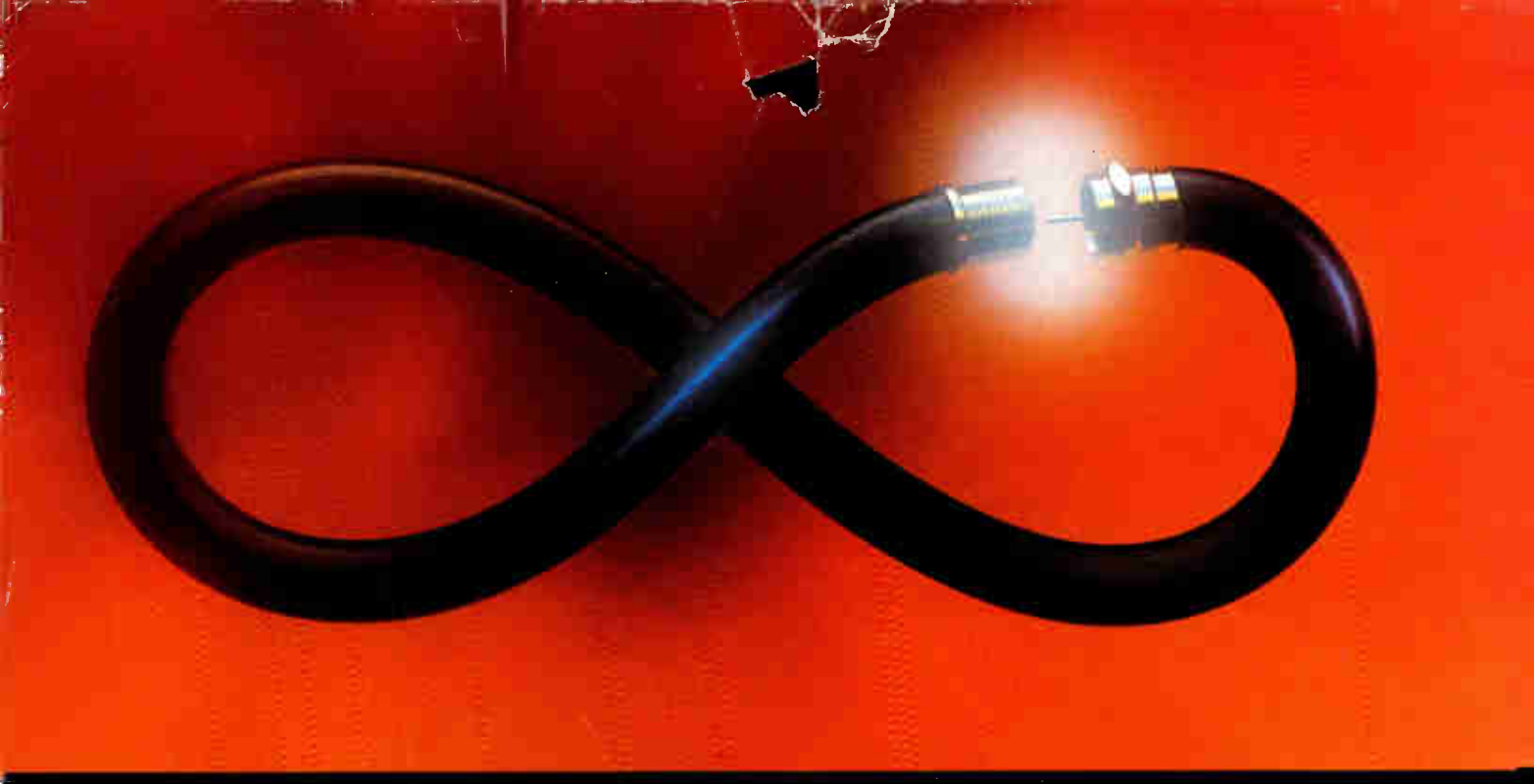
CED

COMMUNICATIONS ENGINEERING & DESIGN
THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS

AUGUST 1996 ◆ CED ◆ Case studies ◆ Security ◆ Low-speed solutions

The data revolution: Cable fires the first salvo



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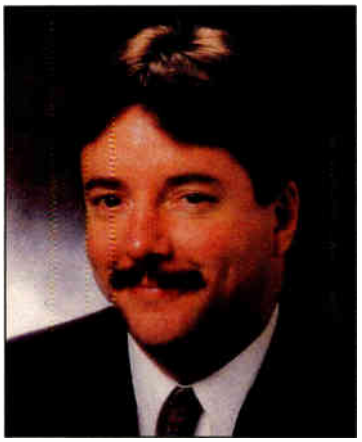

Bury your head–and bury your business

In the course of covering video transmission systems during my tenure here at *CED*, I've investigated the oddly-named "wireless cable" industry for nearly a decade. I've written tutorial stories about the technology, commentaries about its possible use as an adjunct to cable TV (before that idea was prohibited by FCC mandate) and covered new product releases–all in an effort to educate *CED* readers about what was happening with that alternative video medium.

The fact of the matter is, however, that I was never really impressed with the technology. Yes, it worked. But it needed a large, unsightly antenna. It was hamstrung with limited bandwidth. It was hampered by limited access to programming sources. And it had a negative perception in the marketplace, which perhaps manifested itself from the hucksters who dominated the industry in the early days.

All of those drawbacks went away when I recently went out to see Pacific Bell Video Services' digital MMDS demonstration, and after I read accounts of CAI Wireless' demo of high-speed Internet access in Rochester. With new technology and the resources only a telco can provide, wireless cable is growing up and getting strong. Via digital compression, PacBell can offer at least 120 channels of video programming, including near-video-on-demand. Gone are the unsightly antennas. Shadow areas (those pockets where the line-of-sight signal can't be seen) will be reduced to just 15 percent of the Los Angeles area, according to engineers.

And get this: PacBell will be able to offer digital TV signals to 4 million households with a single $20 million hardware investment. Sure, it cost additional money to buy the frequency licenses and will cost more for the subscriber gear (but that's an incremental expenditure based on penetration levels), but show me another infrastructure you can put in place for $5 a house without launching a satellite.

Throughout its L.A. base of operations, PacBell has gone top-drawer: high-quality headend components, sufficient engineering support and an aggressive marketing team are all assigned to the project. The headend facility will be fully redundant after it's tied via fiber into a similar facility that's under construction in the Bay Area. With those two facilities, PacBell can provide all the satellite programming services and insert local broadcast signals to emulate a cable system.

Finally, after years of promises, there will truly be multichannel video competition, complete with local video content–probably by early next year.

That should make the local cable operators–of which there are several–nervous. By choosing Los Angeles to attack first, PacBell picked on a large, urban area that is not dominated by a single carrier, yet which boasts a sophisticated video subscriber base. Cable operators throughout California shouldn't downplay what PacBell is doing: MMDS has matured and is yet another formidable competitor for the video entertainment dollar. Burying your head in the sand and giving the technology only passing attention could be a fatal error.

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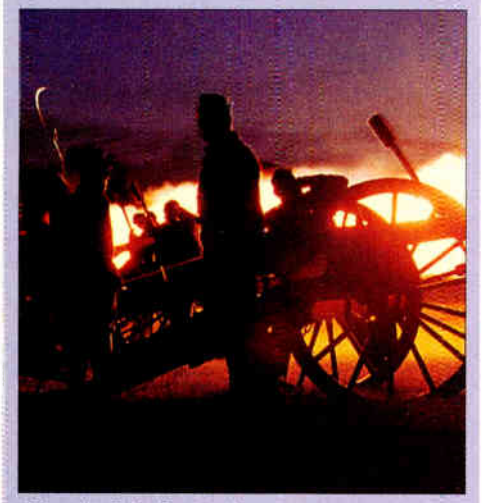

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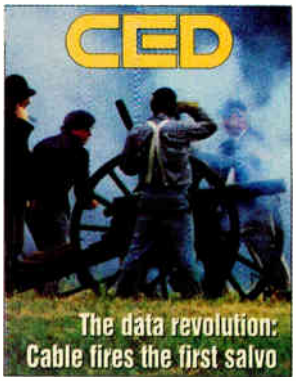

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PacBell demos digital MMDS; ATI tests interactive service in Florida

Pacific Bell Video Services rolled out the red carpet to the media in June and demonstrated digital MMDS service being broadcast from high atop Mt. Wilson to the company's headend facility in El Monte, Calif., some 11 miles away. It is believed to be the first demonstration of a working digital MMDS system that features MPEG-2 compressed video using 64-QAM modulation and ATM switching to route the video to the transmitter.

The work-in-progress is scheduled to be completed shortly, followed by a short testing and debugging period, before the service is rolled out to the Los Angeles market in early 1997.

PacBell entered the MMDS market back in April 1995 when it acquired Cross Country Wireless in a $175 million stock swap. That system presently provides 31 channels of analog video to 45,000 homes in Riverside, Calif. The company also holds rights to unused channel capacity belonging to Instruction Television Fixed Service wireless licensees.

PacBell later acquired V*TV, a wireless service provider owned by Wireless Holdings and Videotron Bay Area. That $160 million deal had not been closed as of press time. When completed, however, the deal will give PacBell access to 4.7 million homes, including 1.5 million in San Francisco, 250,000 in Victorville, Calif. and 2 million more homes in markets outside California.

PacBell also successfully bid for 11 commercial licenses in L.A.; San Diego; San Francisco; Seattle and Spokane, Wash.; Greenville, S.C.; and Tampa, Fla. during the FCC's auction of unlicensed MDS channels.

Since then, the company quietly gutted a building it acquired in El Monte, a Los Angeles suburb, and filled it with state-of-the-art video transmission gear as it prepares to launch a system capable of transporting 120 channels of MPEG-2 video. A transmission tower has already been installed atop Mt. Wilson, which serves the metro L.A. area; a second tower is planned for Mt. Modjeska for customers in Orange County.

PacBell engineers, many of whom came from the cable TV and MMDS industries, have been conducting propagation tests to determine the system's "reach." They report that 80 percent of the metro area can be served from those two towers, and that adequate signals can be received as far as 40 miles from the transmitter.

In a separate, yet related, announcement, wireless cable operators American Telecasting Inc. and People's Choice TV Corp. successfully tested a new high-capacity, high-speed Internet access service together with manufacturers Zenith Electronics Corp., Conifer Corp. and Comwave in ATI's Lakeland, Fla. system.

The test demonstrated that wireless cable frequencies are capable of delivering two-way Internet access at speeds significantly faster than conventional telephone lines. Unlike prior tests of wireless cable Internet access, the Lakeland test utilized wireless cable frequencies for both the outbound and return leg of customer transmission. Both American Telecasting and People's Choice estimate that utilizing a sectorized antenna transmission pattern and two wireless channels for downloading, they will be able to offer Internet access service to as many as 100,000 subscribers in each market at ISDN speeds or greater.

With sectorized antenna transmission patterns, the circular omnidirectional transmission pattern of the wireless cable system is cut into pie-shaped segments. In the test, five 7.5-degree sectors were used. By alternating the frequencies used in such segments, the spectrum can be reused, and the capacity multiplied by the number of sectors used for each frequency. Using two, 6-MHz channels for downloading and 48 sectors, composed of 7.5 degrees each, approximately 100,000 customers could be served in a given market at ISDN (128 kilobits per second) speeds or greater. Further capacity and speed could be gained by either adding more channels, decreasing sector size or adding new transmission points (cell sites), such that speeds substantially higher than ISDN rates could be achieved.

The first phase of the test used modified, off-the-shelf equipment, including the Zenith cable modems, Conifer transverters and antennas and Comwave transmitter systems. In the second phase of testing, the companies plan to further refine the number and size of sectors to derive the specifications for a standard system. The next phase would utilize 64 QAM modulation for up to 27 Mbps speed. Higher-speed wireless cable modems would also be used.

