Outage Reduction*, CableLabs, Sept. 1992.
2. Hamilton-Piercy, Nick, and Robb Balsdon, "Network Availability and Reliability," *CED*, July 1994, pp. 42-72.
3. Large, David, "Reliability of Hybrid Fiber/Coax Distribution Systems," IEC Network Reliability and Survivability ComForum, Nov. 1994 (published in the 1994-1995 *Annual Review of Communications*); "User-Perceived Availability of Hybrid Fiber/Coax Networks," NCTA Convention, May 1995; "Reliability Model for Hybrid Fiber/Coax Networks," International Television Symposium, Montreux, June 1995; and "Predicting and Managing Reliability of Hybrid Fiber/Coax Systems," Raychem Outside Plant Seminar, Sept. 1995.
4. Welch, Doug, "Cable Powering into a Distributed Load," *1995 NCTA Technical Papers*, pp. 13-25.
5. Press release, SNET, Oct. 19, 1995.

Editor's note: This article is based on a paper originally presented at the Society of Cable Telecommunications Engineers 1996 Conference on Emerging Technologies and is reprinted with permission. See Proceedings Manual, *pp. 157-165.*

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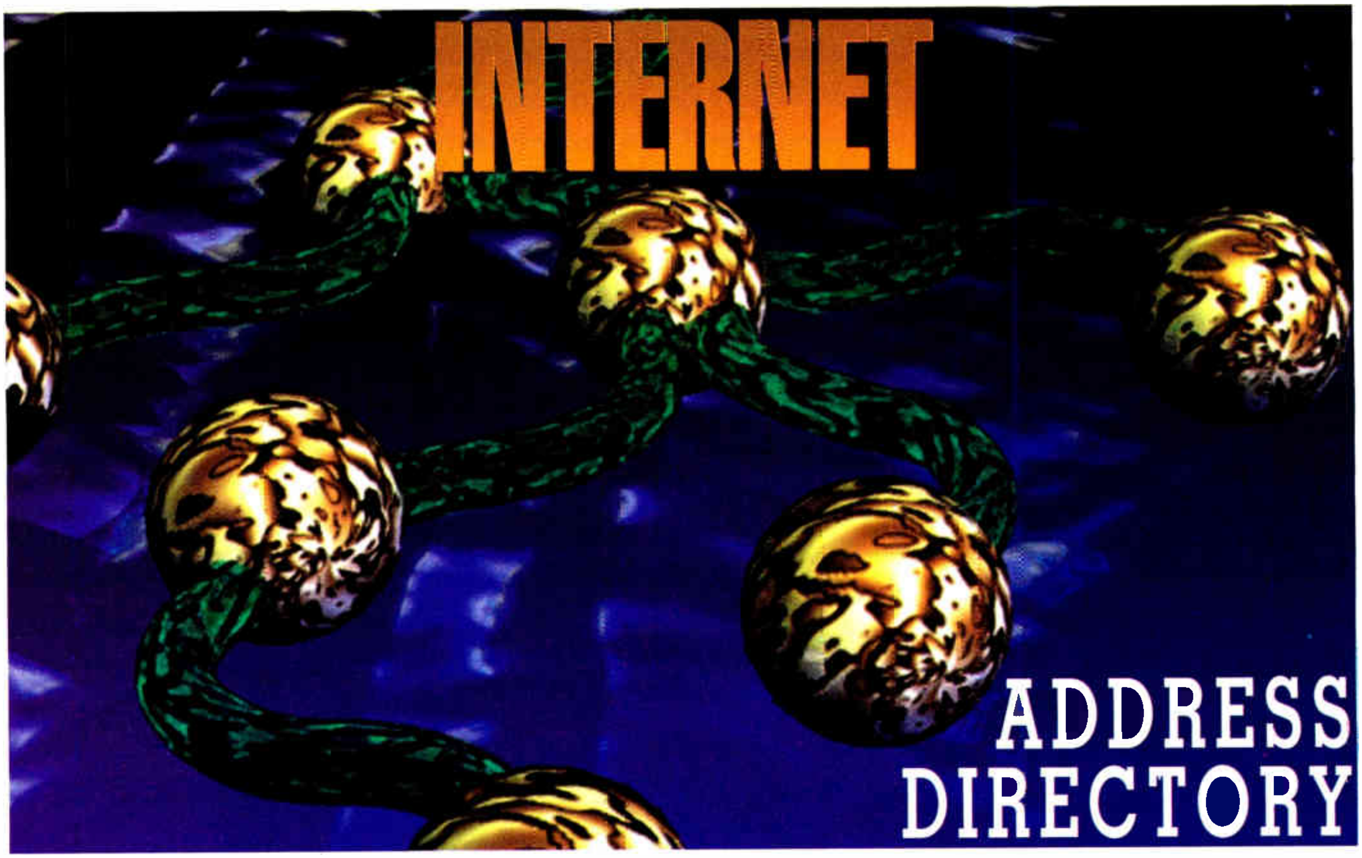

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THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS

Options abound for broadband network powering

Engineers search for solutions

By Roger Brown

Just like the networks themselves, traditional thinking about powering options is undergoing a major revolution. As recently as a few years ago, there was one accepted network power design; today, there are numerous trade-offs to consider.

For example, MSOs are already transitioning from 60-volt AC power to 90 volts to give them more "reach" with power. This also allows them to power a hybrid fiber/coax network using fewer expensive power supplies, which saves money, but also makes it easier to back-up these power "nodes" for longer periods of time.

As the cable MSOs make their systems more "bulletproof" for essential services such as telephony and high-speed data, power supply manufacturers are developing hybrid power/generator units that can provide long-term backup in the event of a power outage.

But is that good enough? Can expensive conventional batteries, which require vigilant maintenance and pose significant environmental issues, be counted on to work when they're needed? Every time? Some top engineers don't think so. Others don't think it's the best solution, but are skeptical about other proposed options.

"In Canada, we have been paying something over $2,000 to install battery-driven standby power supplies," reports Nick Hamilton-Piercy, senior VP of engineering and technology at Rogers Cablesystems. "These expenditures have been made with essentially 'blind faith' that they work. In practice, we find they don't do a very good job when we depend on them."

Why not? Hamilton-Piercy says snap field audits show that a large number of power supplies are either underperforming or not working at all when forced into their standby modes. The effects of climatic changes such as those experienced in Canada rob batteries of reserve power. While batteries promise two hours of reserve, in practice, it's sometimes just a few minutes.

Of course, well-planned and documented preventive maintenance programs are designed to help MSOs keep tabs on such problems. But they're expensive and are often cut when money gets tight. "Guess what happens in the real world when expense budgets are restrained?" asks Hamilton-Piercy rhetorically.

That leaves companies like Continental Cablevision, which want to begin deploying telephony service over their networks, a long way from being able to provide eight hours of backup, as Bellcore suggests.

"Our business plan (was written to) afford batteries, but it would be a real good idea if there was another way," says David Fellows,

(L to R): Photo of Dynasty broadband-specific batteries courtesy of Alpha Technologies; Flywheel Energy Storage System courtesy SatCon Technology Corp. Salida Substation courtesy of the National Archives–Rocky Mountain Region, Denver, Colo. Record Group 115, Bureau of Reclamation. Project Reports, Box 264. CBT 652.00SG53-04. Photos have been electronically altered.

senior VP of engineering and technology at Continental. "With telephony, you need more power supplies in more locations, and that poses cost issues and forces you to wonder if they'll work when you need them."

Tony Werner, director of engineering at Tele-Communications Inc., much like his colleagues from the other major MSOs, has already concluded TCI needs to transition to 90-volt powering schemes for telephony. Otherwise, assuming a 40 percent penetration rate, the number of power supplies in a network would need to double, Werner says.

For example, to provide just video using the 60-volt approach, 67 power supplies would be needed to service an area encompassing 20,000 homes. Adding telephony would double that number. But by going to 90 volts, both video and telephony can be provisioned with just 17 power supplies, Werner says. In addition, it's easier to provide common backup and monitoring with this "centralized" approach.

A novel approach

Southern New England Telephone took the approach several steps further and developed a plan where it uses a special cable to power its network with 480 volts. This allows the company to use its existing central office backup generators and its existing rights-of-way, says Duane Elms, director of advanced systems at SNET.

The company chose to use this high voltage approach simply because no other viable option existed, Elms says. Because of the geological characteristics of Connecticut (it's essentially one big rock), alternative technologies were either difficult to implement, were less reliable than conventional power approaches or were simply vaporware. "We were just flat stymied," Elms reports.

Like cable MSOs, SNET is using the HFC architecture to deliver integrated voice and video services to its customers. But unlike copper, fiber optic cables cannot carry power, so a different approach had to be used. SNET engineers came up with a radical new cable design that uses nine aluminum conductors wound around a plastic inner duct that carries the fiber cable. (*Editor's note:* A more detailed technical explanation of SNET's approach will appear in the April 1996 issue of *CED.*)

SNET's approach has turned more than a few cable engineers' heads, many of whom say they are eagerly awaiting more detail and hoping to evaluate the approach. In the meantime, however, there is intense interest in flywheels as a potential power storage device.

Companies like Trinity Flywheel in San Francisco and SatCon Technology of Cambridge, Mass. have made presentations to a number of telecommunications companies, hoping to gain support to develop a suitable product that could store hours of reserve power without environmental issues or maintenance needs for several years.

SatCon, in fact, has several "letters of interest" from well-known MSOs, including Rogers, TCI, Continental and others for such a product, which has encouraged SatCon to pursue its development. In fact, company vice president and CTO Richard Hockney explained the flywheel concept during an industry conference in January.

SatCon plans to have units available for field trials by the fourth quarter of this year, with commercial production slated to get underway next year, says Hockney. The units, designed for underground installation at pedestal or utility pole locations, are capable of generating one kiloWatt of power for up to two hours in the event of a power outage, he says.

How it works

The system's motor/generator draws power from the electrical bus to spin the flywheel rotor to its steady state speed, which is sustained through use of electromagnetic bearings that greatly reduce frictional contact between parts. If utility power is lost, the kinetic energy of the flywheel is converted back to electricity and sent into the system over the coaxial distribution and drop cables to power network interface units and the ringer on the telephone.

"We think this technology offers a superior alternative to lead acid batteries, which are the main form of backup power available to network operators today," Hockney says. "And we believe it is a more attractive alternative from a cost standpoint than other emerging options, such as fuel cells and turbine alternators."

Officials declined to discuss pricing other than to say the flywheel units will be comparable in cost to the term-of-life costs of battery backup, which includes considerable maintenance and recharging time that isn't required for the flywheel system. But engineers familiar with the technology report that the cost is roughly double that of batteries, based on kiloWatt hours. "Scheduled maintenance (for the flywheel system) is only required after seven to 10 years of operation," Hockney says, adding that, with replacement of certain parts, the estimated life span of the product is in excess of 20 years.

While the approach appears to have merit, at least on paper, it appears to be an expensive–and untested–alternative.

So why all the support? "We know we have to do something," sums Hamilton-Piercy. "We could keep the existing 60-volt inverters at their current locations, but dump the batteries. The flywheel is unaffected by temperature and even if forgotten for eight to 10 years, would continue to operate successfully. It is also silent, unlike gas powered or other backup sources, and 'green' in that it adds no pollution and can be disposed of at any scrap site for recycling."

Hamilton-Piercy hopes to lab test some prototypes and deploy a "few hundred" units in Rogers' technology testbed in Newmarket, Ontario. If they meet performance and price specs, he says Rogers would purchase even more units and place them in a high-speed data launch city such as Toronto or Vancouver.

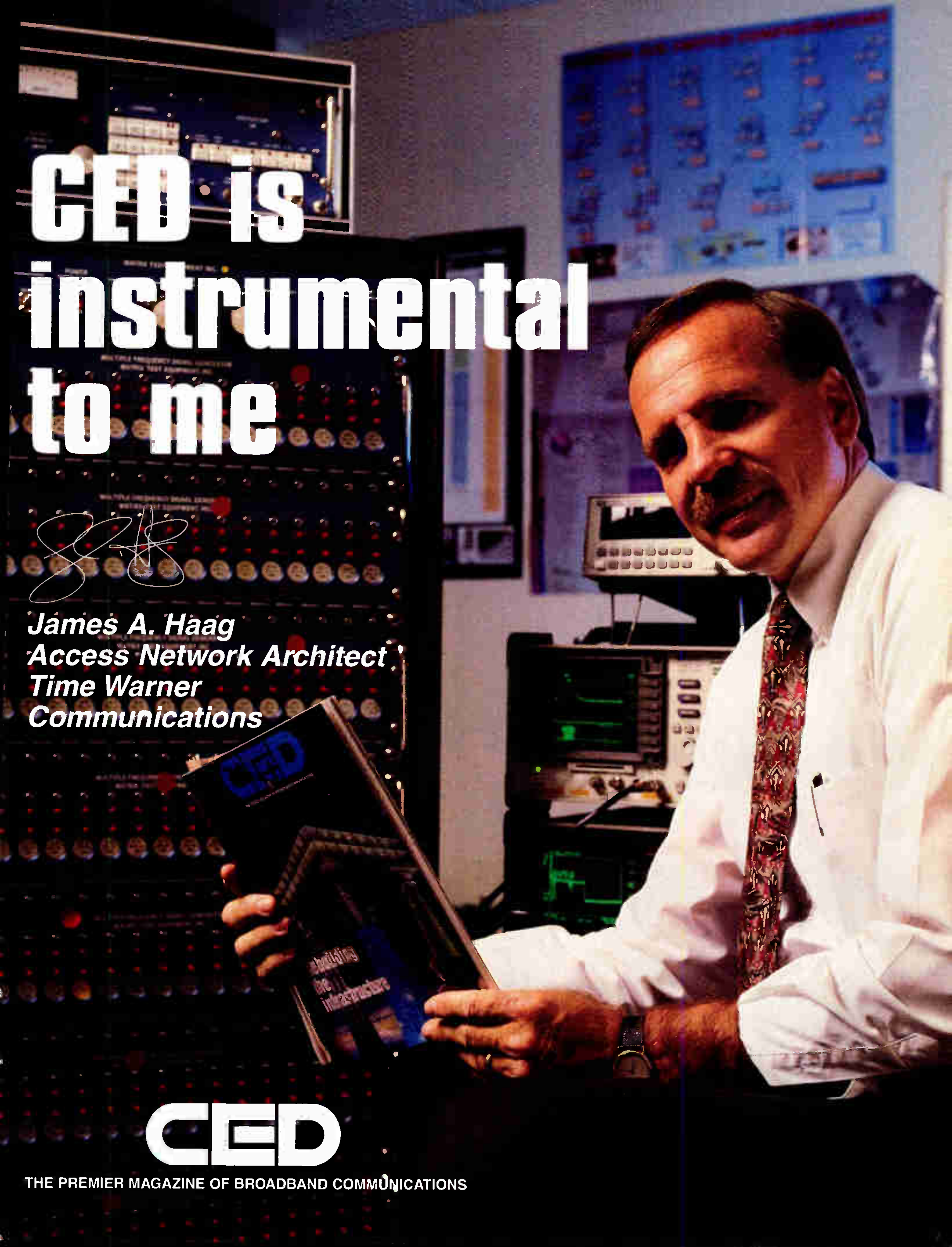
Others, while intrigued, continue to explore different options. Faced with similar decisions, the telephone companies are exploring a host of alternatives, including solar power. Extensive testing by Bellcore and BellSouth in a number of locations, and in two commercially operating optical network units in Charleston, S.C., have some convinced the technology is viable.

But for most, the solution to the powering puzzle is a combination of traditional technology and a new way of thinking. Time Warner, for instance, would prefer to leave power generation to the experts and instead explore novel ways of delivering that power, according to Jim Chiddix, senior VP of engineering and technology at Time Warner, who is keenly aware of the shortcomings of today's powering methods.

In Rochester, Time Warner is working with the local utility to develop a redundant powering method. In this scenario, every power node would be connected to two separate substations, making it virtually problem-free except for a catastrophic outage.

But even that approach won't work everywhere. To fill in the gaps, Time Warner is said to be fond of using natural gas generators to backup power nodes when commercial power is lost.

TCI's Werner is also a big fan of such generators, especially if the MSO decides to deploy centralized power nodes. After commissioning a consultant to explore energy storage options, TCI is now convinced that breakthroughs in battery technology are not likely in the near-term, as the company once hoped. Battery R&D, undertaken in hopes of developing a "super battery," has been disappointing at best, leaving Werner to believe that traditional lead-acid, AGM and gel batteries will continue to be relied upon for years to come. CED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SS7 connectivity: foundation of telephony

Number portability and more

By Daniel Teichman and Donald Reaves, Marketing Managers, STP and SS7 Networks, Nortel (Northern Telecom)

New entrants to the telephony market need to quickly maximize network investment in order to be competitive. As the foundation of telephony infrastructures worldwide, Common Channel Signaling #7 (often referred to as SS7) is a key component in achieving this goal. SS7 is the agreed-upon set of standards for how telephone switches and networks communicate with each other. For telephone companies, SS7 has provided call setup efficiency, allowed the deployment of network-wide services, ensured service availability and enabled rapid service creation. Collectively, these attributes are both cost-effective and revenue-generating.

Each of these attributes also applies to a new entrant in the telephony business. It is equally important to recognize how SS7 will enable regulatory changes which will truly open the industry to widespread local competition. In the compromise House-Senate telecom bill, the provision of Local Number Portability (LNP) is one of the requirements to ensure fair local competition. Without an SS7 infrastructure and SS7 interconnection between network providers, LNP cannot be implemented to any meaningful degree.

By examining how traditional telephone companies have implemented SS7 networks and how they have evolved to date, it is possible to understand in more specific terms what value an SS7 network provides. Furthermore, by projecting what demands a rapidly changing industry will have on the SS7 infrastructure, we can see how an SS7 network provides an integral part of the foundation for the success of cable telephony.

SS7 network architecture

Almost all SS7 networks in North America are built using a quasi-associated architecture. That is, signaling between end points uses a common network (e.g. Signaling Transfer Points for efficient transfer of signaling messages) rather than having to be directly connected between each and every node. See Figure 1.

As Figure 1 shows, the signaling path between telephone central offices (SSPs) is independent of the physical connection. Signaling Transfer Points (STPs) are always deployed as mated pairs for redundancy and load sharing efficiencies. Service Control Points (SCPs), repositories for network or service intelligence, may be deployed as mated pairs sharing the traffic load or in an active/backup configuration. The two primary uses of the SS7 network are for call setup and for transaction messaging such as database queries. Because SS7 is a network signaling protocol, the information it carries is used to interwork with a wide variety of access signaling methods, such as Integrated Services Digital Network (ISDN) and Analog Display Services Interface (ADSI).

Importance of SS7 signaling

A quasi-associated architecture has certain inherited attributes because of the design of the SS7 protocol. (See sidebar p.76, for a detailed description of the SS7 protocol.) Three key attributes are:

- ✔ efficiency
- ✔ service enabler
- ✔ network reliability.

By using an overlay network of separate high-speed "out-of-band" links operating at 56 or 64 Kbps, SS7 significantly reduces network

Figure 1: *Typical SS7 (quasi-associated) network architecture*

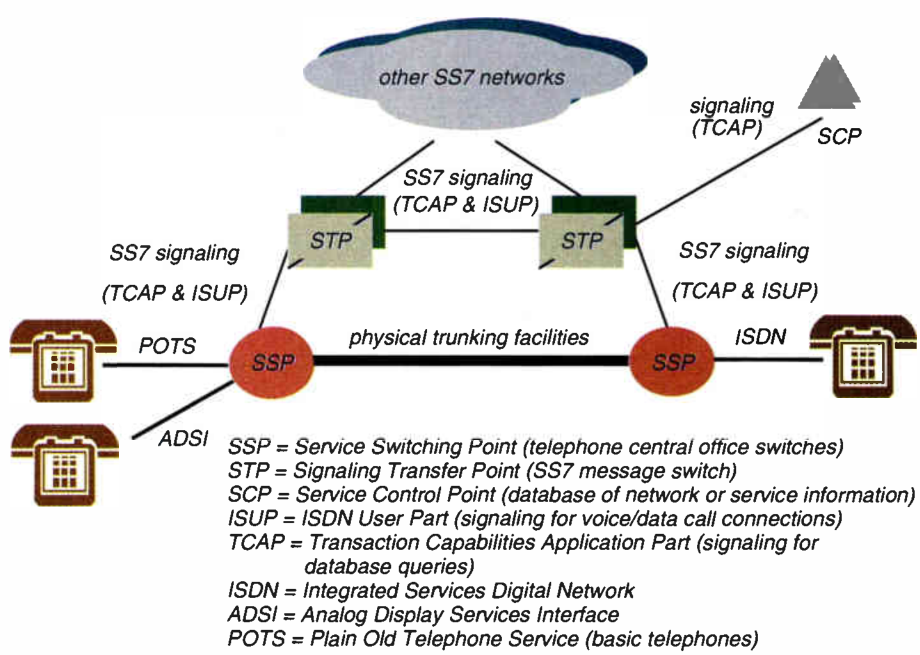
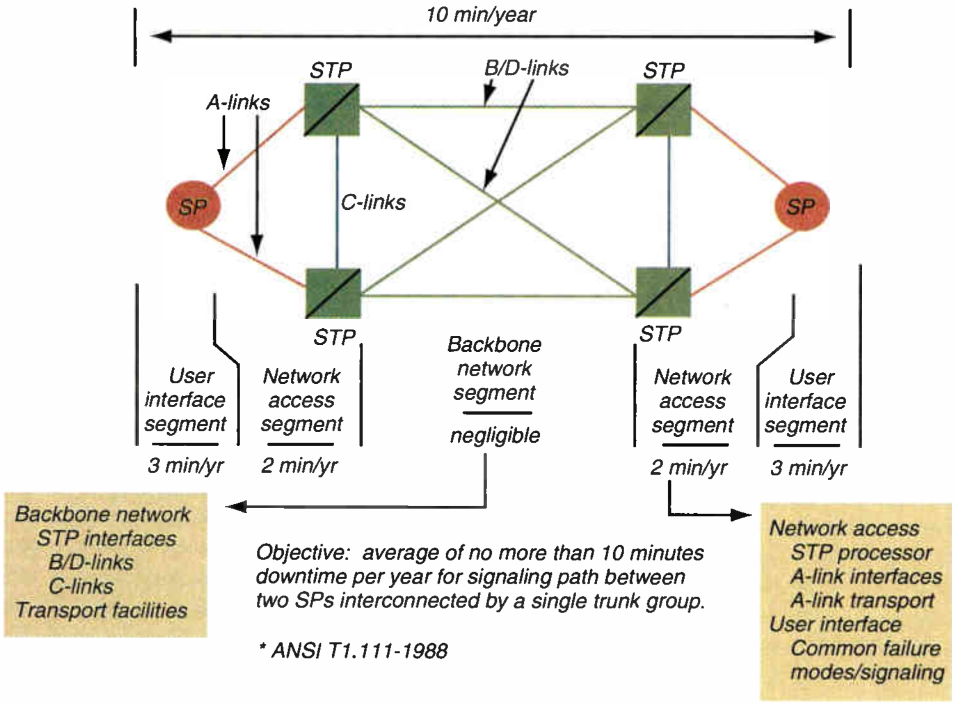


Figure 2: Reference model for Message Transfer Part (MTP) network downtime objective*



provider expenses for call setup procedures. When SS7 is used instead of in-band signaling, trunks are reserved rather than seized until the network is assured of completing a call. By doing so, the call setup savings come from shorter information transfer time (SS7 message transfer is an order-of-magnitude quicker than in-band signaling) and the ability to fall back to the originating end of the call to provide call treatment (e.g. busy signal to end-user). This frees trunk facilities to carry the optimal amount of traffic. Therefore, not only is more network capacity available, but network efficiency is increased as well.

SS7 networks are also service enablers. The SS7 protocol carries the calling number and other critical information which enable residential and business services to work seamlessly across the network. Residential services such as automatic callback and calling number delivery, and business services such as network message service and networked automatic call distribution (NACD) are all dependent upon SS7 to work beyond the boundaries of a single switch. SS7 also provides the ability to have network services where information is stored at a centralized database. Two examples are 800 number service, where an 800 number is mapped to a real directory number for call routing, and calling card validation for credit card calls.

Service value is greatly enhanced by providing services beyond the boundary of a single switch. The SS7 network allows service intelligence on a networkwide basis. It is in this area where advanced access signaling methods, such as ISDN[1] and ADSI become important. Together, ISDN access and SS7 network signaling provide nationwide (and potentially international), end-to-end, digital common channel signaling for data and voice connections. Alternatively, ADSI provides the ability to transfer network/service intelligence to/from analog-based display terminals (phones with small display screens). In both instances, the combination of access signaling and network signaling (SS7) enable network operators to maximize service revenues and end-users to maximize service usage.

Network reliability is the third key attribute of a quasi-associated network architecture. In addition to carrying user information, the SS7 protocol has been defined to carry extensive network management messages. These were designed to handle abnormal network conditions and to meet stringent reliability requirements, thus providing the end user the assurance of service availability.