In still more wireless news, General Instrument demonstrated high-speed Internet access over a wireless MMDS system at raw speeds of up to 27 Mbps. GI's wireless SURFboard modem was used in Denver during the Wireless Cable Association's annual convention in cooperation with ATI. The system uses the MMDS spectrum for the forward path, and the telephone line for the return. Future generations of product will migrate toward an ATM solution to provide a more

Pacific Bell is the newest occupant atop Mt. Wilson. With transmitters also on Modjeska Peak in Orange County, Pacific Bell Video Services will offer digital television to nearly 4 million southern California homes in early 1997.

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robust and wider return channel.

Hybrid Networks also offered up new products, including a cable modem/router and a point of presence server, for wireless networks. With the Hybrid Access System 2000 network, the network operator can send data at 10 Mbps, while return channels are carried over existing Internet connections. This way, consumers can use conventional modems and telephone links for the return connection.

Texas Instruments shows LMDS gear

Anyone who thought the notion of digital "cellular TV" was mere folly had better think again. The technology pioneered by CellularVision in New York City was impressively demonstrated by electronics giant Texas Instruments during Supercomm and appears to be close to mass production.

The 28 GHz, millimeter-wave technology that has become known as local multipoint distribution service (LMDS), has attracted several well-known technology companies, including Stanford Telecom and Hewlett-Packard in addition to TI. It's viewed by many as having the same advantages as MMDS, but offers a return channel for interactivity, which allows voice and data to be sent over the system.

Specifically, TI showed off its MulTIpoint system, which was recently field tested in the U.S. and in Brazil. In the U.S., it was used by BellSouth in an Atlanta suburb during a six-month technology test. That test consisted of 25 apartments that received 160 broadcast and near-video-on-demand channels and 32 video-on-demand channels. In Porto Alege, Brazil, it was tested for two months, where it was determined that link availability of 99.9 percent could be achieved, even during the notorious Brazilian rainy season. That test delivered voice, video and data services simultaneously.

In fact, TI officials said the product is being tested in at least six different sites around the world that represent a wide range of topography, geography, population density and climate. Those tests have also used different modulation schemes, with QPSK coming out as the clear winner, according to TI officials.

The complete TI system consists of a network of transmitter and receiver nodes and rooftop antennas that connect directly to telecommunications and television equipment.

TI intends to begin shipping the MulTIpoint product to initial customers in 1997 and is presently working with several unspecified cable TV and consumer electronics equipment manufacturers to design and manufacture system components, such as set-top terminals, headend gear and telephony switches.

S-A acquires ATx Telecom

Scientific-Atlanta Inc. acquired ATx Telecom Systems Inc. (formerly Amoco Laser) from Amoco Technology Company as a strategic move to round out its family of fiber optic products to include 1550 nanometer technologies, including erbium doped fiber amplifiers (EDFAs).

The transaction is valued at approximately $25 million. S-A will take a charge for a substantial portion of the purchase price in its fourth quarter operations to cover acquired research and development.

Chicago-based ATx is one of the world's leading suppliers of EDFA fiber optic products for hybrid fiber/coax (HFC) networks. EDFA technology has advanced to the point where it supports several different important applications in the fiber optic domain. Based on its patented technologies, ATx has developed extremely powerful and cost-effective EDFA products that have been deployed in broadband applications worldwide.

By adding ATx's EDFA research and development, manufacturing and marketing to its current RF and fiber optic product family, S-A can offer additional platforms, as well as enhanced capabilities for wave division multiplexing (WDM), dense wave division multiplexing (DWDM) and other optical technologies once they become economically feasible for the market. WDM technology allows two or more different laser signals to be transmitted simultaneously on the same optical fiber, thereby expanding the data transmission capacity of the fiber.

The acquisition includes core technologies developed over the past 10 years, resulting in more than 50 patents, licenses and patent applications which provide a foundation for new fiber optic products such as 1310 nanometer optical amplifiers, high power sources for WDM and DWDM and source lasers for ultra high-speed digital transport systems.

"We believe that opto-electronic products and systems will be a fast growing market over the next few years," said Perry Tanner, vice president and general manager of transmission products for S-A. Optical amplifiers are becoming increasingly important as network operators consolidate their systems, interconnect facilities and incorporate redundant ring structures into an HFC architecture to increase network reliability.

"This acquisition allows Scientific-Atlanta to supply its customers with high performance EDFA products today and to provide enhanced products in the future which support multiple wavelength applications centered at the 1310 and 1550 nanometers windows. Our goal is to realize fiber's full potential by exploiting the technologies under development at ATx in combination with our global R&D, sales, marketing and manufacturing resources," said Tanner.

"We are excited to be part of Scientific-Atlanta," said Dr. John Clark, chief operating officer of ATx. "This acquisition enhances our future growth potential and provides us with the ability to continue development of the industry's most advanced optical amplifier technologies. We're especially pleased with Scientific-Atlanta's commitment to support and strengthen our current customers."

DSC seeks air for local loop

DSC Communications Corp. filed a petition with the Federal Communications Commission (FCC) requesting radio spectrum allocation within the 2 GHz band for wireless fixed access local loop services in order to support its Airspan wireless product. The wireless fixed access architecture in Airspan supports high-quality voice, 64 kbps data, and many other premium services.

DSC has developed this innovative system as an alternative to the current copper- or fiber-based local loop. "Having used this technology in countries throughout the world, we realized its applicability to the U.S. marketplace, particularly with regard to the new domestic regulatory environment," said DSC's John Sergo, vice president, strategic planning. "All service providers in the telecommunications marketplace, from incumbent local exchange carriers (LECs) to the new entrepreneurial licensees, can utilize this new product to rapidly bring new service to their customers."

Airspan supports provisioning of new technologies and services to the public and encourages facilities-based local competition and universal service to rural and high-cost areas. Without products to support such goals, system operators, in many cases, will have limited alternatives for completing their local service packages. Limited alternatives typically mean higher prices for the consumer.

The system is based on advanced Spread Spectrum Code Division Multiple Access (SS-CDMA)-based radio technology, which promises certain cost advantages, when compared to copper or fiber loop deployment,

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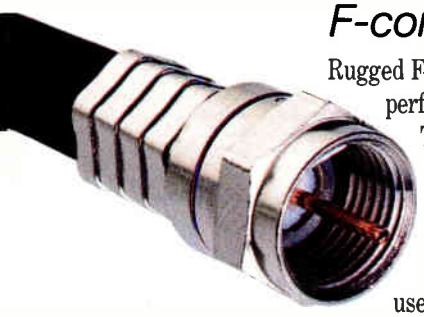

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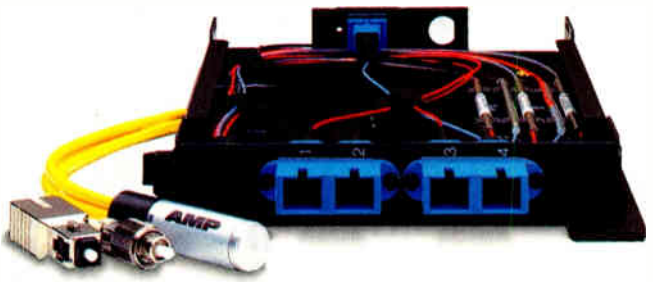
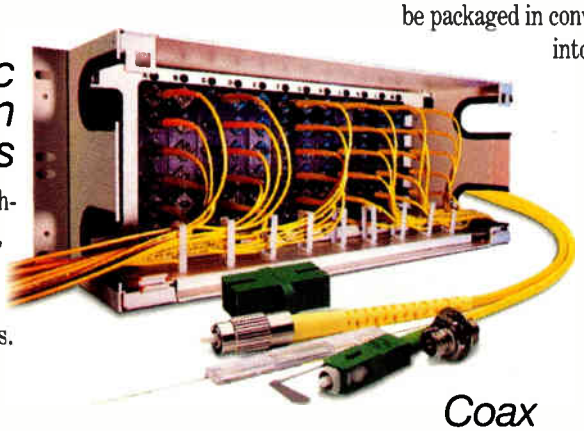


Fiber Optic Control Devices

AMP fiber attenuators, wavelength division multiplexers, and couplers offer low reflectance, reliability, and a wide variety of packaging styles for your specific system's needs. These devices can be packaged in convenient modules that just snap into your fiber frames.

Fiber Optic Interconnection Devices

From complete fiber frames to high-performance cable assemblies, connectors, and splices, AMP is a leader in products to connect, organize, and protect fiber cables.



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including reduced deployment time, reductions in initial and long-term capital expenses, reduced operational and maintenance expenditures and redeployment flexibility.

ADC carries Optus' phone call

While we're on the subject of technical breakthroughs, ADC Telecommunications successfully transmitted local telephone service over its Homeworx hybrid fiber/coax telephony system in conjunction with Optus in Sydney, Australia.

Optus is a joint venture between Optus Communications, Continental Cablevision and Publishing and Broadcasting Ltd. and is Australia's first private phone company. ADC is one of two vendors chosen by Optus to supply network interface equipment that allows telephony to be sent over the integrated network.

ADC's system is based on OFDM (orthogonal frequency division multiplexing) modulation, which provides interference rejection to help make interactive services such as telephony feasible over cable-TV networks that use the noisy sub-low return band.

"This event marks the successful launch of ADC's Homeworx system and the OFDM technology, which makes the promise of the information age a reality," said William Cadogan, ADC's chairman and CEO.

Prevue, TV Guide merge EPG interests

United Video Satellite Group and News Corp. have signed a letter of intent to combine their efforts in the electronic program guide market, including the development of the next generation of interactive television guides. Prevue Networks, a wholly-owned subsidiary of UVSG, and TV Guide, a wholly owned subsidiary of News Corp., will form a 50/50 joint venture called TV Guide Prevue Networks, combining the respective pioneers in the video and print guide categories. The new venture also includes the assets of TV Guide On Screen.

TV Guide Prevue Networks will unite the interactive guide development efforts of all the parties as the venture moves forward with the introduction of interactive guides and navigation systems designed to operate on a variety of set-top platforms, serving cable, telco, satellite, and other multichannel video entertainment providers.

The joint venture agreement includes consolidating the operations of the Prevue Channel, the industry's leading on-screen electronic program guide currently seen in more than 40 million cable households, and the TV Guide On Screen Channel, which is available in 3 million homes. The combined channel will be renamed the TV Guide Channel. The Company will remain headquartered in Tulsa, Okla. where Prevue currently employs more than 300.

TV Guide Prevue Networks has also entered into a master affiliation agreement with a subsidiary of TCI and their affiliates for its products. TCI's subsidiary has made substantial subscriber penetration commitments to the new venture and has agreed to launch the venture's planned digital interactive guide later this year.

CableLabs establishes new services task force

With all the new ballyhooed services that are being promised, CableLabs has created a new task force designed to help its member companies deal with issues associated with deploying digital video, high-speed data and telephony.

With unique technical requirements and training issues associated with these digital services, it will be important for cable operators to understand how digital signals differ from their analog cousins. One result is that new plant test equipment will be required for system technicians, and new operating parameters will need to be established and adhered to.

The task force will be headed by Tony Werner, vice president of engineering at TCI Communications. The CableLabs staff liaison will be Doug Semon, who recently joined the Labs from Viacom Cable as visiting executive for network operations. Other members will be chosen from CableLabs member companies that have an interest in digital technology.