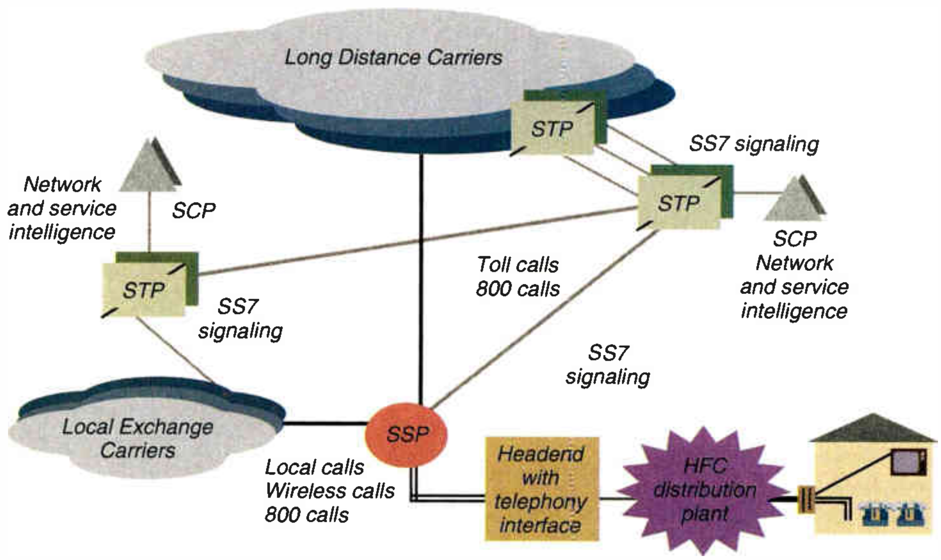
An example can be used to illustrate this reliability. When an STP receives an incoming message, it performs message discrimination to determine which node the message is destined for and what is the application or user of the message information (e.g. Transaction Capabilities Applications Part (TCAP) query messages destined for an SCP vs. an ISDN User Part (ISUP) release message destined for an originating switch to teardown an established voice call). Upon determining the destination address of the next signaling point, network management procedures check the available state of the node and its primary route and transfer the message accordingly, assuming no faults are detected within its routing database. Should the primary route be unavailable, secondary routes are used to transfer the message.

The North American requirement for availability between any two directly connected switches (measured in downtime/year) of a quasi-associated network architecture is 10 minutes. Figure 2 shows the reference model for Message Transfer Part (MTP) network downtime objective. The use of MTP for the reference model is because MTP layer 3 (see sidebar for more detail) is responsible for the routing of data between nodes in the SS7 network. By providing mated pairs of STPs, diverse paths between signaling points and extensive network management capabilities, this objective is achievable.

Industry changes affecting SS7 networks

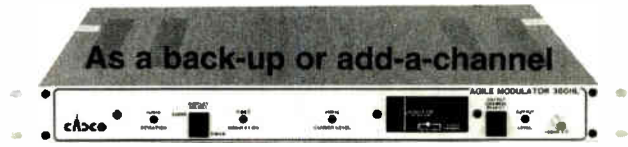
As each telephone company expands its services, the value of its SS7 network continues to increase. In fact, this trend applies to the entire telecommunications industry. As new service providers enter the market and as all service providers add new innovative network-based services, the common factor will be the SS7 infrastructure and SS7 connectivity.

Figure 3: *Cable telephony: a possible network infrastructure*



First, consider the introduction of Local Number Portability. LNP is a critical factor which will promote the successful entrance of cable operators and others into the world of telephony. LNP is the ability of subscribers to keep their telephone number when changing service providers. Industry progress to date has achieved LNP specifications which are defined using SS7, common number portability databases, and requirements to carry certain information in the SS7 protocol. While it will take time to introduce and fully deploy, LNP has become regulatory table stakes and will influence the SS7 network decisions of all telephone service providers.

Second, one can examine the proliferation of service providers (local wireline, local wireless and long distance) and wonder how to handle the increasing complexity of SS7 interconnection. SS7 standards and industry agreements help manage this complexity.[2] For example, two specific STP capabilities are Global Title Translation (GTT) and Gateway Screening. Centralizing GTT at an STP simplifies the amount of data each switch or network must keep locally, while Gateway Screening is essential to ensuring security and integrity between interconnected networks. In parallel to standards bodies, industry forums like the Network Operations Forum address such



issues as link diversity guidelines and the procedures for problem resolution between interconnected networks.

A recent report in the industry press emphasizes the stability of today's SS7 standards.[3] It was reported that all the technical details of interconnection between Time Warner and Ameritech have been fleshed out in good-faith negotiations. The ability of both parties to resolve technical issues has in large part been dictated by clearly defined SS7 standards and SS7 interconnection requirements.

The third factor is service explosion. Most local service providers have implemented or have plans to implement some form of Advanced Intelligent Network (AIN) capabilities. AIN places the intelligence to deliver key features in a Service Control Point (SCP), or an Intelligent Peripheral (IP), instead of in each individual switch. "Triggers" in the software of individual Service Switching Points (switches) momentarily interrupt call processing and generate a query to an SCP for instructions on how to process features for individual calls.

AIN also enables a standardized service creation environment (SCE) that lets any vendor, including the service provider, develop software for the SCP. Service providers can then quickly create (or have other specialized companies create) custom features and load them into the SCP, where they can be immediately accessed and used by any SSP in the network.

As a result of the value SS7 brings to a service provider, successful entrants must have an SS7 network. Figure 3 shows a possible network for providing cable telephony. As shown, SS7 will be used to interconnect to other local and long distance providers as well as access SCPs for network and service information.

For each service provider, there will be a business decision to own (invest in building an SS7 network) or lease (buy network capacity from another network provider). The lease vs. own decision is complex and will be dictated by the tradeoffs encountered with ownership, network control, deployment costs, timing and degree of desired service flexibility. In either case, SS7 is a mandate.

With a flexible SS7 infrastructure, a new entrant will be able to maximize network investment quickly by bringing to market those features and services which are relevant and fill unanswered market needs. This will undoubtedly make new entrants more competitive and benefit end users. With a robust and reliable SS7 infrastructure, service availability and therefore service assurance can be given to end-users. Finally, careful planning of an SS7 infrastructure will make the uncertainty of ongoing industry evolution more manageable. CED

SS7 protocol

By Donald Reaves, STP and SS7 Networks, Nortel (Northern Telecom)

Figure 4 shows the structure of the SS7 protocol. It is based on the OSI reference model where functions are partitioned within seven independently standardized layers with well-defined interfaces between two contiguous layers.

Physical, electrical and functional characteristics of the signaling link are defined within layer 1 of the Message Transfer Part (MTP). MTP Layer 1 is responsible for relaying the bit streams of data containing call control information between two end points over a physical medium such as a 56 kbps or a 64 clear channel kbps link.

The Data Link layer, MTP Layer 2, ensures reliable exchange of information between two signaling points by error control, flow control and other link control activities. Detected errors in transmission can be detected and recovered, thereby masking deficiencies in the transmission quality.

The Network layer, MTP Layer 3, is the workhorse of the SS7 protocol. It transfers data transparently by performing routing and relaying of data between end users. This includes procedures for connection and connectionless addressing, message discrimination and routing, network management, multiplexing several logical links onto a single link and congestion control.

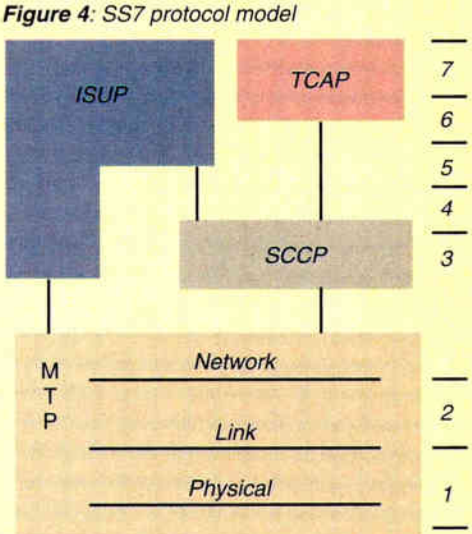
Connectionless addressing is performed by the Signaling Connection Control Part (SCCP), which is responsible for determining the network address supporting a connectionless-based service (e.g. 800 number services or calling card validation), relaying the translated address to MTP and for network management related to connectionless services.

Layers 4, 5 and 6 refer to the Transport, Session and Presentation layers. These optimize resources based on the type of communication and application, such as ISUP or TCAP.

The ISDN User Part (ISUP) corresponds to these higher layers. ISUP uses fixed messaging procedures for setting up, coordinating and taking down voice/data trunk calls. ISUP is also responsible for transporting data about the signaling user (e.g. calling and called party number) in the ISUP message parameters.

Layer 7, the Application layer, specifies the nature of the communication required to satisfy the user's needs such as ISUP (call setup) and Transaction Capabilities Application Part (TCAP) for database queries. End user applications are resident within this layer. -DR

Figure 4: *SS7 protocol model*



MTP = Message Transfer Part
SCCP = Signaling Connection Control Part

References

1. Two ISDN user-to-network interfaces have been standardized: Basic Rate Access (BRA), intended to support single terminals or small groups of terminals; and Primary Rate Access (PRA), designed mainly to give PBXs access to the SS7 network.

2. The Alliance for Telecommunications Industry Solutions (ATIS) oversees the activities of both American National Standards Institute (ANSI) and Network Operations Forum (NOF). Both address issues of national scope with respect to SS7.

3. *Telco Business Report*, Vol. 13, No 2., Jan. 15, 1996.

Provisioning of HFC telephony networks

A new approach to network management

By Keith Dorking, Senior Staff Computer Science Engineer; and Jack Mann, Manager, Telecom Products, Scientific-Atlanta

With the advent of telephony over the hybrid fiber/coax (HFC) plant, operators can take advantage of a "clean slate" opportunity to design their network management systems. Early on, they will face vitally important decisions. Making the right choices will determine whether they avoid the pitfalls many local exchange carriers have experienced.

One of the mission-critical tasks that brings network management issues to the forefront is provisioning. When a customer calls the operator to request that telephone service be established, both the switch and the HFC access platform must be alerted to create a circuit for that individual. As a result, provisioning is likely to be among the top priorities for HFC operators implementing telephony.

TMN

The Telecommunications Management Network (TMN) standards are intended to provide an organized structure for the interconnection of different types of operation systems (OS) and equipment through the use of standard architectures accompanied by standard protocols and interfaces. Generalized, functional and physical architectures are defined which identify the scope and location of standard interfaces. Figure 4 (p. 80) demonstrates a generalized architecture.

Mediation functionality is required at any point were a translation among command sets or object models occurs. This functionality is often incorporated into the element manager. It is required in the early stages of network development, especially when interfaces to legacy systems (such as billing) are still necessary.

Two broad options are available to the operator for provisioning an HFC telephony platform. One option follows the method used by local exchange carriers today for provisioning, billing and other network management functions. The other reflects a newer, more effective approach to network management.

The traditional approach

The current state of telephony networks can be traced to their evolution over many years at the local exchange carrier. Mainframe computers are still prevalent within telephony networks, because management software required their power to manipulate large databases.

With the growth in complexity of telephony management software, different departments were created at the local exchange carrier to focus on distinct functions. For instance, provisioning and billing typically operate on independent computers. Custom interfaces were implemented to communicate with related elements, including switches and digital loop carriers, some of which became de facto standards.

As Roger Brown noted in *CED's* July 1994 cover story on operational support systems (OSS), RBOC solutions "consist of layers of proprietary software that have been simply stacked upon one another as new network devices and services were brought on-line. Today, it is not uncommon for a single RBOC to have thousands of OSSs and hundreds of thousands of interfaces that had to be custom written to bring new calling features on line."

Numerous conversions

With no central point for communication from management systems to element managers, each computer communicates directly with the relevant element manager to set up a connection from the switch through the access network (see Figure 1) and finally to the home. Because standard and consistent interfaces are not used within higher network levels, such as at the subscriber management computer, numerous conversions take place throughout the network. Messages frequently originate via primitive TL1 protocols and are converted to CMIP/CMIS (defined later) by the local element manager for internal processing.

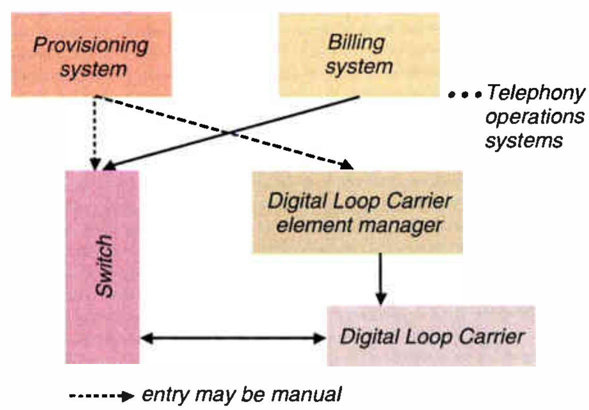
The "overseer" approach

Thanks to the maturity of networking technologies, an operator developing a new telephony network today can depart from the traditional piecemeal approach to implementation of provisioning, billing, performance monitoring and other network functions.

The new management philosophy relies on a network manager to oversee all plant operations. This system takes a broad view of the network, including many network elements, such as Sonet transports, switches and access equipment.