Interactivity comes to New Brunswick

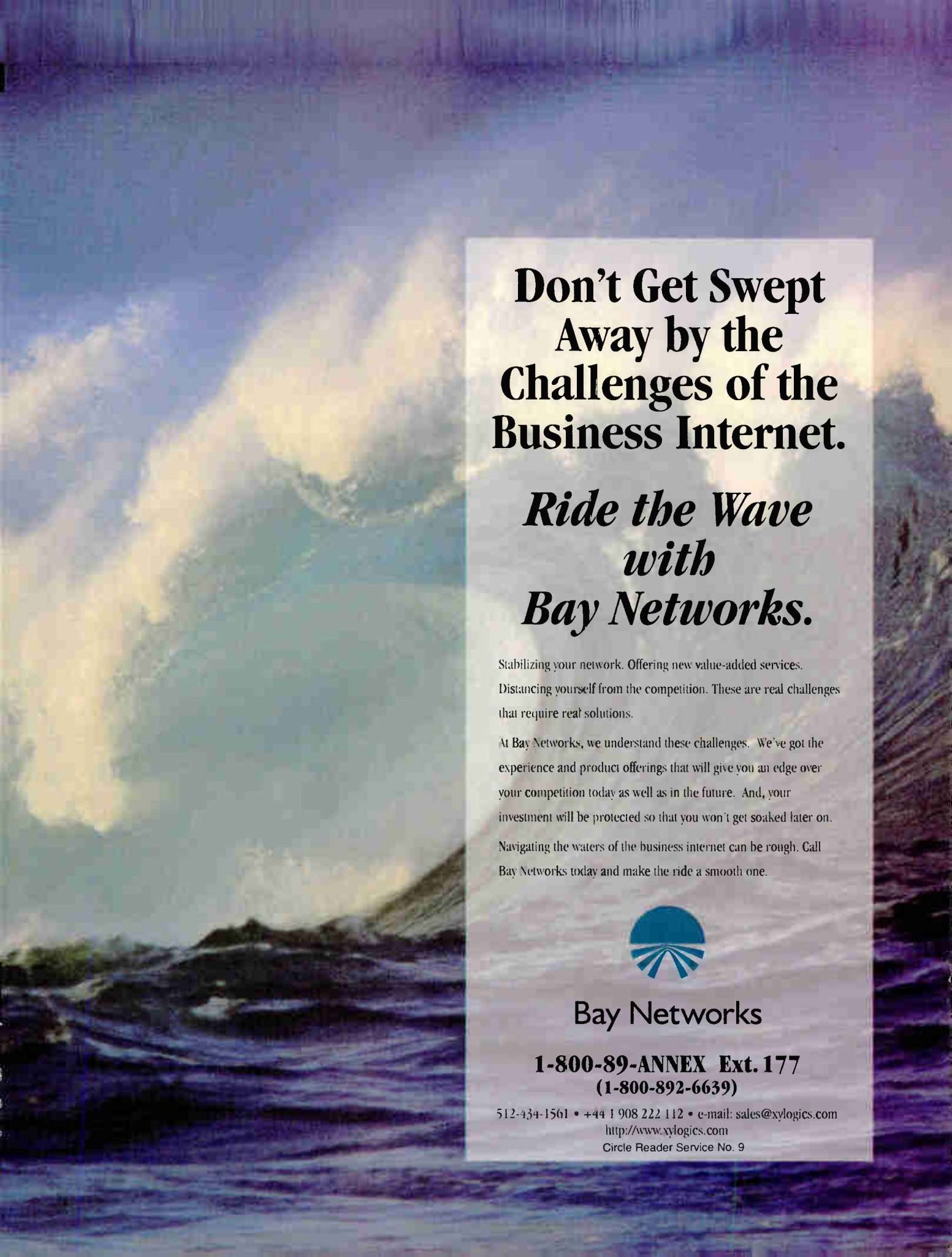
The New Brunswick Telephone Co., Ltd. (NBTel) has begun delivering multi-megabit-speed interactive services and Internet access to home personal computer users, using ATM technology developed by Nortel.

Nortel's Interactive Broadband system combines end-to-end Asynchronous Transfer Mode (ATM), high-speed access technology (with megabits available to users both downstream and up), standards-based network and control interfaces, and service control software that is able to work with a variety of vendors' products, to create a service delivery network platform with a high degree of flexibility and scalability.

For consumers, this means much more than just high-speed access to the Internet. Small business and work-at-home customers will realize LAN-like speed and performance for access to corporate networks, and to multimedia educational and information service providers, with a high level of network security. Other highly interactive applications, such as two-way video or World Wide Web content sourcing, will also be enabled. The flexibility of the access infrastructure will be further exploited with the delivery of Interactive Television (ITV) services in 1997.

Jottings

West End Networks and **Lucent Technologies** will be working together to offer voice, data, video and Internet services to cable TV network operators in Europe. Under a memorandum of understanding, West End's WestBound 9600 platform will be used over existing integrated cable TV and telephony networks that use HFC architectures. Lucent will act as a systems integrator for both cable and telephony network operators . . . **Zenith** plans to market and sell technology from **Focus Enhancements** that converts PC images for display on TVs. Focus' PC Micro Presenter, a seven-ounce, pocket-size box, converts a PC image into an interlace scan in real time. Zenith will offer the technology in its "Presentation Series" of commercial TVs . . . **Southern New England Telecommunications Corp.** (SNET) plans to join Ameritech, BellSouth, GTE, SBC Communications and The Walt Disney Co. as a partner in the americast venture, giving the group a toehold on the geographically important northeast corridor. The deal gives SNET access to americast's planned content, which it plans to distribute over its $4.5 billion HFC network, which is currently under construction . . . Yeah, but how much did the lawyers get? That might be what some ask upon hearing that **General Instrument** will only have to shell out $136.7 million to settle litigation between **Next Level Communications**, its newest subsidiary company, and DSC Communications, a telecom equipment manufacturer and former strategic partner of GI's. The final judgment is a substantial reduction in settlement from the $369 million awarded several weeks ago. The lawsuit alleged that Next Level principals walked off with fiber-to-the-curb intellectual property from DSC . . . **Objective Systems Integrators Inc.** (OSI) and **Comunicaciones Broadband** signed a memorandum of understanding to jointly create solutions for companies facing the challenges of managing telecommunications networks, including integrating technologies such as SDH, DACS, Access and network element management systems . . . . CED



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Inventor of S-CDMA rises above noise

Shlomo Rakib

"There's a goldmine on the Internet, but if I have to spend hours to get information, it's just a lot of wasted time," says Shlomo Rakib, president and chief technical officer of Santa Clara-based Terayon Corporation, with just a hint of frustration in his voice. "We need cable modems to save time and leverage the resources that exist over the Internet."

Rakib, who echoes the frustrations of many who surf the 'net, articulates his three-year-old company's mission as providing scalable, end-to-end systems that will enable cable operators to deploy both data communications services and telephony.

"We want to provide solutions to the cable industry to support interactive services–telecommuters' connections, home office applications, educational services and other services for residential users," he adds.

The company's data platform, the TeraComm Data Network, specifically targets hybrid fiber/coax architectures for the delivery of two-way data, video and telephony. The core of the platform's physical layer modules is built around Synchronous-Code Division Multiple Access (S-CDMA), a modulation scheme which Rakib firmly believes is the enabling technology for the upstream path. Not only does he believe that CDMA is robust enough to overcome the impulse noise and narrowband interference which plague the return path, but in addition, the synchronous implementation of the technology which Rakib invented cancels and thus overcomes the self-generated noise added by each user.

"We have synchronized all of the users so that we can guarantee orthogonality among users and the headend," he explains. "I can add as many users as I want, and I know that they are not adding noise." In fact, Terayon filed four patents on S-CDMA technology early last year.

In the field of modems, Rakib was ahead of his time. Back in 1981, when he worked as chief engineer for a high-tech company called Phasecom in Israel, he was already designing cable modems: among them, a point-to-point, frequency agile modem designed for institutional cable systems. At the time, companies like General Motors and Boeing were promoting the cable TV infrastructure to run data communications traffic through their factories, essentially, over broadband LANs.

In the course of designing modems for these institutional applications, Rakib worked with an alphabet soup of modulation schemes, everything from BPSK, QPSK, FSK and ASK to FDMA and TDMA, depending on the applications, their requirements and complexity. And when the cable TV business started to slow in the late '80s, Rakib turned to exploring ways to send data over twisted pair, developing a transceiver for high-speed Ethernet applications.

When things began to heat up again in the early '90s, with hype about video-on-demand and other interactive applications picking up steam, Rakib saw a void in the market for companies that could actually provide the hardware to support interactivity. The identification of that need, coupled with 14 years of experience in moving bits across coax, convinced him to leave Phasecom and come to the U.S. to establish Terayon, working with his brother, Zaki.

"The U.S. is the land of opportunity," he notes. "The skills that exist here, the funds that can be raised, there were lots of contributing factors" for the move.

It is undoubtedly a different world from the one in which Rakib was reared. Born in Egypt, he attended a Jesuit school, where he learned French, in addition to Arabic. After moving to Israel where he studied both Hebrew and English, Rakib graduated from high school at the tender age of 16, then graduated from Technion University, Israel's equivalent of MIT, at the age of 19.

After that, he spent five years in the Israeli navy as a captain in charge of the development of several weapons systems, and joined Phasecom in 1981.

Cable as cultural guardian?

Starting Terayon from scratch was a difficult task, so it's not surprising that, for the last two years, Rakib's work day has started in the early morning and ended far into the night. And when he gets a free moment, what does he read? Technical material.

There are a couple of bright spots, though. One is his understanding wife, Gabriella, who provides bountiful moral support. The other is that Rakib also enjoys reading a good biography, usually about one of his technology heroes. One favorite is a biography of Evariste Galois, a Frenchman who made great contributions to the field of error correction, but who was subsequently targeted by the French authorities for involvement in the French Revolution. Those same forces later provoked Galois into taking part in a duel, which was the end of his contribution to the field of error correction.

"These people spent all of their youth reading and studying, and they were taught by mentors," notes Rakib. "Education is the key."

As a father of three children, two girls—ages 14 and 12—and a boy of seven, Rakib despairs that the cultural environment of today is not nearly as rich as that of his heroes. "Looking at my kids and how much of their time is spent watching TV, the content that we are filling their brains with is too shallow," he laments. But that's precisely why he believes that cable modems can save the day, as their speed and capacity will overcome short attention spans, while feeding curiosity.

"Our cable modem technology, combined with imagination and cable operators' networks," says Rakib, "will enable fast and continuous high-speed data services. These tools will significantly enhance the next generation's knowledge."

–Dana Cervenka

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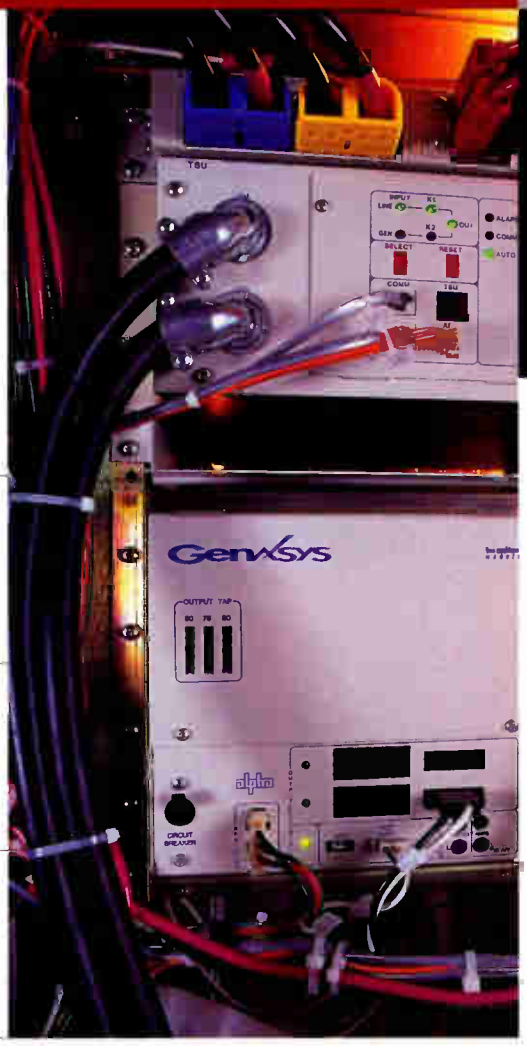

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The NRIC needs cable's support now

By Wendell Bailey, VP of Science and Technology, NCTA

In 1990, the U.S. was hit by a serious failure of its national telephone network. It was still possible to get a dial tone and to place a local call, but it was difficult, if not impossible, to make a long distance connection. The culprit turned out to be a software glitch in the common control switching system (CCS) program. This is the mechanism that coordinates the workings between switching centers. After this calamity was brought under control, the FCC wanted to know what had happened, and what could be done to ensure that it never happened again.

Proceedings were started, and comments and reply comments were filed. Subsequently, in 1994, the FCC formed an advisory committee called the Network Reliability Council, which was given the 18-month task of studying the problem and making recommendations as to what steps could be taken to ensure a more reliable national network.

At the end of the initial two-year period, the FCC decided that it would reactivate the NRC with a new, expanded charter. At issue was the concern that the FCC has about reliability in the new world of converging telecom networks.

The cable television industry was invited to participate, along with the cellular telephone and satellite industries, in that two-year effort. Throughout that activity, the cable industry was reluctant to offer reliability data. This was primarily due to the fact that no cable systems were, at that time, offering telephony services, and the data that the council was collecting was related mostly to traditional telephone service offerings.

The FCC has once again reconstituted the Advisory Committee on Network Reliability, but this time, it has added "interoperability" to the title. The Network Reliability and Interoperability Council held its first meeting on July 15, 1996 at the FCC office in Washington. At that meeting, the official charter of the NRIC was unveiled. It reads: "The purpose of the committee is to provide recommendations both for the FCC and for the telecommunications industry that, when implemented, will assure optimal reliability and interoperability of, and accessibility and interconnectivity to, the public telecommunications networks."

The charter goes on to spell out the issues the council will address: "1) Barriers to interconnectivity, interoperability and accessibility." "The recommendations will ensure the ability of users and information providers to seamlessly and transparently transmit and receive information between and across telecommunications networks." "2) Oversight of coordinated public telecommunications network planning and design." "3) Standards-setting organizations: The committee will consider and provide recommendations on how the commission most efficiently can participate in the development by appropriate industry standards-setting organizations of public telecommunications network interconnectivity standards...". " And 4) National Network Reliability: The committee will report on the reliability of the public telecommunications network services in the U.S."

In the earlier versions of this council, the cable industry was not able to provide much in the way of guidance to the committee. We were involved, nonetheless, in the whole effort. In this third effort, the FCC will, for the first time, turn its focus to the future of various telecom industry players and their relationships with each other.

It's time for the cable industry to get serious about its involvement in this process. With all of our efforts focused on the digital services that we might offer, the need to make sure that fair and workable relationships exist with the other facilities-based service providers is of the utmost importance. With all of the hoopla surrounding the offering of telephony service by cable operators, and the offering of video services by traditional local exchange carriers, we are beginning to see two entirely different approaches to interconnection agreements.

Some agreements have been reached in specific areas between an MSO and an incumbent LEC (local exchange carrier). What is not clear is whether or not these agreements are as fair and as even as possible. The MSOs accepted them, and the LECs offered them. But one cannot assume that these deals were struck out of expediency, rather than as the result of successful (for both parties) negotiations.

We've been down this road before

If the FCC intends to accept recommendations as to what regulations it should enact, then we had better be a part of the deliberations. In reviewing the initial organizational structure of the two working groups, I am struck by the fact that there are only two cable people named: one from our major trade association (me), and the other from the telecom subsidiary of a major MSO.

A legal debate is already brewing. On one side, the telcos argue that these deals can be struck within a framework administered at the city level. The other camp (cable et al) argues that the only way that we can work these issues out is under clear and enforceable federal standards. The idea that we would be willing to comply with the vagaries and uncertainties of thousands of different standards, each written by the local LEC and a city official, boggles the mind.

We have been down this road once before (in 1972), and the results so alarmed the federal government that it promptly rescinded the authority of cities to impose local rules on cable technology. If we are not diligent in working on the NRIC and its working groups, we run the risk of the heavily telco-weighted committees recommending regulations, practices and standards that will be harmful to our businesses. If you would be willing to serve, and your company would support your efforts, let me know. Let's not make the mistake of thinking that lawyers can bail us out if this process comes out wrong. CED

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

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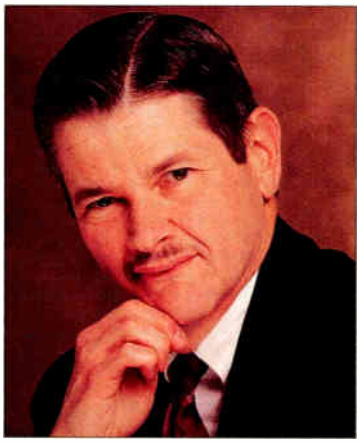
Return of the curmudgeon Brunswick

Some months ago, I introduced my friend, who is with an unnamed cable TV system. Though not his real name, we call him Brunswick, because he's always getting in a stew about something. Well, I've heard from him again, and I'm in a stew, too.



By Jim Farmer, Chief Technical Officer, Antec Technology Center

The trouble with Charlie

Hi, Jim:

Boy, am I in a stew right now! My friend Charlie is the reason. I've worked that guy every way I know how. I've explained cash flow and return on investment. I've explained carrier-to-noise ratio. I've explained composite second order and composite triple beat. And now, just because he sees those things in his picture, he's gone and bought one of those digital satellite dishes. He says he doesn't care how he gets his TV. He just wants it good and easy to use.

Charlie is one of those subscribers you really love. A real TV nut, he can have a party with a dozen friends, and they can all watch a different show. He has a giant screen TV in his TV room–the kind I hate, because they show up every little problem with my signals. He has so many loudspeakers that he cleaned out three stores. His TV room would look like a movie theater if he'd let me spill my drink and popcorn on the floor (and rip the upholstery on his chairs). He buys a bunch of premium services (or used to), and buys PPV stuff every month. If watching TV ever interferes with his job, he'll quit his job.

I've taught him all about cable TV, but he went to the store, just like he was a dumb consumer, and asked the salesman questions about owning a satellite dish. Would you believe, the darn salesman got all the answers right? He really knew what he was selling. Charlie told him that he had his whole house wired for cable already. He said he wanted to get two satellite channels at once on different TVs. He wanted one program in his living room; he wanted the other program to be on any TV in his house, and he wanted to be able to control it from wherever he was. He wanted to be able to find any program before it ended, and wanted to tune it without having to think about what he was doing.

I relaxed, because I knew nobody could do all that. Would you believe, the salesman said "no problem" to everything Charlie wanted to do? He sold him a dish and two receivers. One receiver has IR remote control and goes in the TV room. It has an SVHS connector that gives better pictures than regular baseband does.

The other receiver has an RF remote that works all over the house, with a house code, so if his neighbor gets one, they won't interfere. That receiver goes at the input to his home distribution system, after an isolation amplifier, and has an RF modulator that puts out a signal on any unused channel.

If that weren't enough, Charlie gets an electronic program guide. It's easy to use, and he likes it better than the channel card we sent him once, even though the card is still right on most channels. He even likes it better than our scroll, which shows all the programs that are on now (If you are a fast reader, if you happen to be looking at the screen at the right time, and if you are really patient waiting for the programs to scroll past, you can find your program, if you remember the channel number long enough to tune it.).

"Well," I said, "bet those guys from the store can't hook all that stuff up and get it working."

"Wrong," Charlie said. "Their installer was there when he promised, and it only took a few hours to install it." Charlie played dumb again, but the installer answered all of his questions correctly. Seems he'd been to school on the equipment he was installing, and knew everything about it.

Somebody did a lot of thinking about how people want to watch TV. They designed the stuff for the viewer, not for the satellite TV operator. Then they actually trained the people who sell it, and those who install it.

Now Charlie is raving about the picture he gets. I'm afraid he'll convince more subscribers to go for the satellite. Sure, he spent some dough on the system, but he claims it was worth it. For now, he'll continue to take basic cable from us, to get the local stations, but gone are the expanded basic, the premiums and the pay-per-view.

Just wait, some day...

The boss said to explain to Charlie that we were going to rebuild some day, and the pictures would be better. We might even put on a lot of new channels if we can get enough for them. We're planning to start answering our phones quicker. We may let our guys go to an SCTE meeting for training. I reminded him about why he had some CTB and why there was noise. He said he didn't care if he got his TV from his water pipe, if it worked all the time, had good quality, and was easy to use.

The big guy says, "Things were better a few years ago, when we were the only game in town. We didn't have to worry about losing subscribers if the picture wasn't perfect. We worried about the city getting mad at us, and the customers complaining, but what the heck? They got mad, they complained, they wrote letters to the editor, but they paid their bills. Oh well, we are still getting a little money from Charlie, and until the price of the satellite stuff drops, not everybody will get it, so we still have a business."

For awhile.

Best,

Brunswick CED

Have a comment?

Contact Jim via e-mail at: jfarmer@ix.netcom.com

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Circle Reader Service No. 12

Baseband digital interfaces, revisited

By Jeffrey Krauss, interfacing with the digital world and President of Telecommunications and Technology Policy

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

Early last year, I wrote about the digital interface that is being developed to interconnect digital TVs, VCRs and cable boxes. See "The next big interface debate," in the April 1995 issue of *CED*. This work has run into a major conflict that is almost certain to lead to incompatible, consumer-unfriendly products. And this time, nobody can blame the cable industry. The blame rests with two different groups of TV and VCR manufacturers.

Background

The EIA set out a few years ago to adopt a standard for a baseband digital interface that allows digital TVs, VCRs, cable boxes and other audio- visual media to send signals to one another. Think of this as a local area network connecting these devices within a single room. The EIA decided that the data rate should be at least 50 Mbps in order to carry two digital HDTV signals at the same time.

The EIA 1394 standard was agreed to last year as the physical layer of the network. This was developed by the computer industry and is called "FireWire" by Apple. It can carry packetized data, including digital video or digital audio, at data rates of up to 400 Mbps on twisted pair cables.

The next step is agreement on a command language. This is needed to allow different devices on the network to talk to one another, identify each other and execute the commands that the user sends with his handheld remote control. For example, it allows the cable box to tell the TV which channel it should tune to in order to allow the customer to watch a pay-per-view movie. This example assumes, of course, that there is only one digital tuner, located in the TV and shared by the other devices in the network.

The conflict

Well, it now turns out that there are two command languages on the table, each with a group of proponent companies. The CAL command language, which is used in analog audio/video and home automation products that work on a network called CEBus, is supported by a group of TV and VCR manufacturers headed by Thomson Consumer Electronics.

Other CAL supporters include Intel, Honeywell and AT&T. The AV/C command language was developed by the Digital VCR Conference and is supported by Sony, Mitsubishi and (they claim) more than 50 other companies.

Both of these groups plan to have TV sets and digital VCRs on the market within the next year. Thomson and other companies will have digital VCRs later this year that connect to the RCA DirecTV satellite receiver and record the satellite-delivered digital programming. These products will use the CAL command language. Sony, Mitsubishi and others will have digital VCRs and TVs on the market later this year, and they will talk to one another using the AV/C command language.

Implications

Products using the CAL command language and those using the AV/C command language can coexist on a 1394 network. But they can't talk to one another. You won't be able to use a Sony digital VCR with a Thomson DirecTV receiver, or an RCA Digital-VHS recorder with a Sony TV.