A subset of the functions now performed by the switch will ultimately migrate to the network manager. Because this transition will require vendor changes to switch software, a two-stage implementation is necessary.

Figure 1: *Traditional telephony network architecture*



In the first stage, the network manager will request that the switch operations system (OS) provision the network. The switch creates a circuit and passes corresponding provisioning information to the remote terminal. Any information which cannot be provided by the switch for provisioning is passed directly to the remote terminal through its element manager (See Figure 2).

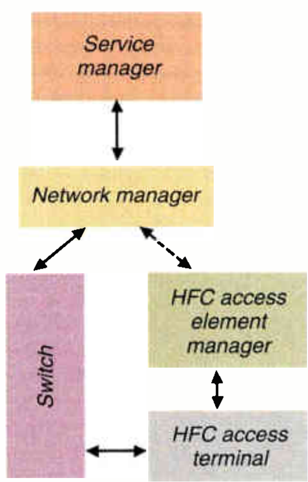
As an interim step, the switch OS could provision itself and the remote manager through a connection between the switch and the remote terminal's element manager. However, the costs to do so would be prohibi-

Table 1	Benefits	Drawbacks
Traditional approach	•Tested approach	• Relies on switch software including expensive upgrades • No central control over network resources • Increased hardware and maintenance costs • Difficult to evolve
"Overseer" approach: switch to element manager	• Minimal changes to existing switch OS • Some central control over resources	• Relies on switch software including expensive upgrades • Coordination among elements required to add features
"Overseer" approach: network manager to switch and to element manager	• Gain independence from switch OS • Lower overall costs • Increased number of features available • Central control over network resources • Promotes faster network evolution enabling quicker addition of new services	• Early implementations will require further testing

tive, and the benefits would be limited.

A better solution: In the second stage, the network manager will simultaneously provision both the switch and remote terminal through its element manager, thereby enabling true "flow-through" provisioning. The process is called "flow through" because communications flow is from layer to layer instead of across layers and sporadically downward.

Figure 2: TMN–type telephony network architecture



Benefits, drawbacks

Centralized administration of all operations, administration and maintenance procedures at the network manager simplifies the network. Fewer elements and fewer connections among the elements are required. Several other benefits are notable:

1. Commands can be processed more efficiently because they are passed directly to the products controlled and are not translated by an intermediary device.

2. Status of individual devices can be monitored because the network manager communicates directly with element managers controlling each of the relevant products.

3. Reliance on the proprietary switch OS is reduced because the interface and its attributes are standardized and moved from the switch to the access network's element manager.

4. The incorporation of emerging Telecommunications Management Network (TMN) standards, including GR-2833, will create common object models, which will allow multiple manufacturers to more easily interface with a single network manager.

5. Network reliability will increase as intelligence is distributed among multiple systems, avoiding single points of failure. Incorporation of advanced features, such as self-awareness, will also lead to early detection of potential problem sources.

Flow-through

In a TMN-type network architecture, information passes through a service level, a network management level and an element level. The hierarchy of systems, instead of a hodgepodge of disjointed systems, enables information to be viewed from any perspective. This approach to network management enables flow-through provisioning.

When designing a network based on flow through provisioning, the network planner should specify several items that will accommodate the process. These include:

CMIP/CMIS instead of TL1 transaction sets: CMIP/CMIS (Common Management Information Protocol/Common Management Information Services), an OSI protocol/service interface for managing heterogeneous networks, is the approach best suited to retrieve and pass information among managing and managed systems.

If a product is currently using TL1 as a transaction set, then the mediation device or network manager is probably performing a translation to CMIP/CMIS. Such a transla-

CMIP/CMIS vs. TL1

CMIP/CMIS and TL1 perform similar roles, but CMIP/CMIS does so in a much more elegant and powerful manner. TL1 messages cover a range of system configurations such as point-to-point and point-to-multipoint. A destination and access code exist within the message to identify both a particular element and entity within it. TL1 input commands take a common format of:

Verb	**Modifier**	**Modifier**

Example: RTRV-ALM-rr means retrieve alarmed conditions for digital facilities.

Unlike TL1, which is a specific set of commands, CMIP/CMIS was designed to work directly with object models. CMIP/CMIS provides a common message framework for procedures invoked remotely. It uses the Remote Operations Service Element (ROSE) and the Association Control Service Element (ACSE) to establish communications with peer object models. Both association establishment and release are performed by ACSE. Once associations have been confirmed, either notifications, such as event reporting, can be invoked, or operations can be performed, such as the retrieval of information with the M-Get service. A variety of data manipulation services, as well as the capability to issue a series of multiple replies to such services, are also provided. Conversely, TL1 requires the generation of numerous commands to achieve the same CMIP/CMIS linked reply.

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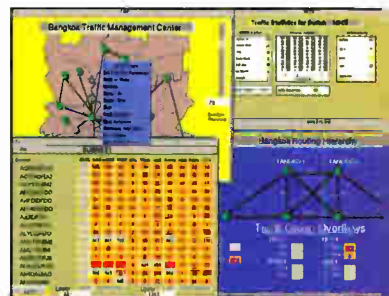

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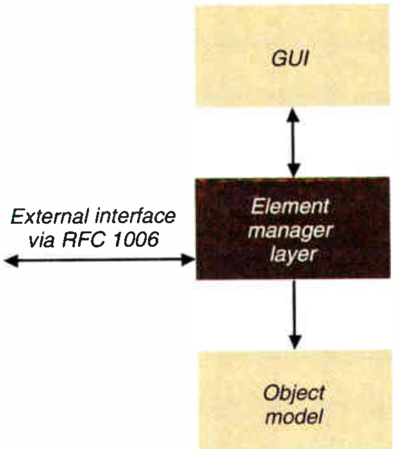
Figure 3: Recommended modularity within element manager



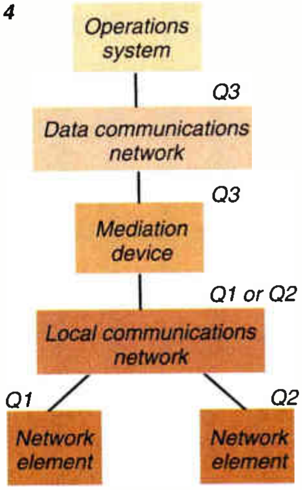
tion is time-consuming and adds unnecessary hardware and software costs to the network (See sidebar on page 78).

Internal architecture of element manager which permits access to object model from multiple points: Two interfaces to object models that reside on the access platform or switch are required. One will come from support personnel who are monitoring the particular product via local graphical user interfaces. The second will come externally, from the network manager for automated provisioning.

A single software module within the element manager will be responsible for both interfaces and will also act as a gateway to the object model.

The same module must provide an RFC1006 stack for external access via an Ethernet local area network (See Figure 3).

Figure 4



Note: Q1, Q2 and Q3 are several of the defined TMN interfaces

Complete object models: To speed time to market, it is sometimes convenient for the manufacturer to compromise the object model by only including a limited feature set. However, the importance of the features excluded is usually discovered either during transitional states to the complete management network or once basic functionality has been exercised.

The operator should verify the presence of vital capabilities during each phase of the network migration.

Longer term migration

Adherence to TMN standards will continue to benefit the operator. New features will first be implemented in a proprietary format by specialized element managers. These features, such as HFC spectrum management and improved surveillance of the HFC plant, will soon after be incorporated in standards.

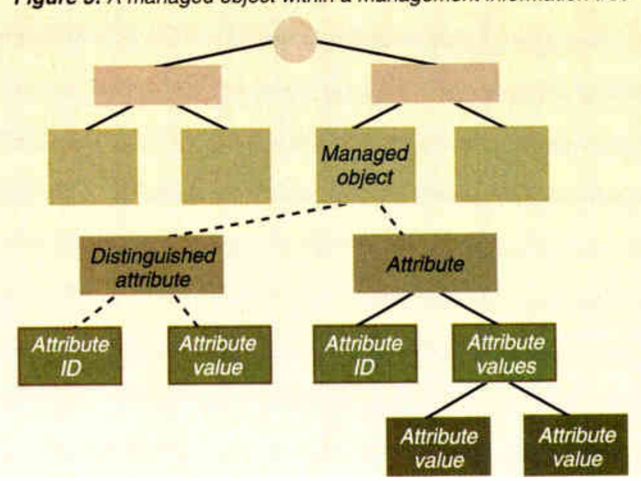
Object models

A managed object model consists of a collection of managed objects arranged hierarchically into a Management Information Tree (MIT). The MIT hierarchy (see Figure 5) reflects the relationships of the objects being managed.

Every managed object maintains a list of attributes, which are a type of value(s) describing the status and/or history of the object. The managed object may be capable of performing a range of actions. In addition, operations such as the "Get" command are intended to act on the attributes of a managed object.

Of particular relevance is the managed object's ability to report events. The object's specification defines notifications, which are events which the object is capable of reporting on.

Figure 5: A managed object within a management information tree



Because the same object model is used among multiple levels of the network, coherence will quickly be gained on the use of the feature.

The common interfaces and interoperability among platforms will ultimately provide the operator with superior products. Because similar open products will be available at all levels, vendors will be forced to quickly introduce new features to maintain their competitiveness. CED

Cable modem mania is beginning to build

Deploying a broadband data service

By Thomas W. Carhart, Product Marketing Manager, Motorola Cable Data Products; and Raja Natarajan, Principal Staff Engineer, Motorola Multimedia Group

Broadband data services have recently received a lot of well-deserved attention from the media and cable system operators. These novel data services provide extremely high-speed and cost-effective access to the Internet and other electronic services to residential and commercial subscribers. They create new value for cable system operators by capitalizing on cable systems' most unique asset–installed coax cable to the home. In addition, broadband data services will create a foundation for the growth of new revenue sources as traditional video entertainment services reach market maturity.

Before investing in a broadband data service, it is essential to explore its deployment and operating costs. Maximizing investor value depends heavily on the functionality and cost-effectiveness of the cable modem system used for service delivery. This cable modem system has the capability to drive up to three-fourths of the investment cost in such a service.

Broadband data services are targeted to cater to the growing consumer and business uses of on-line services, the World Wide Web and other emerging Internet applications. These data services provide content and high-speed transport of networked applications over hybrid fiber/coax (HFC) systems using the Internet Protocol (IP). The broadband data system shown in Figure 1 (p. 84) illustrates the major components of a system that provides high-speed data services over an HFC network. Computers and communications equipment used in this type of service are located in subscriber homes and headend sites (or regional headend sites for operators of multiple headend locations).

Functionality of major components

Headend environment

✔ Cable router. Cable routers (or other types of modem termination systems) interface data traffic from the two-way HFC system to locally and remotely attached networking devices. The cable router interfaces data traffic from the HFC system to standard IP networks; manages bandwidth and spectrum usage in the HFC system; provides robust operation in existing noise environments; implements encryption for secure data transport over the shared HFC network; and downloads software to subscriber modems to provide feature upgrades without dispatching technicians.

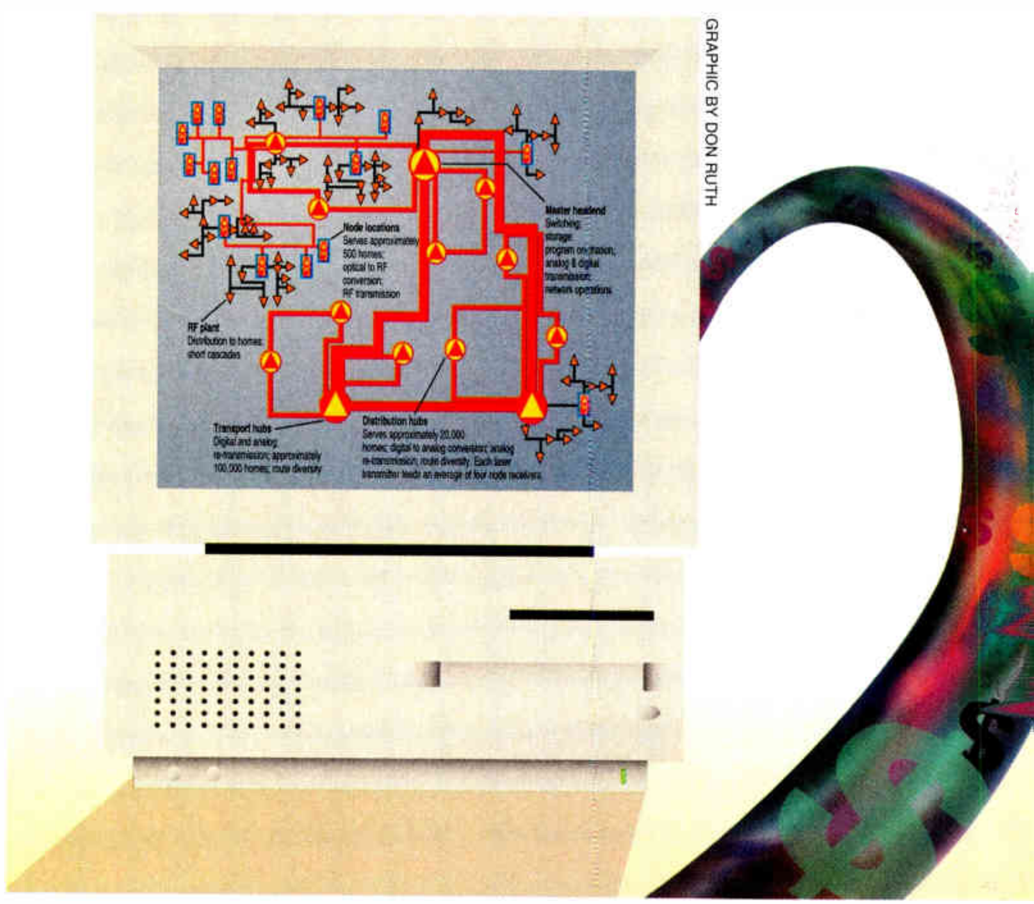
✔ Router/switch. A standard router, or high-speed data networking switch, combines local network connections from multiple cable routers with other data networking devices or servers using standard LAN/WAN interfaces.