Digital cable boxes can be designed to support both the CAL and AV/C languages. This will increase their costs, of course, because it requires additional processing capability. But it doesn't seem likely that boxes that only speak one language will be able to operate in the same network with boxes that only speak the other language.

This is something like the Beta vs. VHS split in the analog VCR market. But there, the video cassettes were physically different and incompatible, and consumers could understand that. Here, the physical 1394 cable will connect into both groups of products. The incompatibility is deep in the electronic signals, hidden from view. Try explaining that to consumers.

What will happen? It's too soon to say. Both sides seem committed to their command language. Neither command language appears to have any significant superiority over the other. This may be a case like driving on the right-hand side of the street, versus driving on the left-hand side. Neither one has any apparent superiority over the other, but there are huge benefits to the public when everyone does it the same way.

A compromise?

Maybe, like the Beta/VHS case, one will win in the marketplace, and the other will wither away, but only after consumers make a huge investment in hardware.

Maybe a market will develop for command language "translators." Because the incompatibility is in the signals, it is easier to build "translators" than if there were physical incompatibilities. Think about the difficulties of playing a VHS tape in a Beta VCR, or a music CD in a cassette player. But running PC software on a Mac is feasible.

Or maybe one side will back off and accept the other's command language. The consumer electronics industry has behaved like this in the past, in order to avoid product incompatibilities. Now's the time for them to work on such a compromise, before there are large consumer investments at stake. CED

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SOAs & gain-clamping

By Venkatesh G. Mutalik, Fiberoptics Engineer, Philips Broadband Networks Inc.; and Luuk F. Tiemeijer, Research Scientist, Philips Optoelectronics Centre

Optical amplification schemes at 1550 nm using erbium-doped fiber amplifiers (EDFAs) have demonstrated their superiority over conventional optical repeaters in terms of noise and distortion performance. They are already being used in connecting headends and in other analog supertrunk applications. However, their use in dense cable TV systems has been rather slow because the externally modulated transmitter that is required to combat dispersive effects at the 1550 nm low loss window is expensive.

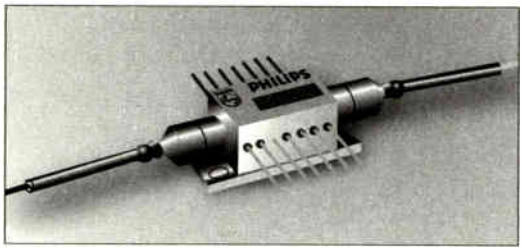
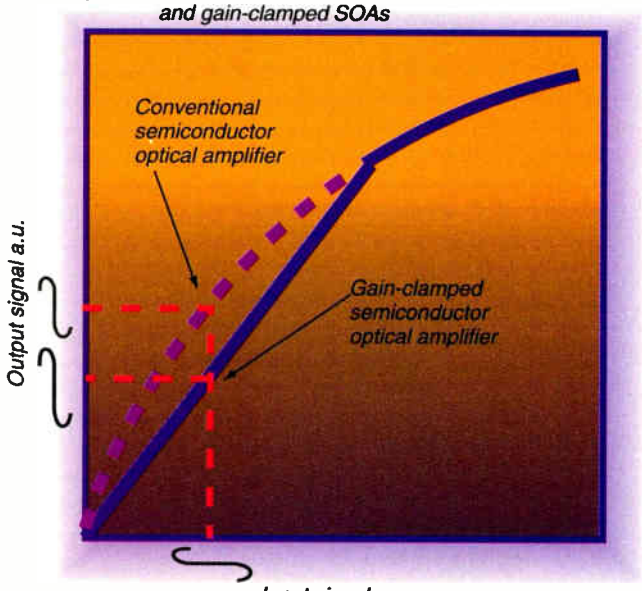


Figure 1. Illustration of a fully packaged semiconductor optical amplifier.

Semiconductor optical amplifiers (SOAs), on the other hand, provide amplification at the low dispersion, 1310 nm optical window. Furthermore, the electronic control of these amplifiers is similar to that of present-day DFB lasers, so they help preserve present system architectures. SOAs are now available as a fully packaged product and have already been used to enhance the performance of digital systems [1, 2, 3]. Their use in cable TV applications has been limited because their optical gain varies with instantaneous changes in input signal level. This generates distortions that cannot be tolerated by conventional AM-VSB signals.

Recent research suggests that this drawback can be overcome using a new technique called *"gain-clamping"* [4]. For gain-clamped SOAs, output powers in the range of 10 dBm to 15 dBm, and IMD products approaching that of linear DFB lasers, are predicted to be possible. This paper reviews the performance of presently available SOAs and discusses the prospects for linearizing their performance using the gain-clamping technique. Finally, we will review their potential applications in conventional AM-VSB systems with respect to optical budget, cost and flexibility.

***Figure 2:** The transfer characteristics of conventional and gain-clamped SOAs*



Semiconductor optical amplifiers

Semiconductor optical amplifiers are now available as a fully packaged and pigtailed product, with a size and power consumption comparable to that of the well-known 1480 nm pump lasers. The only difference is an additional input-optical fiber. The semiconductor optical amplifier chip inside this package is based on a high-performance multiple quantum well semiconductor laser structure of proven design. The chip employs a 10 degree angle stripe and high-quality AR coatings to suppress cavity effects and to obtain the optimum performance. Their fabrication technology is identical to that of semiconductor lasers. See Figure 1.

Unfortunately, so far, this optical amplifier has been considered unsuitable for use in cable TV fiber optic transmission, mainly because of its nonlinear transfer characteristics. The dashed line in Figure 2 shows the characteristic output power versus input power of a conventional optical amplifier. The decrease in output power for high levels of input power is caused by gain saturation in the active medium.

Although an EDFA has a transfer function similar to the one shown, the gain mechanism in the EDFA is very slow (about 10 ms) compared to the typical modulation frequencies applied in the cable TV transmission. Hence, the above transfer function applies only to average signal levels rather than to instantaneous changes in input signal levels. Therefore, the EDFA can amplify the signals in the cable TV frequency band undistorted.

The major obstacle toward using semiconductor optical amplifiers for the same type of application is the fact that their gain mechanism is very fast (about 0.2 ns). This means that even instantaneous changes in input signal levels will modulate their gain. This gain-modulation eventually results in the generation of generally unacceptable levels of second- and third-order distortion products.

Recently, we demonstrated that gain-clamping is an effective technique to overcome the problem of gain

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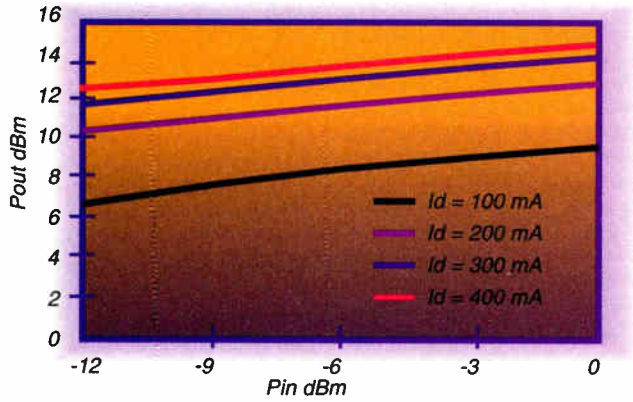
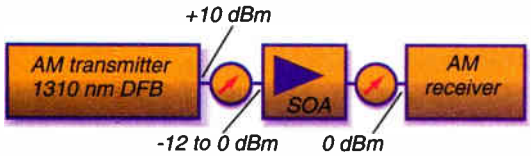
Figure 3: Pin vs. Pout graph for an SOA for different bias currents



modulation in the SOA. With this technique, laser action is initiated at an out-of-band wavelength of 1290 nm by a weak one percent to five percent reflective Bragg grating, which is monolithically integrated with the amplifier chip. This grating is transparent for the 1310 nm cable TV signal. Lasing at 1290 nm clamps the carrier density to the laser threshold level, and thus stabilizes the optical gain efficiently. This is illustrated by the solid curve in Figure 2.

When this gain-clamped amplifier is operated well above the lasing threshold for 1290 nm emission, and a fiber Bragg grating filter is used to block the 1290 nm emission, a highly linear 10 to 15 dB fiber-to-fiber gain around 1310 nm is obtained.

Figure 4: Test set-up for measuring AM performance of an SOA



Results based on preliminary analysis indicate that after design optimization, second-order IMD products in the range of -69 dBc are possible. This is for output powers in the range of +10 dBm using a two-tone modulation frequency pattern of 125 MHz and 226 MHz with a modulation depth of 35 percent. For the same system, third-order IMD products in the range of -100 dBc are possible. These numbers are better than the corresponding numbers for a DM DFB laser.

SOA performance evaluation

SOAs have already been used to enhance digital performance at 1310 nm. In one experiment, a 1310 nm polarization insensitive semiconductor optical preamplifier enabled a power budget of close to 40 dB, at a bitrate of 10 GBps.

This is sufficient to bridge 102 kilometers of standard singlemode fiber. In another experiment, a cascade of four polarization insensitive amplifiers transmitted a 20 GBps soliton signal over 200 km of standard singlemode fiber.

Digital systems are very forgiving of noise and distortions and can tolerate gain-modulation effects inherent in SOAs. Also, the average power levels for these systems is quite low, where the SOA distortions are considerably weaker. These examples prove that SOAs work well in digital systems.

For conventional analog systems, the power at any optical node is roughly 0 dBm. This requirement puts a premium on the output power of the SOA. Presented in Figure 3 is the Pin versus Pout performance of an SOA for varying bias currents. The SOA output power saturates at higher bias currents. This graph demonstrates that SOAs can provide enough power gain for cable TV level inputs.

However, the requirements on distortion and noise performance for conventional cable TV systems are far more aggressive. Shown in Figure 4 is a test set-up for SOA testing.

Based on tests conducted on the SOAs, using the test set-up, and a 40 channel loading (300 MHz to 550 MHz), typical CNR of 40 dB and CTB of 40 dB were measured with presently available SOAs. This clearly indicates that the noise and distortion performance of SOAs in the present form is unsuitable for conventional cable TV systems. The gain-clamped version should help in this case.

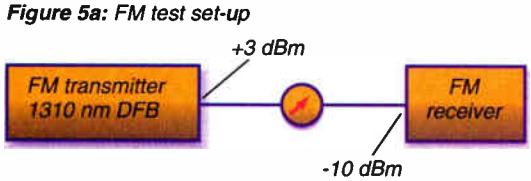
FM transmission on fiber closely imitates digital transmission. Shown in Figure 5a is the test set-up for a 16-channel FM test. The output of the transmitter is a set of 16 unmodulated CW carriers which are incident on the FM receiver at an optical power of -10 dBm, as consistent with FM requirements.

Now, the SOA is inserted between the transmitter and the receiver. As is clear from Figure 6a, the SOA has an input of -10 dBm and gives an output of +10 dBm. Then, as above, -10 dBm is incident on the receiver.

A comparison of the two responses indicates that the noise floor has degraded by 6 dB, allowing a CNR of 47 dB, and that the distortions are limited to about -35 dBc. The addition of the SOA has also resulted in an enhancement of the link budget by 20 dB, roughly corresponding to 60 km of fiber length.

This is just the preliminary result, and we expect that with optimization of the SOA parameters and optical filtering of the amplifier spontaneous emission noise, cascading of several SOAs while maintaining low noise and distortions is possible.

Figure 5a: FM test set-up



Return systems

SOA testing for a return system was carried out using 20 to 80 channels of QPSK at T-1 rates in a

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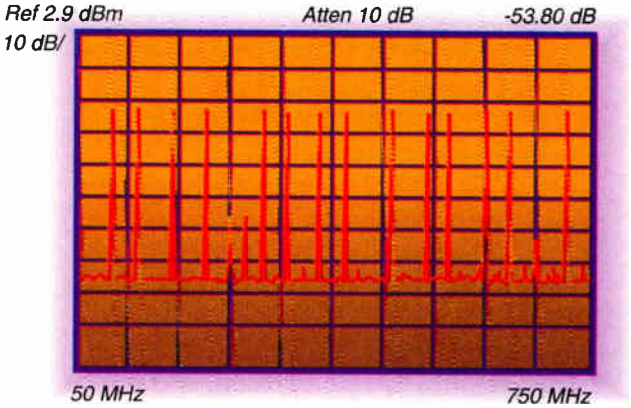
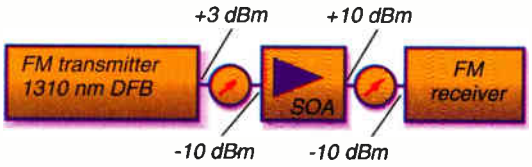
Figure 5b: *FM response with -10 dBm input to the receiver (RBW 300 KHz, VBW 3 KHz)*



fiber. The results involving SOAs are inconclusive. This is because the laser used to transmit the QPSK channel is a Fabry Perot laser with no isolator protecting it from back-reflections. This is not a major concern for normal systems.

Figure 6a: *Test set-up for measuring FM performance of an SOA*



However, when an SOA is inserted in the signal path, the amplified spontaneous emission (ASE) of the laser, along with the Rayleigh backscatter feed-back into the FP laser, increase the laser noise and affect its performance. Further work needs to be done to identify this problem precisely and to propose a cost-effective solution.

Discussion

Development of viable optical amplifiers at the 1310 nm window is a great opportunity for the cable TV industry to protect its investment in presently deployed 1310 nm systems [5]. Clearly, SOAs in the present form are not suitable for use in analog cable TV networks, other than for FM systems. However, improvements in SOA technology will in all probability lead to better devices that can handle analog cable TV signals.

To be fair, we must mention two other competing amplification schemes that exist at 1310 nm. They are the praseodymium-doped fiber amplifiers (PDFAs) [6] and the Raman Fiber Amplifiers [7]. Both of these amplification alternatives are bulky and expensive. Because these amplifiers use multiple high-power pumps and special types of doped fibers, their reliability with respect to continuous use has not yet been confirmed. The manufacturing process of building SOAs, on the other hand, is the same as that for DFB lasers. This mature technology and the associated high reliability, at prices competitive to DFBs, make the future of SOAs secure. With this in mind, we need to compare SOAs to conventional repeaters and to 1550 nm externally modulated systems.

The superiority of a fully functional gain-clamped SOA over a conventional optical-RF-optical repeater is considerable. SOAs will help in eliminating cost and complexity associated with maintaining a separate receiver and transmitter at each location. This would reduce congestion in dense headend locations. SOAs would also be able to provide optical budgets for bridging medium distances and for multiple splitting options. And they do all of this while maintaining the present system architectures at competitive prices.

In supertrunk applications, especially in providing headend-to-headend connection over long distances (in the range of 80 to 100 km), EDFAs have some obvious advantages. Fiber attenuation at 1550 nm is almost half that of 1310 nm, while the passive split losses are the same at the two wavelengths. In all likelihood, EDFAs will continue to have an upper hand in this sector. However, these systems involve at least one externally modulated 1550 nm transmitter and a combination of EDFAs, depending on the specific application.

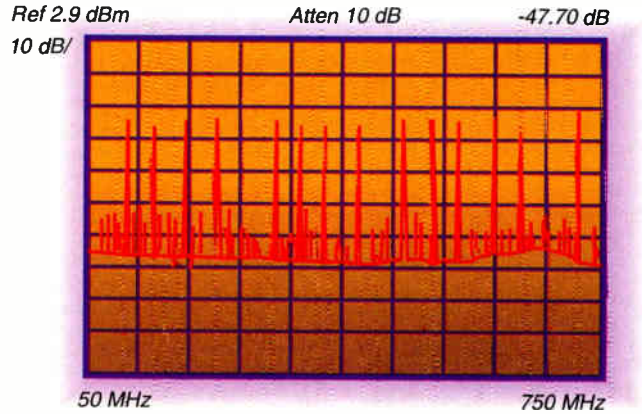
The design of good external modulators to compensate for Stimulated Brillion Scattering (SBS), Double Rayleigh Backscatter (DRBS) and fiber dispersion is expensive and non-trivial. Maintaining low noise figure (NF) in EDFAs with high reliability is non-trivial as well. The resulting system, while it works well when properly designed, is expensive and complex.

In high-split applications, an additional amplifier is provided at the last headend. The output of the amplifier is split into multiple fiber lines and distributed directly to the hybrid fiber/coax network. Here, both amplification schemes have equal loss budgets, since splitter losses are the same at both wavelengths.

Hence, if the system configuration calls for short hops followed by multiple splits, SOAs have the distinct advantage. This is because total compatibility of the 1310 nm wavelength is maintained.

The full potential of narrowcasting or broadcasting can now be realized, while preserving all existing 1310 nm networks.

Figure 6b: *Response with SOA with -10 dBm at the FM receiver (RBW 300 KHz, VBW 3 KHz)*



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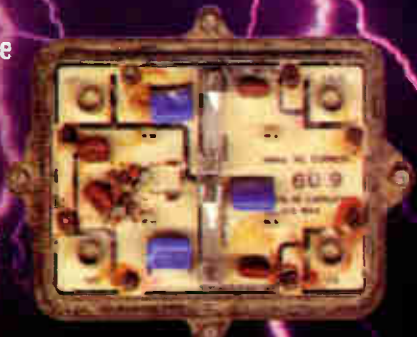

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The chief advantages of 1310 nm SOA technology are: flexibility, scalability, dispersion immunity and compatibility

Conclusions

In this paper, presently available semiconductor optical amplifier technology was reviewed. The basic architecture of these amplifiers, including gain-clamping of SOAs for linearizing their performance, was briefly explained. Performance of presently available SOAs in different transmission schemes was then discussed in detail.

Finally, potential applications of 1310 nm SOAs and how they compare to currently used solutions were indicated. The chief advantages of 1310 nm SOA technology are: flexibility, scalability, dispersion immunity, compatibility with existing systems, and low cost. Now, for the first time, both power budget and dispersion are non-factors in transmitting optical signals. CED

Acknowledgments

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Taking the PC out of the data comm loop

New technologies bring mass market and the Net together on TV

By Michael Lafferty

Remember that classic scene in *Moonstruck* where Cher gives Nicholas Cage a swift high-five upside the face and yells, "Snap out of it!"?

Consider yourself slapped and duly instructed.

For the past year or so, as many in the industry have paced the floor, wrung their hands and consumed mountains of Zantec to calm roiling stomachs churning with cable modem distress, it seems everyone's attention has been focused on the personal computer as the only on-ramp to the information superhighway and new revenues.

Rub your stinging cheek, turn off your computer and head for the family room. There are some new, economically deployable technologies that could bring data communication off-ramps into millions of homes through a very familiar device. It's called a television.

And if that weren't enough of a sock to the chops, guess what? These new technologies, in all likelihood, will breathe life back into a concept pundits, both in and out of the industry, have been trying to bury with heaps of scorn this past year. It's called interactive television.

Brian Dougherty

Wink technology brings a constant stream of data into the home on the VBI.

Consider yourself slapped and duly instructed...again!

PCs are dandy, but...

The cable modem fever that's swept the industry for the past year or so has infected many, but not all. One of the cool and collected is Brian Dougherty, president of Wink Communications (http://www.wink.com). While he's certainly no high-tech Luddite, Dougherty has very definite views on the limitations of PC penetration.

"I'll tell you," explains Dougherty, "at least with the operators I've talked to, I have yet to get a good explanation of why they're so excited about cable modems. Market research shows only a third of U.S. homes have PCs. And that's actually any PCs, including old XTs, Commodore 64s and Apple IIs. And of the one-third that actually have PCs, only a small number of them are leading-edge PCs capable of doing a good job of Internet web surfing. In fact, market research on the number of home PCs that are connected to any kind of on-line service is actually only around 10 percent."

Dougherty continues his lesson in PC math. Ten percent of 33 percent, that translates to roughly 3 percent of the total home market. Then, if you overlay cable's approximate 60 to 65 percent penetration of U.S. homes, the number goes even lower. He gives the benefit of the doubt and rounds it to five percent of the market and poses a logical question: "Of that five percent of your customers, how many will really do so much Internet surfing from home that they're willing to pay the money, etc.?"

He and others like him are the first to acknowledge there's a viable PC market, in homes and businesses, that cable modems will be able to tap into. Yet, it's still limited. That's because PC costs and their perceived complexity, at least for the two-thirds of the population that doesn't have a PC, are big, big road blocks for any significant gains in PC penetration in the foreseeable future.

Dougherty's view of the near-term future (18-24 months) is not that much different from other cutting-edge developers. "I just think a bigger industry is coming," he states. "And just as the PC industry, by con-

ILLUSTRATION BY ANNEY GROSSBERG. SCREEN CAPTURE COURTESY OF DISCOVERY CHANNEL ONLINE

Enter... "the-TV-as-computer" concept that could bring the great unconnected masses into the information age.

trast, makes the mini computer/mainframe industry seem small or less important, I think information or interactive enabled televisions and telephones are going to be an even bigger and more dramatic marketing opportunity."

Enter the new technologies and "the-TV-as-computer" concept that could bring the great unconnected masses into the information age.

Keeping it simple

The new technologies are focusing their energies on the consumer mass market with one overriding thought, simplicity. User-friendly to a fault, they employ different, albeit complimentary, strategies to achieve the same goal, connecting the PC-challenged consumer. In fact, these new, relatively low-cost technologies have the capability of not only opening up new revenue streams relatively fast, but containing, if not reducing, in-house operating costs as well.

If Dougherty and his cohorts have anything to say about it, the disparaging term "boob tube" may become antiquated soon. Founded by the management of Geoworks, a manufacturer of operating systems for personal digital assistants (PDAs), Wink introduced its proprietary authoring software which delivers interactive programming over existing networks last year.

Wink technology capitalizes on the vertical blanking interval (VBI) and an incredibly compact software design to create its ICAP (Interactive Communicating Applications Protocol), a platform-, transport- and user-interface-independent protocol. Easily integrated in either analog or digital systems, the technology includes the Wink Engine, the software component that can be installed in set-tops, televisions, VCRs, cellular phones, etc., to decode the applications and return the ICAP response packets.

Wink's licensee list is impressive. General Instrument will ship its Wink-enabled CFT-2200 early this fall and will adopt it for its digital set-tops at a reported one-time royalty fee of less than $5 per box. Scientific-Atlanta will use it in its 8600x and other products, as will Pioneer in boxes available in 1997. A consortium of 53 companies, including Nippon Telegraph and Telephone and leading TV manufacturers Matsushita, Sony, Toshiba, Pioneer, NEC and Mitsubishi, are gearing up for an ambitious, nation-wide Wink-based interactive launch in Japan this fall as well.

While Wink provides the interactive enabling technology that works behind the scenes, other licensees develop Wink-compliant applications for their own uses. CNN, Time Warner Cable, HBO and The Weather Channel have already signed up to use Wink technology.

CableSoft's applications offer ops new revenue streams and branding opportunities.

Another Wink-compatible application developer is CableSoft Corp. (http://www.cablesoft.com) based in Burlington, Mass. Its suite of local content applications – LocalWorks, ClassiFinder and Yellow Pages – are attracting lots of interest from operators who are looking to deploy on-demand information services that generate revenues.

"It resonates very quickly," says Bruce Jones, president and CEO at CableSoft, "and obviously the ability to bring up the commercial revenues behind it is also very appealing. There's no boot up. There's no search. There's no downloading files at so many kilobits a second. It's there with just a few clicks. The real win for everybody here is if people will use it and get used to the fact that they can get this additional content out of their television."