✔ Network management system. The cable system operator uses a network management system to monitor operation and change configuration of components. The system automatically detects and alerts the cable operator to malfunctions.

✔ WWW caching server & Internet firewall. A World Wide Web caching server stores frequently accessed Internet information within the cable system to reduce Internet access requirements and improve subscriber response times. These computer platforms also act as an Internet firewall, providing increased security.

✔ Local application servers. Local network applications, such as e-mail and WWW servers, can be deployed within a headend environment as part of the cable operator's broadband data services. Subscribers will realize better response times for locally stored content compared to remotely stored Internet content. Local content storage is an additional value-added service for the cable operator.

✔ Subscriber management system. The subscriber management system is used to control and monitor individual subscriber access to data services. The system also interfaces with an external billing provider, if one is used by the cable operator.



GRAPHIC BY DON RUTH

Subscriber home

✔ Cable modem. Cable modems interface the HFC system coax cable to a standard 10BaseT Ethernet in the subscriber home. The 10BaseT Ethernet LAN (a short twisted pair cable from the modem to the PC) is used to connect one or multiple subscriber PCs to the broadband data service.

✔ Subscriber PC. The subscriber's personal computer is connected, via the local Ethernet, to the high-speed IP data service. The data service enables a high-speed connection to the Internet, on-line services and content offered by the cable operator. Using this service, subscribers can transport data at more than 100 times the speed of existing dial modems. In addition, subscribers always have instant access to the broadband service, eliminating the delay caused by dial-up time and busy signals when using dial modems.

Subscribers receive high-speed access for a monthly fee, which is higher than the fees for on-line services

The economic model shown in Table 1 quantifies the value created by such a service and identifies the key levers in maximizing investor value. This model indicates cash requirements for constructing, as well as cash generated from operating, a basic broadband data service in an HFC system passing 50,000 homes.

The cash flow model for broadband data services assumes a stable data service penetration of 20 percent after six years, and is based on recent dramatic growth in on-line service subscriptions and WWW usage. All deployment investments, operating costs and subscriber revenues have been scaled to the number of subscribers in this system.

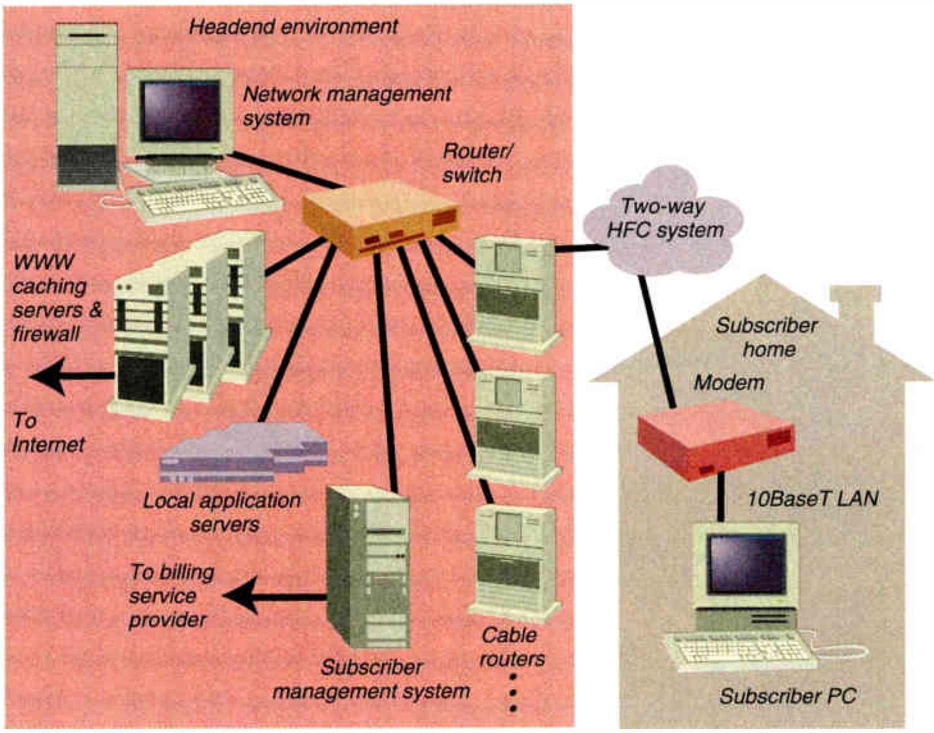
Revenues in Table 1 are generated by a fixed monthly subscription fee of $25. Subscribers receive high-speed access to the Internet in return for this monthly fee, which is moderately higher than the fees for on-line services. Other potential revenue sources, such as advertising and local content provision, are not included in this model because they are evolutionary services and will vary from one system to another. These additional services are noteworthy because they can generate high margins, leverage the installed broadband data service and represent future growth opportunities.

Table 1: Cash flow model for broadband data service	Year						
	1	2	3	4	5	6	7
Penetration	2%	6%	10%	14%	18%	20%	20%
Subscribers	1,000	3,000	5,000	7,000	9,000	10,000	10,000
REVENUE							
Monthly service subscription	$25	$25	$25	$25	$25	$25	$25
Basic subscription service	$300,000	$900,000	$1,500,000	$2,100,000	$2,700,000	$3,000,000	$3,000,000
CASH EXPENSES							
System upgrade cost	$1,430,000						
HE cost							
Cable router cost	$300,000	$0	$0	$150,000	$150,000	$0	$0
Server cost	$70,000	$0	$0	$50,000	$0	$0	$0
Subscriber management system	$200,000						
LAN/WAN equipment cost	$38,500	$16,000	$31,000	$31,000	$16,000	$8,000	$0
Installation cost	$4,000	$8,000	$8,000	$8,000	$8,000	$4,000	$0
System integration cost	$120,700	$3,200	$6,200	$46,200	$33,200	$1,600	$0
Subscriber cost							
Installation cost per sub	$30	$30	$30	$30	$30	$30	$30
Modem cost per sub	$500	$400	$320	$260	$200	$165	$130
TOTAL subscriber cost	$530,000	$860,000	$700,000	$572,000	$469,600	$193,840	$131,072
Operating cost							
Marketing & sales	$15,000	$45,000	$75,000	$105,000	$135,000	$150,000	$150,000
Internet access fees	$48,000	$144,000	$180,000	$180,000	$180,000	$180,000	$180,000
Network management	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000
Billing services	$15,000	$45,000	$75,000	$105,000	$135,000	$150,000	$150,000
Customer service	$19,100	$57,300	$95,500	$133,700	$171,900	$191,000	$191,000
TOTAL operating cost	$347,100	$541,300	$675,500	$773,700	$871,900	$921,000	$921,000
TOTAL EXPENSE	**$3,035,300**	**$1,428,500**	**$1,420,700**	**$1,630,900**	**$1,548,700**	**$1,128,440**	**$1,052,072**
CASH FLOW	$(2,735,300)	$(528,500)	$79,300	$469,100	$1,151,300	$1,871,560	$1,947,928
Cash flow per subscriber	$(2,735)	$(176)	$16	$67	$128	$187	$195
Cost of capital	15%						
Discounted cash flows	$(395,564)						
Discounted terminal value	$5,614,287						$12,986,187
NPV	$5,218,723						
Average NPV/subscriber	**$522**						

Sources: System Dynamics Inc., Economics & Technology Inc., vendor quotations and literature


In a future
where everything converges,
ACCESS
IS KEY.

Figure 1: *Network diagram for major components of broadband HFC data system*



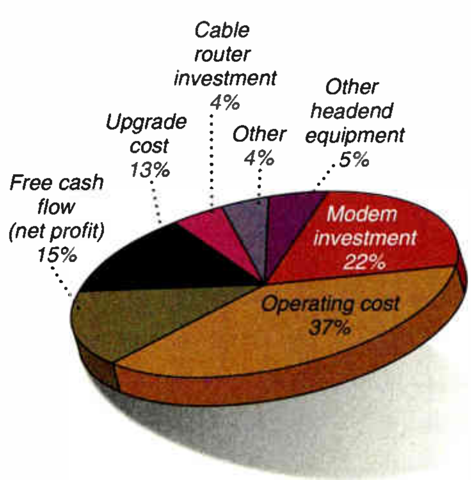
These services may subsidize the monthly service fee, similar to the way advertising fees cover the cost of basic television programming.

Cash expenses for the service listed in Table 1 are divided into four categories. First, there is a "system upgrade cost," which covers the HFC system improvements that might be necessary prior to deployment. It is assumed that all equipment and labor costs for activation of the two-way plant must be incurred. Installation costs for filters that improve ingress noise in the upstream spectrum and replacement of one-half of all data subscriber drops are also included.

The second cash expense is the "HE cost," which includes all equipment costs and installation fees for networking components in the headend. Headend costs include operators' costs for cable routers configured to support increased traffic capacity as penetration grows. WWW caching and application server requirements also scale with penetration. The $200,000 in subscriber management expenses incurred in the first year includes a Simple Network Management Protocol (SNMP) platform and the development of operator specific management applications and billing system interfaces.

Finally, local and wide area network equipment, interfaces and installation expenses are included. The economic model assumes use of the Fiber Distributed Data Interface (FDDI) for all local area network connections in the headend. The local routers, servers and HFC communications equipment (including cable modems) are designed to support full-speed (30 Mbps downstream, 768 Kbps upstream) connectivity for users who are browsing WWW content and downloading audio and video clips. Multiple T-1 private circuits are assumed for Internet connectivity until the third year, when a T-3 private circuit connection can be cost justified. A system integration fee for installation and startup services, in addition to the development of operator-specific management applications, is also included. Integration services are an estimated 20 percent of all headend equipment costs.

Figure 2: *Cash flow usage over seven-year investment horizon in Table 1*



A third category of expenses in the model is "subscriber cost," which includes all subscriber equipment and installation. This model assumes that subscribers are responsible for providing local Ethernet connections to personal computers. (This is a low-cost card and installation provided by many computer resellers.) Installation of in-home cable outlets accessible to the subscriber PCs is included in the installation costs. The primary subscriber cost is the cable modem shown in Table 1 as $500 in the first year, with a 20 percent annual price reduction over the seven-year investment horizon. The estimated cable modem pricing is based on estimated manufacturing volumes during the investment horizon.

The fourth expense category is "operating costs." Basic high-speed Internet service costs are estimated in Table 1. The marketing and sales expenses are estimated at 5 percent of annual subscription revenues. This figure assumes incremental expenses to existing sales and marketing costs for the cable operator. Internet access fees assume multiple T-1 private circuits (or, after year-three, a T-3 private circuit) connecting to the Internet and are based on current access charges. Network management costs are for personnel expenses associated with seven-day-a-week, 24-hour coverage. It is important to note that an equal or larger reduction in HFC system management expenses could offset ongoing network management costs. Billing services, comparable to those for existing cable services, include the cost for use of an external billing provider. Finally, customer service expenses are based on the experience of on-line service providers.

Operator cash flows listed in Table 1 are determined from estimated revenues and expenses and discounted at a reasonably conservative 15 percent cost of capital. The net present value per subscriber indicates the value created by making the broadband data service investment commitment, and is $520. The annual cash flow generated by each subscriber is $195 at maturity. This figure is comparable to the annual cash flow per subscriber received from all existing cable TV services (in 1994, *Multichannel News* estimated the value for all MSOs was from $135 to $230).

A closer look at the costs associated with deployment in Table 1 provides insight into the importance of a cable modem system. Figure 2 illustrates these costs.

Figure 2 indicates that the most significant use of cash (37 percent) over the investment horizon goes to operating expenses. The second most significant use of cash (22 percent) is modem investment. This suggests that a

Table 2: Critical cable modem system features

Feature	Description	Benefit
Dynamic frequency agility	Reassignment of cable modems to new channels due to congestion; reassignment of carrier frequencies due to ingress noise.	System activities, which are transparent to subscriber and operator, result in high throughput without operator intervention.
Dynamic signal leveling	Detection of received signal levels in system and automatic adjustment of transmission level; alarms management when out-of-range condition occurs.	Broadband data system is insensitive to variations in upstream amplification over time and temperature; modems notify operator when HFC system is out of the specified operating range.
Minimal provisioning & dynamic host configuration protocol	Modems may be authorized and bar coded into a subscriber management system and immediately deployed to subscribers without further headend staging; the installer need only connect the modem to the coax and active Ethernet cables to enable subscriber services.	Reduces receiving, staging and installation activities and time.
Transparent security	Public and private encryption keys assigned, periodically updated and managed by cable modem system without operator intervention.	Prevents theft of service, provides subscriber privacy; does not require operator provisioning or control.
Software downline loading	Cable modem software may be downloaded over the HFC network for functionality upgrade without operator or subscriber involvement.	Minimize or eliminate subscriber service calls and modem upgrade cost
Standard network management	Use of SNMP and MIB II as standard network management interfaces for use with existing network management systems and applications.	Lowers cost to purchase management system hardware and develop software applications.

well-designed cable modem system, one which minimizes operating cost and modem investment, is a major lever in the value creation from a service investment. Furthermore, the third most significant expense, system upgrade cost, depends heavily on the noise sensitivity of the cable modem system. As a first year cash outlay, the system upgrade cost is also an important consideration in the selection of a cable modem system.

Leverage of the cable modem system

Cable operators should seek to maximize the value of their broadband data service investment by carefully selecting the cable modem system deployed for subscriber services. Features of a cable modem system can drive up to three-quarters of the investment cost in such a service, as suggested in the examples below.

First, consider modem pricing sensitivity. If, in the analysis above, modem prices were to fall by only 10 percent annually, rather than 20 percent, the net present value per subscriber for a data service investment drops by approximately $100, or 20 percent of the $522 shown above. Operators should carefully consider their cable modem system architecture selection to insure that it is one of enduring low cost, which will fall as manufacturing volumes increase.

Second, consider the difference that operational features of the cable modem system, shown in Table 2, make to system operators.

The difference between the best and worst case operating features, identified above, may mean there's a need for one or two additional operating personnel, less productive installation and more complex HFC system management, and modem upgrade processing costs that add up to $210 per subscriber (using the model presented in Table 1). Because this exceeds 40 percent of the net present value created per subscriber, operators should be aware of these critical operating features when selecting a cable modem system.

The robustness of the cable modem system also has a significant impact on the value

Finally, consider the system upgrade costs that are incurred prior to service launch. If the robustness of the selected cable modem system could allow operation in noisy cable systems with large node sizes, and if the dynamic signal level range of the cable modem system is wide enough to tolerate HFC plant variations over time, system upgrade costs may be reduced by another $80 per subscriber. The robustness of the cable modem system also has a significant impact on the value created from a data service investment.

Conclusion

It is widely known that customers have accepted many of the evolving Internet services. Broadband data service is an exciting new technology that takes advantage of the inherent broadband capabilities of cable TV systems to provide Internet connectivity. With the increasing demand for high-speed data services, cable operators are well-positioned to generate new revenue streams. As mentioned earlier, however, it is essential that operators avoid potential pitfalls and maximize the value created in deploying a data service by selecting a cable modem system designed for maximum throughput, robustness in existing RF environments, low-cost deployments, operational simplicity for service providers, and ease-of-use for subscribers. This type of cable modem system not only capitalizes on today's market requirements, but also establishes a strong foundation for future service growth. CED

Operators are looking at ways to exploit CD-ROM content, including full-motion video components

packaged for transport in the IP format, which includes all on-line as well as Internet services and on-line stored media such as CD-ROMs.

These cards will be priced at about $200 and will be put to use in the cable modem-to-PC interface of the GI/FORE product, eliminating the 10 Mbps 10baseT "bottleneck," says Ed Zylka, director of marketing, network telecommunications systems at GI Communications, who declines to say whether there will be a 10baseT PC/modem interface option offered with the ATM product line. "As a company, we're saying ATM is going to play a strong role," Zylka says.

"This doesn't mean we're coming out and saying that the PC connection should be based on ATM or that all set-tops are going to migrate to ATM," he adds. "But it does say that the next step for GI beyond the development we've done for digital TV and cable-delivered data is to create a strong core network technology."

The GI strategy drew praise from Microsoft Corp., which has been working with GI and FORE for the better part of two years and has long espoused ATM as the best framework for all types of digital communications in the future, including MPEG video. "We believe this announcement will help speed Microsoft's efforts to bring new services to PCs and televisions," says Microsoft senior vice president Craig Mundie.

The importance of content

Operators stress the importance of their foray into data as much more than Internet access, which places further demands on the system protocols. "We're not in this to become another Internet access provider," Vecchi says. "Our research shows that customers want much more."

For example, operators and commercial on-line content providers are looking at ways to exploit CD-ROM content, including full-motion video components, as well as to create new content built around the widely used authoring tools of the CD environment. "We see a lot of work going on in the commercial on-line community that hasn't been made public that will take advantage of these high speeds," says Vecchi.

In another case in point, Continental, now in a 200-home trial in preparation for commercial rollout in the second half, is working on content as well as technical details as it moves to widescale deployment, notes Jeff DeLorne, executive vice president for the MSO. He says Steve Hill, the MSO's new senior vice president for high-speed data, is focusing his energies on working with a variety of entities to put together locally- as well as nationally-oriented content, including services with a large video component.

In another major development aimed at fostering more advanced content, @Home has tapped Macromedia Inc. to supply software tools that could speed development of multimedia content uniquely suited to the high-speed data access environment. The two companies say they will put Macromedia's Shockwave software to use in conjunction with other software from Macromedia, Netscape Communications Inc. and Sun Microsystems to provide a user-friendly environment for creating and linking multimedia across the World Wide Web.

"The economies of scale we achieve through our distribution agreement with TCI allows us to negotiate from strength with companies like Netscape and Macromedia as well as hardware suppliers," says @Home's Medin. "We can be the low-cost provider for doing things which it would be hard for individual cable companies to do on their own."

@Home demonstrated some of the combined capabilities of these software systems at the Western Show with applications such as multimedia game playing and video clips imbedded in the network's home page. Shockwave works with Macromedia's Director, the multimedia industry-standard authoring tool, making it as easy to tailor content for distribution over the World Wide Web as it is to prepare it for other distribution formats such as CD-ROM, says Jane Chuey, spokesperson for Macromedia.

"We use the same intuitive approach that we use with Director, which means you don't have to be a software programmer to port material to the Internet," she says.

Sun's Java, which is a language that does require a programmer's skill, takes the content development another step, allowing developers to add interactivity within any downloaded page. The combined power of these tools will make fast action multimedia applications readily available to anyone with a cable modem, officials said.

@Home and Macromedia also say they were cooperating on development of new tools that will go beyond the static text and graphics capabilities of today's HTML (hypertext markup language). The tools will allow developers to use the latest video, sound, 3D and interactivity support systems in conjunction with rich multimedia effects.

One aspect of this initiative uses the principles of a new software system developed at the University of Colorado, known as "Harvest," Medin notes. "This is a new kind of search engine that includes modules that go beyond what can be done with HTML," he says. "For example, it can be used to search and retrieve something from an MPEG file."

FORE's Nelsen argues that Ethernet "is not particularly useful for audio and video," whereas the ATM system, which will deliver service at minimum speeds of 2 or 3 Mbps to an individual user during peak usage, can be set to assure the minimum throughput and continuous bit stream is maintained to support video. But Medin argues that it is too soon to take ATM all the way to the home, and others contend that, even if the ATM package is taken to the modem, it should be converted to 10baseT for low-cost insertion at the PC.

Medin, Vecchi and others banking on the 10baseT interface make clear they want the kinds of capabilities Nelsen alludes to built into their systems. In other words, whether it's called ATM or something else, cable is seeking a true multimedia data system capability that looks beyond today's Internet and commercial on-line service base. By all appearances, it's going to have it. CED

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Trade shows

4/28-5/1 Cable '96, produced by the National Cable Television Association. Location: Los Angeles. Call NCTA Industry Affairs (202) 775-3669; NCTA Convention Headquarters (202) 775-3606.

June

10-13 SCTE Cable-Tec Expo. Location: Opryland Hotel, Nashville, Tenn. Call (610) 363-6888.

MARCH

4-5 SCTE Region Training Seminar. Topic: Introduction to telephony, with SCTE director of training Ralph Haimowitz. Location: Exton, Pa. Call SCTE National Headquarters (610) 363-6888.

4-6 Telecommunications Traffic Engineering. Produced by the George Washington University Continuing Engineering Education Program. Instructor: Robert Cooper, Ph.D. Location: Washington, D.C. Call the registrar (800) 424-9773 or (202) 994-5288; fax (202) 872-0645.

5 Digital Video Learning Network (DVLN) **Switching Site Installation.** Location: Nortel Training Center, Raleigh, N.C. Call (800) NT-TRAIN.

5-7 China Broadband '96 Exhibition and Conference, organized by Information Gatekeepers Inc. and China International Conference Center for Science & Technology. Location: Beijing International Convention Center. Call Information Gatekeepers Inc. (617) 232-3111.

6-8 SCTE Region Training Seminar. Topic: Introduction to fiber optics, with SCTE director of training Ralph Haimowitz. Location: Exton, Pa. Call SCTE National Headquarters (610) 363-6888.

11-15 Broadband Communications Network Design, produced by General Instrument. A five-day training course which includes an overview of the broadband network with a special focus on operational theory and design. Location: San Diego, Calif. Call Lisa Nagel at (215) 830-5678, or fax (215) 830-5602.

12-14 Telecommunications Network Engineering for Technicians, produced by General Instrument. A three-day training course which includes technical instruction on distribution networks, architectures and fiber optic transport systems. Location: San Diego, Calif. Call Lisa Nagel (215) 830-5678, or fax (215) 830-5602.

14 Rocky Mountain Chapter SCTE Meeting. Topic: Digital signals & troubleshooting. Location: National Cable Television Institute, Littleton, Colo. Call Dave Barrett (303) 754-4924.

14 3rd Annual Telecommunications Vendor Show & Workshop. Sponsored by the Great Plains SCTE Chapter. Location: Holiday Inn Central, Omaha, Neb. Call Duff Campbell (402) 466-0933.

14-15 Fiberworks: Broadband Cable Television Technology (BCTT). Produced by Antec. Location: Antec Technology Center, Atlanta, Ga. Call (800) FIBERME.

18-19 Wireless Cable Forum: Competition Strategies for the Emerging Video Marketplace. Location: The Fairmont Hotel, Dallas, Texas. Call Kate Hinely (312) 540-3860; fax (312) 540-3015.

18-21 Fiber Optic Training, produced by The Light Brigade. New, four-day class format. Location: Anchorage, Alaska. Call Pam Wooten at (800) 451-7128 to receive a complete schedule.

19-22 Fiberworks: Fiber Optic System Training (FOST). Location: Antec Training Center, Denver, Colo. Call (800) FIBERME.

20 Island Empire Chapter SCTE meeting. Topic: Telephony: Where it came from, and where it's going, with featured speakers from Telect Inc. Location: Telect Inc., Liberty Lake, Wash. Call Roger L. Paul at (509) 484-4931, ext. 230; or fax to Paul's attention (509) 483-9261.

20 Piedmont SCTE Chapter Meeting. Topic: FCC testing, system proofs, system test equipment, cable fault locators, TDRs. Location: Statesville, N.C. Call the Piedmont SCTE voice mailbox (919) 220-3889 for more information or to pre-register.

20 Golden Gate SCTE Chapter, Technical Seminar. Call Mark Harrigan (510) 927-7060 for details.

23-27 Power & Communication Contractors Association 51st Annual Convention. Location: The Ritz Carlton Hotel, Amelia Island, Fla. Call PCCA at (800) 542-7222.

25-28 Fiber Optic Training, produced by The Light Brigade. New, four-day class format. Location: Vancouver, B.C. Call Pam Wooten at (800) 451-7128 to receive a complete schedule.

25-29 Headend Maintenance and Performance Testing, produced by General Instrument. A two-week course, featuring hands-on set up and testing. Location of lab: Hatboro, Pa. Call Lisa Nagel (215) 830-5678, or fax (215) 830-5602.

APRIL

2-3 Planning for Cable Telephony, produced by Scientific-Atlanta Institute. Location: Atlanta, Ga. Call Bridget Lanham (800) 722-2009, press 3.