Jones reports trials of its applications are slated to start sometime this month. He says headend gear costs, which includes the server, software, licenses and data insertion equipment, and is independent of system size, run "somewhere between $80,000 and $100,000." He sees operators, depending on the market and any cooperative deals struck with local newspapers (ClassiFinder) or telephone companies (Yellow Pages), could generate anywhere from $10 to $30 a month from subscribers for such services. That's on top of any ad revenues from either service, or possible sponsorship revenues generated with the community information service.

Surfing the Net...on TV?

Up to now, conventional wisdom held the Internet and television were mutually exclusive. That was based primarily on the fact that the resolution characteristics of NTSC video did horrible things to images and text designed for higher-resolution computer monitors. A growing number of companies, including WorldGate Communications, Diba Inc. and WebTV Networks Inc., have developed ground-breaking software and patent-pending technology that's all but destroyed that Berlin-like wall between the two media.

WorldGate's (http://www.tvol.com) TV On-Line (TVOL) service is headed up by the renowned former GI exec, Hal Krisbergh. His appearance, along with a working demo of the TVOL service, at this year's NCTA show (in S-A's booth, no less), created quite a stir. Drawing big crowds, including an entourage led by Time Warner's Gerald Levin, the TVOL demo put the industry on notice that the Internet was no longer a PC-dominated media or revenue stream.

TVOL's computing intelligence is based in the headend, and it uses eight VBI lines to send content to ana-

log set-tops. Viewers can surf the Net with their remote controls or communicate via e-mail and visit chat rooms and newsgroups using a $25 wireless keyboard. Its recently announced Channel Hyperlinking capability will allow TV viewers one-button access to Internet options (web sites, e-mail, chat rooms, etc.) shown during TV shows and advertisements.

The service, estimated to cost cable subscribers $4.95 per month for five hours of Internet access, claims downstream speeds of up to 100 kilobits per second and upstream speeds of up to 20 Kbps using a modified form of the impulse pay-per-view (IPPV) circuits used in most advanced analog set-tops. Company officials say field tests this fall are "still on track," with test partners to be announced this month. While product is expected by early 1997, major announcements could be made at this year's Western Show (Dec. 10-13).

Information appliances

According to Joe Gillach, chief operating officer at Diba Inc. (http://www.diba.com), the signs are everywhere and cable companies and other broadband communications providers have a clear choice to make soon. Gillach recounts a conversation he had with an acquaintance at a major financial software company whose stock is continuing to perform badly. While the ubiquitous software is enormously popular, the basic problem, says Gillach, is that the company's product "is gated by the growth of more PCs." Because PC sales are slowing down, what should the company do?

"The answer is very clear," says Gillach. "You have to start putting your applications on platforms and devices that average people can buy. And that's what it's all about. There's this huge battle taking place between consumer electronics companies and PC companies about who is going to bring the other 65 percent (of the population) into the information age. And if I were a cable company today, I'd be looking at these consumer electronics companies and saying, 'Okay, what are the devices you're going to bring into the consumer home that I can be the pipeline to?'"

Funny they should ask, but that's exactly what Diba wants to do with its family of Interactive Digital Electronic Appliances (IDEAs). Diba's founders and staff, most of whom came out of Oracle's New Media Division, have developed a broad technology platform which allows consumer electronics and appliance manufacturers to deliver relatively inexpensive IDEAs to market.

The company has identified 40 or so different information appliances that could be developed for a wide variety of consumer applications. Three have

Diba's information appliances (Internet IDEA-top, Mail IDEA-bottom) are specifically designed for mass market consumption. Estimated production cost: $150-$200.

been announced publicly to prime the creative pump of potential licensees. The Internet IDEA is a World Wide Web browsing appliance that can be developed as a stand-alone product or incorporated into televisions. In fact, Diba recently announced an agreement with Zenith Electronics to incorporate their technology into its high-end NetVision television line. Diba has also proposed a Mail IDEA which is a low-cost communications appliance that combines electronic mail with a standard phone. The Kitchen IDEA provides consumers with electronic recipes and nutritional information.

WebTV's imaginative founders: (left to right) Steve Perlman, president, CEO and CFO; Phil Goldman, senior vp-engineering; Bruce Leak, COO and executive vp-engineering.

Gillach says other consumer electronics agreements are imminent, including one with a large Korean-based manufacturer and with two Japanese manufacturers who are "doing what I would call broad categories of communication-like terminals." For cable companies looking to exploit their pipeline into American homes, branded information appliances could be a way to go.

Gillach reports a huge interest from a variety of telcos. In fact, it's been reported that Cable & Wireless PLC is very interested in both the Mail and Internet IDEAs, which are cheap enough to be "given" to customers who would then pay a monthly fee.

Electronic yellow page directories, for home and offices, could provide added revenues from data and advertising bases that could be updated continuously over phone lines, instead of just once a year. This device could also allow consumers to search for products and services "out of region," thereby generating more long distance or toll call revenue for the phone company as well.

You...lean back in your chair and use your thumb to browse the web the same way you surf the television.

Another IDEA is relatively inexpensive ($500 or so), single-purpose or limited-task computing devices. "The keyboard," says Gillach, "would be customized for a specific application or work process. You could get an order for 10,000 devices customized for customer service types, and the keys would reflect the specific functions or fields they would be entering data into.

"And, because you're only supporting one application, the processing power, the memory and all the extra stuff you need can be much lower. Also, training costs go down, I think they estimate something like 90 percent. So, the training becomes a non-issue, and technical support becomes much easier as well."

WebTV debut

One of the newest entrants in the "TV-as-computer" market is WebTV (http://www.webtv.net), the creative brainchild of three former Apple multimedia alumni. With more than 30 patents pending on their standards-compliant system, WebTV co-founder Bruce Leak, chief operating officer and executive vp of engineering, says it's more than ground-breaking technology.

"We're all technology folks," says Leak. "But the technology is not what we're selling to the customer. What we're selling is a turnkey, easy experience. It's centered around your living room. It works well there. You can use your television remote control, you can lean back in your chair and use one thumb to browse the web the same way you surf the television."

The technology has obviously paid off. The graphics and text are amazingly clear. So much so, that the company recently announced licensing agreements with both Sony Electronics Inc. and Philips Consumer Electronics Co. who are expected to announce products targeted for consumer sales this coming Christmas, estimated in the $300 price range.

Leak says the technology, which could be easily incorporated in set-tops and adapted to cable modems, will be supported by their own Internet access service which will offer unlimited access at competitive prices (projected in the $20 per month range), along with a wide range of user-friendly features and services.

WebTV's founding trio has lofty and laudable consumer goals. "We're ashamed of the price of $300," says Leak. "But, we also were unwilling to miss this Christmas. We feel this Christmas is critical to establishing this product category. And so if it has to be $300, it has to be $300. I believe early adopters will take that burden. But long run, it's not going to be a mass product unless it's $149 max.

"Our motivation is that we are the service. We're not selling a cheap box they can take home, and if they don't ever use it again, we're happy because they bought it. We've got to keep them happy. We've got to keep them coming back and feeling good about it. It's a full-spectrum solution."

Leak reports that full-spectrum approach also includes cable, noting they're moving forward on discussions with set-top manufacturers. "We've gotten a lot of interest from them," says Leak. " As we move our price point down to very cheap, clearly the cable box manufacturers might like that. There are also options for integration of what they do and what we do. There's a lot of overlap and a lot of things we can do inside a cable box that they haven't got dedicated hardware to do now, that we can do with our incredibly high-performance processor and some of our graphics hardware that they like. So, it's attractive from a lot of directions."

These recent advances in technology are especially attractive to cable operators looking to tap new revenue streams without busting the bank. It's amazing what can happen in a year's time. Suddenly, TV viewers may have an inexpensive route to the information superhighway and cable operators could help pave the way. CED

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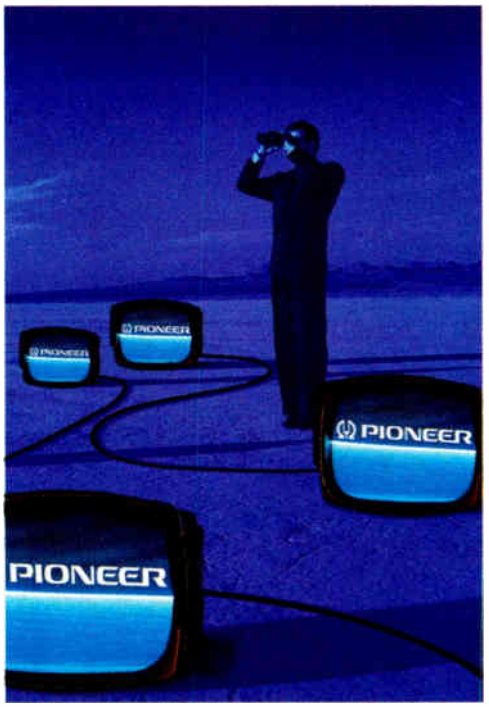

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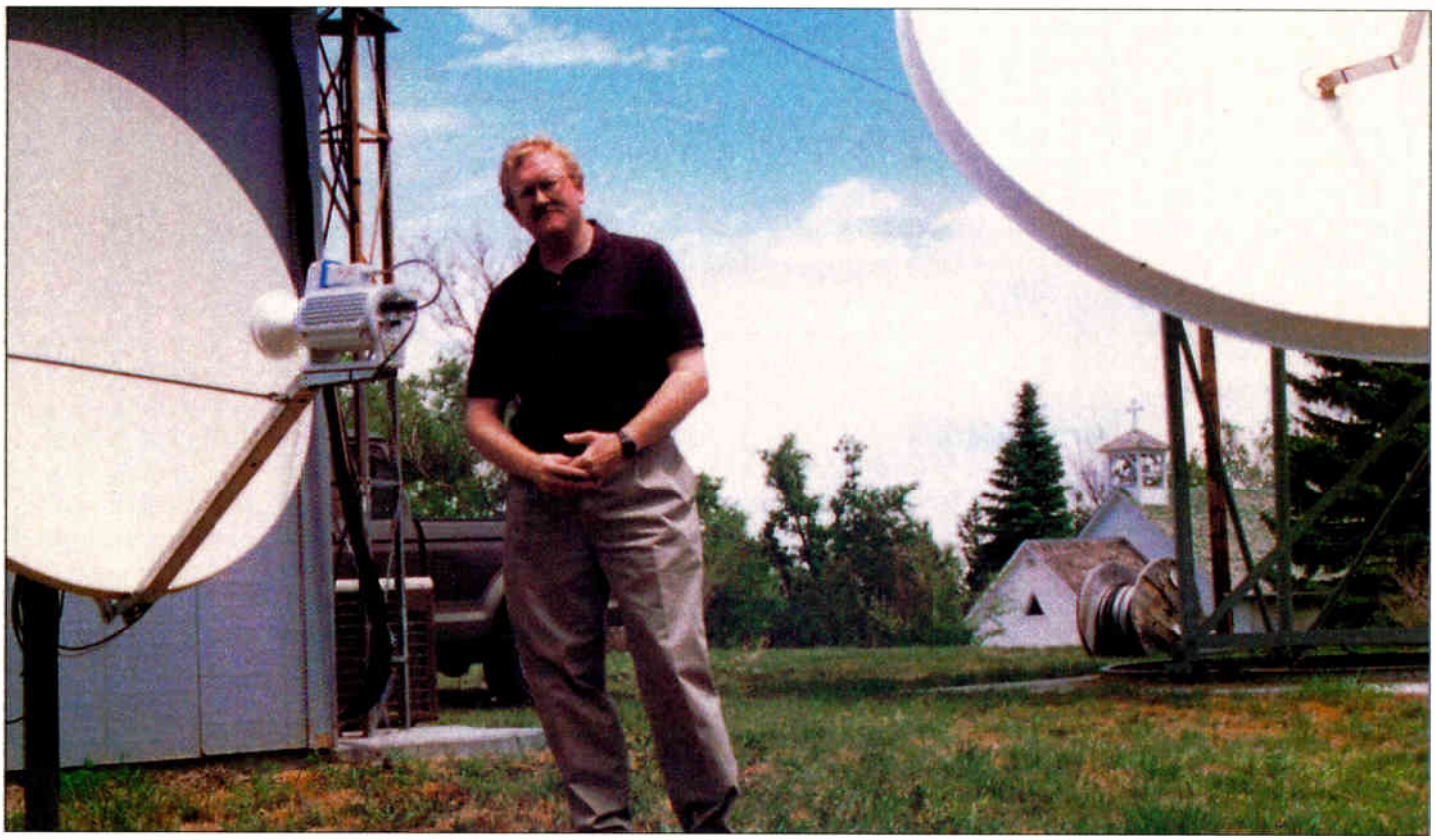


Bauer's Harrison headend features a VSAT system to deliver data to his customers.