The issue: Powering

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The questions:

1. Is your system currently involved in, or planning for, an upgrade?

❑ Yes ❑ No ❑ Don't know

2. How likely is it that telephony services will be added to your system in the near future?

❑ Very ❑ Somewhat ❑ Not at all

3. How likely is it that high-speed data and Internet access services will be added to your system in the near future?

❑ Very ❑ Somewhat ❑ Not at all

4. What power voltage will your company's newbuilds and rebuilds utilize?

❑ 60V ❑ 75V ❑ 90V

5. What is the optimum size (in number of homes) of fiber nodes in your system?

❑ <500 homes ❑ 500 homes

❑ 1,000 homes ❑ >1,000 homes

6. Does your system presently employ standby power supplies throughout the plant?

❑ Yes ❑ No ❑ Don't know

7. Would you favor using a centralized power approach in your newbuilds?

❑ Yes ❑ No ❑ Don't know

8. When it comes to reserve power, how much do you think will be adequate in the future?

❑ 2 hours ❑ 4 hours ❑ 8 hours ❑ Other

9. When it comes to power supply companies and technologies, what are the key requirements you look for?

❑ Price ❑ Reliability ❑ Quality

❑ Modularity ❑ Switchover time ❑ Other

10. Are you familiar with alternative powering options such as flywheels, natural gas generators and others?

❑ Yes ❑ No ❑ Don't know

Your comments:

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Official rules: No survey response necessary. Enter by returning the completed survey via fax or mail to the locations indicated above, or print the words "CED Return Path" on a 3"x5" card and mail it along with your name, address, daytime phone number and signature. To be eligible for the drawing, entry forms must be received by 5 p.m. on April 30,1996. CED is not responsible for lost or misdirected mail. One entry per person. Forms mutilated, illegible or not in compliance with these rules shall be considered ineligible in the sole discretion of the judges. Odds of winning depend on the number of entries received. A random drawing from eligible entries will be held on or about May 1, 1996. Winner will be required to provide his/her social security number and proof of identification and is solely responsible for all federal, state and local taxes incurred. Prize is not transferable to any other person. Sweepstakes participants agree to waive any and all claims of liability against CED magazine, Capital Cities Media Inc., Capital Cities/ABC Inc. and its affiliated and independent contractors for any injury or loss which may occur from participation in this sweepstakes or receipt of the prize. Winner consents to publication of his/her name for publicity purposes without further compensation. Participants must be 18 years of age or older. Employees of CED magazine, Capital Cities Media Inc., Capital Cities/ABC Inc. and its affiliated and subsidiary companies, and their respective employees, agents and independent contractors, and their immediate families are not eligible to participate. Void wherever prohibited, license required, restricted or taxed by law. Sweepstakes sponsors reserve the right to change or modify the sweepstakes rules while the sweepstakes is in progress. Participation in the sweepstakes constitutes acceptance of all sweepstakes rules.

RESULTS

The issue: The return path

Whether it's interactive TV, telephony, high-speed data or even just pay-per-view, a key to success is having a good, working return system in the cable plant. The cable industry touts its wide bandwidth, but few real-time, two-way systems have been activated. Consequently, cable operators don't have much experience with the return system. This survey tries to focus on the key issues.

The results:

The results of this month's survey are skewed because only a small number of questionnaires were returned, but some of the answers are enlightening. For example, no one who responded intends to use the return spectrum for telephony–they're more interested in data and pay-per-view applications.

Additionally, two-thirds said they expect the return plant to reliably pass both analog and digital signals from the home back to the headend, but only half have conducted any tests to determine if the spectrum is "clean" enough to pass those signals. Furthermore, only one-third said they were familiar with the plant characterization tests carried out, which pointed out how fragile and crowded the return spectrum can become.

Not surprisingly, the major concerns engineers have when it comes to the return band revolve around noise ingress and issues related to in-home wiring.

Congratulations go out to Gregg Brazee of Auburn Cablevision in New York, who won $50 just for sending in a response to this survey. Fill in your answers on the previous page to be eligible for this month's drawing!

1. Is your cable system presently two-way active (e.g., able to communicate with set-tops in real time)?

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

2. If not, are there any plans to activate the return channel within the next year or so?

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

3. If so, how long has the return channel been operating, and how many subscribers are connected?

Avg. of 2 years Avg. 4,500 subscribers served

4. If your system intends to activate the return channel soon, what will be the primary use of the channel?

Data	Telephony	PPV	Other
50%	**0%**	**50%**	**0%**

5. Do you personally have any experience in maintaining or servicing a two-way active cable TV system?

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

6. How old is the oldest portion of your coaxial cable plant?

Avg. 11 years

7. Do you think your system, including the in-home wiring, can adequately pass digital and analog signals from the set-top to the headend?

Yes	No	Don't know
67%	**17%**	**16%**

8. Have any tests been conducted to determine if your system's 5 MHz to 40 MHz band is "clean" enough for telecommunications use?

Yes	No	Don't know
50%	**50%**	**0%**

9. Are you familiar with the return path characterization studies performed by CableLabs, Jones Intercable and equipment suppliers?

Yes	No	Don't know
33%	**50%**	**17%**

10. When it comes to two-way communication over cable plant, what is your biggest concern?

Noise ingress	Age of plant	In-home wiring	Other
50%	**17%**	**33%**	**0%**

11. How important is the return path to your system's management?

Very	Somewhat	Not at all
50%	**50%**	**0%**

Your comments:

"We found that ingress in the 5 MHz to 18 MHz range is very difficult to deal with. Management and techs will have to work together (to fix it). I have my doubts the 5-30 MHz band can be used with 100 percent reliability."
– *Larry Langevin, Greater Media, Ludlow, Mass.*

"We find that 99 percent of the problems relate to in-home wiring and outdated splitters and braided wire that can't pass sub-band. The 'system' works fine."
– *James Humphreys, Cablevision Systems, Riverhead, N.Y.*

"The return path reflects the importance of preventive maintenance and (use of) quality materials to deliver trouble-free, two-way service."
– *Gregg Brazee, Auburn Cablevision, Auburn, N.Y.*

OSI, Data Sciences ink agreement

FOLSOM, Calif.–Objective Systems Integrators (OSI) has signed an agreement with Data Sciences of the Netherlands to market OSI's NetExpert Operational Support System (OSS) and Network Management application throughout the Netherlands, Benelux, the United Kingdom and Germany.

The Data Sciences Group had sales of $186 million in 1994-95 and markets advanced telecommunications solutions to some of Europe's largest telecommunications service providers.

Under the agreement, OSI and Data Sciences will jointly market OSI NetExpert's framework to communications providers in the European Economic Community.

VisionTel to incorporate Internet access

PHILADELPHIA–VisionTel Inc. has announced that Internet access will be integrated into all of the company's multimedia software management systems.

Through VisionTel's Internet connection, clients will be able to access customer support and download product upgrades and new software releases. AdVision, the company's traffic and billing software system which includes real-time inventory analysis and other proprietary sales tools, will be announcing an Internet promotion in the coming months. In addition, VisionTel plans to introduce its own Web server in the second quarter of 1996.

Alpha recommended for ISO 9001

BELLINGHAM, Wash.–Alpha Technologies has been recommended for ISO 9001 certification. Preparation time for the adoption of ISO certification can range from several months to two or more years, depending on the existent level of the quality program already in place. Alpha completed the process in a little more than six months, according to company officials.

ISO (the International Organization for Standardization) is a worldwide federation of national quality standards bodies that work in cooperation to promote procedure models that help ensure quality manufacturing, service and operation.

Multicom moves to larger quarters

LONGWOOD, Fla.–Multicom Inc. has moved its facilities to larger quarters. The company's new address is: 1076 Florida Central Parkway, Longwood, FL 32750. Telephone and fax numbers remain the same: phone (800) 423-2594; fax (407) 339-0204.

The new building is double the size of the previous facility, according to Multicom chief operating officer and vice president Jordan Miller.

Mfrs embrace Macrovision technology

SUNNYVALE, Calif.–Three semiconductor manufacturers have joined the list of component suppliers who offer Macrovision's Pay-Per-View (PPV) Copy Protection Technology in their digital set-top decoder ICS. OKI Electric Industry Co. Ltd., Mitsubishi Electric Corp. and VLSI Technology Inc. are now authorized to build set-top decoder ICs which include Macrovision copy protection capability.

More than 2 million digital set-tops in consumer households now have Macrovision copy protection capability. Thirteen companies are now authorized to produce Macrovision-enabled chip sets–up from eight at the beginning of 1995. The company's semiconductor partners also include Analog Devices, Brooktree Corp., GEC Plessey Semiconductors, NEC Corp., Philips Semiconductors, Raytheon Semiconductor, Samsung Electronics, SGS Thomson Microelectronics, Sony Electronics Inc. and Texas Instruments.

Fujitsu signs extension with Nynex

RICHARDSON, Texas–Fujitsu Network Transmission Systems Inc. has announced that Nynex has extended its contract with Fujitsu for synchronous optical network (Sonet) systems for two more years.

The existing contract between Fujitsu and Nynex, originally scheduled to expire in 1996, was extended through 1998. The $100 million extension calls for Fujitsu to supply the FLM 6, the FLM 150 ADM (add-drop multiplexer), the FLM 600 ADM and the FLM 2400 ADM, which provide transport capacities from 150 megabits per second to 2.4 gigabits per second, and access rates from 1.5 Mbps to 150 Mbps.

Rainbow Network moving to fiber

WOODBURY, N.Y.–Rainbow Network Communication (RNC) has announced its intention to move to fiber-based terrestrial regional delivery systems. Doug Keck, RNC vice president of technical services, cited satellite scarcity and lifespan, and signal quality and security issues, in addition to the technological advantages of fiber, and the economies offered by this multi-channel delivery system as reasons for the change. Keck said the plan would be implemented over an undetermined period of time.

Internet access trial in Boston

BOSTON–Continental Cablevision Inc. and BBN Planet Corp., a subsidiary of BBN Corporation, have announced a market trial for high-speed Internet access and on-line services to Continental Cablevision subscribers in the Boston suburbs. About 200 homes will be included in the trial.

Grass Valley Group merged into Tektronix

GRASS VALLEY, Calif.–Tektronix Inc. has announced the merger of its subsidiary, The Grass Valley Group Inc., into Tektronix. This integration of the two companies has been underway for several years and has resulted in the development of new products for the broadcast and post-production markets, as well as improved product delivery schedules, according to information released by Tektronix.

The Grass Valley Group became part of Tektronix's Video and Networking Division (VND) headed by Lucie Fjelstad in 1995. In this latest move, Grass Valley will continue as a development and manufacturing site for Tektronix, specializing in switchers, routers, effects and video communications products.

The Grass Valley name will continue as a product brand name. VND's development and manufacturing operation in Oregon will focus on video storage, Netstation and systems products; its London operation (Lightworks Editing Systems) will continue to be VND's European development center and will focus on its video editing products.

CBIS implements solution for Time Warner

CINCINNATI, Ohio–Cincinnati Bell Information Systems (CBIS) has implemented its CableMaster 2000 Subscriber Management and Billing Solution for Time Warner Cable in Austin, Texas. The subscriber base in Austin, at more than 225,000, is one of the 20 largest markets in the United States.

Laser Video, IBM sign agreement

NEW YORK, N.Y.–Laser Video Network Inc. and IBM have announced an agreement to provide a major technology update to LVNI's College Television Network.

The network will be populated with technology that will allow for an array of new services, such as insertion of news and local programming, localized advertising, connection to cable programming and broadcast capability.

The agreement encompasses a system-wide technology upgrade to new IBM servers and integrated hardware; a 24-hour customer service call center for service and dispatch; daily digital video satellite transmissions of LVNI's content; and a financial package, which includes the financing of all IBM and vendor components through IBM Credit Corp. The terms of the agreement are contingent upon a letter of credit to secure payment.

Upon installation of the IBM system upgrades, estimated to begin with the 1996 fall semester, Laser Video will be transmitting site-specific nightly feeds to the colleges, providing custom-tailored programs and ad insertion through an encrypted datastream. CED

Two connectors, one housing

LISLE, Ill.–Molex Fiber Optics Inc. is introducing the SC Duplex Connection System. The SC Duplex combines two widely-accepted NTT-SC standard connectors in a common duplex housing. The housing makes it easy to insert and remove connector pairs while maintaining polarity. Using Molex SC connectors offers a duplex configuration that combines the economic benefits of the easy-to-assemble, one-piece connector body with the reliability of the Bellcore 326 connector design, according to the company. The system features a low insertion loss of < 0.15 dB typ. in singlemode, and < 0.34 dB typ. in multimode.

A variety of duplex adapters are available from Molex to support the use of optical fiber as a cabling media in the networks, especially in horizontal premise applications.

Circle Reader Service number 51

Universal test system

VANIER, Quebec–EXFO has introduced the new FTB-300, a full-featured, modular, mini-OTDR. The compact and rugged FTB-300 offers the ability to simultaneously house up to three test application modules. To date, several modules have been developed, such as the singlemode OTDR with > 32 dB dynamic range, multimode OTDR, Automated Optical Loss Test Set, Optical Light Source, Optical Power

Labeling system

MILWAUKEE, Wis.–Two thermal transfer printing systems from Tyton Corp. offer heat shrink label users the ability to print clear, crisp marks directly on heat shrink tubing.

Tyton's TT1000 printer, for medium to high volume users, and the TT10SM printer, for medium to low volume users, both print high contrast text, logos, bar codes and graphics on heat shrink tubing. Even small imprints are readable after the tubing is shrunk. The thermal transfer printers are used in conjunction with either Tagprint II or Tagprint for Windows software. Both software packages offer different text choices, serial numbers, bar codes, graphics and additional choices.

Thermal transfer printing systems

In addition to the thermal transfer labeling systems, Tyton offers Shrink-Tag heat shrinkable labels. Shrink-Tags are available in yellow or white and have a 3:1 shrink ratio, allowing each size of Shrink-Tag to conform to many wire diameters. Tyton Shrink-Tags are self-extinguishing and meet UL standard 224 for print performance, heat shock and flammability.

Shrink-Tags are also available to meet MIL-I-23053/5, Class I and III, and MIL-M-81531 for print performance. The shrink tags can also be printed on a standard dot matrix printer. Tyton's thermal transfer label printers, with Tagprint labeling software and Shrink-Tag labels, constitute a complete heat shrinkable labeling system.

Circle Reader Service number 52

Singlemode fault locator

LACONIA, N.H.–Wilcom is introducing a singlemode fault locator, called the FRS-10, to complement its multimode FRM-5 fault locator.

The new locator utilizes optical time domain reflectometer (OTDR) technology to identify cable faults and other events to distances greater than 10 km. Features include single-button operation; switch-selectable display for readout in feet or meters; 1300 nm wavelength operation; and an accuracy of ±2 meters (6 feet) with an IOR of 1.5, +0.02 percent of cable length. The unit can be used in continuous update mode or a "one-shot" (single) mode.

An optional fault locator program upgrade is available for capturing and analyzing data via a laptop computer. According to Wilcom, the FRS-10 costs about one-third the price of a mini-OTDR. It can be equipped with an ST, FC or SC connector and is powered by rechargeable nickel-cadmium batteries.

Circle Reader Service number 53

Curb markers

HOUSTON, Texas–VIP Products has designed and field-tested a line of curb markers that can be applied to either the top or sides of a curb using a one-part adhesive. The resilient curb markers provide a warning to utility companies and contractors of the presence of in-ground fiber optic or cable TV lines. Cable routes and road crossings can be permanently marked with these low profile markers, instead of the more obtrusive sign and post.

"Fiber Optic Telephone" and "CATV" are two standard stock legends available for same-day shipment. Curb markers can be customized for copy, color and size, and can include a company name, logo or even a phone number.

Circle Reader Service number 54

Duct termination connector

PLACENTIA, Calif.–Jackmoon USA Inc. has introduced a new connector for securing innerduct to pull boxes, junction boxes and electronic equipment cabinets. The connector

EXFO's FTB-300 Universal Test System, a full-featured, mini-OTDR

Meter, Visual Fault Locator and Optical Talk Set. The ToolBox software runs all modules. The Application Test Modules can be changed in the field, making the FTB-300 an "all-in-one" solution, according to EXFO.

The unit is designed to ease the logistical and operational problems for the telecommunications technician who must deal with a variety of test equipment.

In addition, a 1x12 Optical Switch module is offered with the FTB-300, which enables the user to reduce instrument requirements and manual intervention, and to increase overall efficiency by testing multiple fibers or ribbon fiber more quickly. The FTB-300 mainframe unit features a large monochrome touchscreen display.

Circle Reader Service number 50

has many applications and is used anywhere a knockout can be found, or a hole drilled. The teeth on the female end of the connector lock onto the duct. By inserting the male-threaded end through a knockout and tightening the adjustable locking rings, it will be held in place. The simplified duct connector is made of durable anodized aluminum, so it's corrosion proof, according to the company.

Circle Reader Service number 55

Flexible coax

RICHMOND, Ind.–Belden Wire & Cable Company has introduced Part Number 9913F, a low-loss, RG-8U-type coaxial cable. The new cable is a high-flex version of Belden's 9913 coax. Like the 9913, the 9913F provides the lowest loss of any flexible RG-8/U-type cable on the market, according to Belden.

The High-Flex 9913F is a 50-ohm cable suitable for high-power RF transmission. The 50-ohm impedance has been proven to be the optimum compromise between maximum voltage withstand and optimum power transfer, opening the door to a variety of power transmission applications.

The cable features a 10 AWG stranded bare copper center conductor that provides improved flexibility and flex life. The cable also utilizes a flexible Belflex jacket for cut and abrasion resistance over a range of temperature extremes. The cable's flexibility means it will coil better and exhibit less kinking than other RG-8/U-type coaxes, says Belden.

Circle Reader Service number 56

Fiber optic modem

GREENLAWN, N.Y.–Telebyte Technology Inc. has introduced a fiber optic modem designed for use with a campus Internet server and remote clients. The Model 278 Fiber Optic Short Haul Modem provides an enhanced digital solution for connectivity between a workstation and a server running a campus Internet link. These links utilize SLIP/PPP protocols that require two, out-of-band signals in addition to the two, full duplex data signals. One of these signals must be at least one-eighth of the data rate, RTS/CTS (Request to Send/Clear to Send); whereas the second can be slower, DTR/DCD/DSR (Data Terminal Ready/Data Carrier Detect/Data Set Ready). This capability, coupled with fiber optic link support, produces a device that is immune to noise, surges, lightning, RFI and ground loops.

Model 278 Fiber Optic Short Haul Modem

Circle Reader Service number 57

Fiber testing

MEDFORD, Mass.–Fotec has introduced a software package that automates fiber optic testing with any fiber optic power meter and source. The software, FOtest Lite, runs on any PC-compatible, any Macintosh using Soft-PC, or any Hewlett-Packard palmtop computer.

FOtest Lite is designed to automate the measurement of optical power and loss, the most common fiber optic measurements. The software visually prompts the user for test setup and procedures, minimizing the possibility of mistakes. Data can be printed or stored for later analysis. FOtest Lite can interface directly to the Fotec Smart Instruments, or can be used with any fiber optic instruments for manual data entry. The user has a full record of all test data.

Circle Reader Service number 58

Network status

FRESNO, Calif.–DPS Inc. has released T/GrafX for Windows, an alarm system display providing graphic representation of network status in a windows environment. T/GrafX is an adjunct to DPS' T/MonXM WorkStation and Intelligent Alarm Mediator (IAM). Multiple T/GrafX Workstations can be served from one T/MonXM or IAM master.

T/GrafX shows a map-oriented display of the network with icons to represent alarm sites. The network can be segmented into multiple levels, which can be quickly scanned to determine trouble spots. The system is available in a software package for installation on an existing PC, or can be purchased as a factory-configured workstation. The workstation utilizes a Pentium-90 processor and a one-gigabyte hard drive. A CD ROM drive and 17-inch monitor are included.

Circle Reader Service number 59

Fiber optic source

WESTLAKE VILLAGE, Calif.–Aerotech World Trade has introduced a new range of rugged, portable fiber optic sources which feature a stabilized laser source, standard output powers of -10 dBm or 0 dBM, and a variable output power option which allows adjustment over a 35 dB range using a dial control.

The Opcom SLS series offers a high stability of just 0.1 dB or 0.05 dB (depending on model) and can be used either in CW mode or with a 2 kHz tone. A cooled (TEC) laser is offered as an option to provide the higher stability over a broad temperature range. Standard temperature range is 0 degrees C to 55 degrees C (increasing by 5 degrees using TEC cooling). A further option is provided which enables the laser to be modulated from DC to 200 MHz using an ECL signal. Models are available with lasers for use at 1300 nm or 1550 nm wavelengths. The standard optical interface is an FC/PC connector, but FC/APC, ST/PC, SC/PC and DIN types can also be fitted. Electrical connection is via BNC or SMA connectors.

Circle Reader Service number 60

Cable puller

MANKATO, Minn.–Condux International's new Fiber Optic Cable Puller is 30 percent lighter and offers forward and reverse pulling capabilities. The lighter weight improves the transportability of the puller, allowing easier use with a remote stand, utility truck mount or trailer mount. With the addition of reverse pulling capacity, time-consuming directional setup changes are eliminated.

The puller also features load cell torque input. The electronic control system directly measures the rotational torque at the motor, thereby indicating actual cable pulling forces.

Circle Reader Service number 61

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Competition sharpens business skills

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

Competition is the enemy of stagnation, apathy and over-confidence. Competition is like the proverbial 2 by 4 laid smartly across the backside of a stubborn mule to focus his attention. Everyone would rather avoid competition, but it certainly focuses the mind on such matters as cost containment and customer service.

There were no deep pockets in the 1950s, only shoestrings and bootstraps. Many of the pioneering engineers who designed the equipment for cable TV were amateur radio "hams," or electronic hobbyists with engineering degrees. Many had never even seen a well-equipped electronics laboratory. Issuing purchase orders for professional instruments was a seldom experienced luxury. They built their own test equipment with pieces salvaged from the junk box under the bench, and ingeniously modified whatever was handy and adaptable. Administrative overhead and cost of sales were just part of the engineering and manufacturing process. Engineers swept the floor and emptied the trash, made the sales and shipped the product, answered the telephone and kept the books (sort of).

Times have changed, of course. Suppliers are now well-equipped with modern precision laboratories, and engineering is competently supported by extensive administrative and marketing departments.

Cost-conscious tradition

Nevertheless, the cost-conscious and innovative traditions of the early days persist. In 1987, Jack Koscinski, research engineer with Irving Kahn's General Optronics Corp., proved that laser transmitters could successfully be used to transmit at least 12 channels of VSB/AM television on optical fiber, all analog. In the spring of that same year, American TV and Communications Corp. (ATC) was also experimenting with AM analog optical links. By 1988, Jim Chiddix was demonstrating 42 channels using direct modulated lasers in the ATC Denver laboratories and the Oceanic system in Honolulu.

The cost of the AM analog fiber optic link is a tiny fraction of the cost of a digital or FM analog link. The "experts" scoffed. It was "well known" that lasers were either "on" or "off," and nowhere near linear enough for analog AM/FDM operation. They also disparaged the tree-and-branch network topology that had been so successful for cable TV, touting instead the switched star long used for telephony. Gradually, however, as telcos scrambled to compete in the cable TV marketplace, while facing competition in telephony, they began to recognize the advantages in cost and customer acceptance of Chiddix's hybrid fiber/coax (HFC) architecture. On the other hand, the cable TV industry is trying mightily to learn how to adapt telephone technology to compete in the telephone marketplace.

Contrary to popular legend, competition does not necessarily assure either high quality or low prices. For example, deregulating the airline industry did indeed yield low fares, but only for the most popular routes, and generally with a host of restrictions severely limiting access to the low prices. Arguably, safety, comfort and convenience on the popular routes have not been impaired by deregulation. But delegating short flights and less popular routes to so-called commuter or express airlines has definitely compromised comfort and convenience, if not safety, at distressingly high fares.

Another example of illusory price reductions is the widespread practice of offering rebates or discounts only to consumers who accept the inconvenience of mailing back a coupon and waiting for the rebate from the manufacturer. Competition is more likely to stimulate ingenuity in pricing than lower prices.

To prepare for competition, the telephone companies are laying off large numbers of personnel. If they can maintain the same service quality with smaller staffs, does this mean they were previously overstaffed? How will the introduction of innovative services be affected by laying off the people who participated in their project planning committees? What is the effect of downsizing and redirecting Bell Laboratories and Bellcore? What effect will entry into a competitive, entrepreneurial culture, where profits are no longer assured, have on the traditional Bell System objective of achieving perfection at costs that can be justified to the PSC? Will the entrepreneurial telephone companies, like cable TV, know how to achieve the best possible, most cost-effective results within the very real financial constraints imposed by consumer purchases?

Cost containment–cable's advantage

With respect to costs, the competition will be on cable TV's home turf. The genius of cable TV, from its beginnings nearly half a century ago, has been its ability to meet realistic performance requirements at much more modest cost than government, military or regulated utilities. While, for example, dynamic upstream route assignments based on expensive headend server and switching gear may be the best way to provide for video-on-demand (VOD), cable TV has found that headend switching is an inefficient way to provide basic, premium, PPV or even near-video-on-demand (NVOD). Moreover, although the Sonet standard may be well-suited for interexchange telephony, it's likely to entail much more expensive hardware and software than necessary to meet the more limited requirements of cable TV.

Cable TV ought to adopt telco-generated techniques, standards or hardware because they clearly meet identifiable needs; not simply because they were developed by and for the telephone industry. CED