High-speed data comes to the Great Plains

Small systems can surf the 'Net, too

By Roger Brown

Bill Bauer is on a mission to redefine the cable industry. He sees a future where cable operators are full service communications providers, offering traditional video for sure, but complemented with high-speed Internet access, telephony, video-on-demand and other services.

No, Bauer's views are not unique. There are plenty of industry leaders who see a bright, competitive future for their companies. What does make Bauer different, however, is that he sees the same promise in his tiny, rural systems that bring entertainment and information to customers' homes in the high plains of western Nebraska.

In fact, while industry big boys Tele-Communications Inc. and Time Warner Cable garner the headlines about Internet access and intentions of widely launching cable modems, Bauer is actually doing it through his tiny WindBreak Cable company—without fanfare.

Seeing the gleam in Bauer's eyes when he talks of launching data services, or listening to the passion in his voice during a conversation on competition, you can't help but be infected by his dogged determination and sense of entrepreneurial spirit. This guy would have been right at home 30 years ago when pioneers like Bill Daniels, Glenn Jones and Bob Magness were bringing television signals to rural Americans via cable.

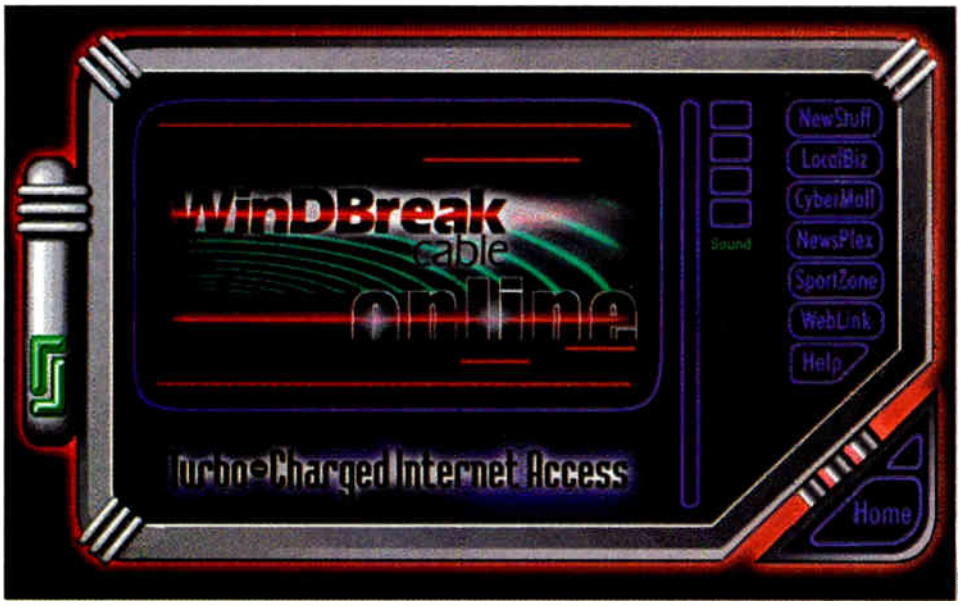
But Bauer is clearly a '90s icon—constantly tethered to his pager and cellular phone, working on deals and solving day-to-day problems. He stands ready and willing to jump into his pickup and drive the 50 miles of open range between his home and his flagship system in Harrison, where high-speed access to the Internet is being launched—to all 110 subscribers who want it.

Observers might be tempted to laugh at Bauer's system, an eight-year-old network featuring Sylvania actives, five miles of plant and 17 channels of video. But once deep into the subject, the chuckles and snickers fade away, replaced by feelings that this guy has a clear vision of his future, knows how to get there, and in fact, has already started the trip.

"I'm not just out here trying to sell (Internet access)," proclaims Bauer, "I'm trying to salvage the cable industry. Our biggest problem is that we don't market ourselves very well. The telcos tell the world they can do everything, and the world swallows it up. Well, I think the small (cable) operators will come through and save our backsides."

A simple presentation

Bauer first caught the data bug a few years ago, when, as a member of CableLabs' (he is, by the way, the smallest member of the R&D consortium) Telecommunications Subcommittee, he heard a presentation about



When users sign on to Bauer's system, they're treated to a rich graphics environment and an eye-catching video interface.

the growth of the Internet. After being swarmed with interest from cable operators, CableLabs convened a week-long meeting on high-speed data to learn more about the subject and to hear presentations from vendors.

Naturally, most solutions focused on terrestrial networks, with hard-wire connections to Internet service providers. While that works well in populated areas, most vendors don't have an affordable solution for areas where there are more miles between houses than there are total subscribers.

To get access to an Internet provider isn't cheap either. In Harrison, a T-1 line costs $4,300 a month. That's why when Bauer heard about using VSAT technology to access the Internet, his ears perked up. Today, he has a dish sitting outside his headend, attached to a Zenith router and a proxy server. When users connect to "WinDBreak Cable Online" via their 4 Mbps cable modems, they're getting access to content at speeds tremendously faster than the telephone, via a satellite transponder.

While Bauer has taken some ribbing for working with Hughes (remember, Hughes has a major stake in a competitive video service called DirecTV), he shrugs it off. Besides working quite well, the solution was the only affordable way he could offer the service.

And make no mistake: While many in the industry are posturing themselves to offer data services, there are a lot of eyes on Bauer. His colleagues who serve on various CableLabs committees are anxiously awaiting the reviews. "One goal of the Technical Advisory Committee was to make this work in a 100-subscriber system," Bauer says. "If you can do that, doing it anywhere else is easy. Think about it—making it work over my system is like making it work over a single node in a larger system."

The Hughes system uses shared bandwidth downstream (the user is assigned a time slot for each data packet), and TDMA is used upstream. Importantly, Bauer gets all of Hughes' satellite knowledge and experience, plus a six-hour repair time if a connection should go down.

"Before I found the satellite system, I couldn't afford to get into this business," says Bauer. "We had to find an innovative way to make it happen. We're also not using a Unix-based server (instead, he's using Windows NT). We have to find solutions that work, and they may not be the same as the solutions for a big system."

Up and running

To get his system shipshape for the unknown world of data delivery, Bauer did "nothing heroic," he notes. However, his system only had three trunk amps and two line extenders between the headend and any of his customers. On a Monday a few weeks ago, he drove up to the system from his home just outside Scottsbluff with a couple of pre-configured computers. On Tuesday, he began activating the return plant. By Thursday night, he had set all the amplifier levels and installed the Zenith equipment in the headend. In four days, he was ready to sign on.

Were there any surprises? Only good ones. "The return path wasn't as bad as I had anticipated," Bauer notes. "Good maintenance practices should be more than adequate in a small system." Bauer knows the plant was built well and is maintained as it should be. After all, he built the system eight years ago and he maintains it, too.

He did have to move his return channel frequency assignment from 15 MHz to 25 MHz because of some interference caused by the British Broadcasting Corp., but with a dearth of FM radio in Bauer's corner of the world, he had little problem finding clean spectrum.

When consumers sign on to the service, they're presented with a custom graphical user interface that is menu-driven (see Figure 1) and features lots of graphics in motion. By clicking on various boxes, the users are presented with anything from news to shopping services.

"We want to show off the capabilities of high-speed transport, so we built our own navigator to show what we can do," he says. "We're writing stuff that simply can't be done over a telephone line."

"One of the smartest things I did was hire a graphic artist and turn him loose on the computer," Bauer says. "He builds nice things that people enjoy." As time goes by, the on-line look of the service will change by evolution.

The computer equipment Bauer intends to sell to other operators will take up about one rack of space.

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"We know we have to constantly change the look of the navigator so that there's always new eye candy to bring the customers back."

In order to speed up his system even more, Bauer installed a caching proxy server that captures Web pages and other information a user might download and saves it for later use, giving the next user lightning-fast access to that site. The approach also results in fewer requests that have to be sent over the satellite.

Other computers serve as e-mail, Gopher and FTP servers, and soon, a newsgroup and pointcast server (for news) will be added as well. When all is said and done, Bauer will have spent between $15,000 and $17,000 for hardware and software in the headend and another $375 for each modem. His break-even point is a mere 15 subscribers.

"We're following very closely the Rogers Cablesystems model of charging $40 per month (for unlimited use) and $100 for an install where we put an Ethernet card inside the computer and install Netscape Internet browser software," Bauer says. Is he nervous about potential liabilities associated with opening a consumer's computer and configuring the software? Of course he is. "But there's no other way to do it," he says. "The nearest computer store is 75 miles away." When you're just 20 miles south of South Dakota and five miles east of Wyoming, you have to be a full-service company.

Bauer reviews usage data from the caching proxy server.

In the course of setting up a few computers, Bauer has determined that the minimum configuration that will be able to run his navigator and take advantage of the high-speed modems is a computer with a 486-class processor running at 25 MHz, with 5 megabytes of RAM and a sound card. But sometimes, even that's not enough. Bauer has found that his full-motion navigator takes a full megabyte of video to display.

Under this new paradigm, Bauer is finding he's changing the way the network works. "What we've done is remove the modem as the bottleneck," Bauer says. "We're to the point now where the bottleneck is the computer."

Without advertising, Bauer had six customers and even wired the local high school's computer lab. While his customers aren't exactly computer savvy, they are by no

means unsophisticated. After all, when some of your customers own cattle ranches that stretch as far as the eye can see, they're bound to be worldly and perhaps starving for information.

"This community is excited about this," he notes. "It's had enough exposure to the Internet to understand the issue of slow telephone modem speeds. We sit them down in front of this system, and it's like (putting) kids in a candy store."

In spite of his early success, Bauer intends to add subscribers slowly. "I want a few people on who will allow me to make mistakes before I start advertising. This is going to be a real challenge and a learning experience."

Perhaps no user is more excited than the local school, which has already signed on to Bauer's service—and paid for a full year, upfront.

A recent summertime trip to the school found a teacher inside, navigating the Internet for the first time. The students will be able to quickly search for information they need for their assignments, beginning in the fall.

A few lessons of his own

With so few users, Bauer never really expects to run into problems with excessive traffic caused by too many simultaneous users. But he does expect to learn enough about usage patterns to extrapolate that information to larger systems.

One of the services which Bauer offers is on-line shopping.

That will be important for other MSOs, with whom Bauer is working closely. In fact, Bauer has started another company, called Intertech, which will provide turnkey Internet access services for other small systems. Already, companies like Buford Cablevision, which has 150,000 subscribers scattered over 232 headends in Texas, Telemedia and Summit Cable are showing intense interest, Bauer reports.

Intertech will set up the same VSAT system, configure the headend, establish the IP addresses and provide support for other systems. "The learning curve is so steep right now," reports Bauer. "I've been at this for four years, and sometimes I still feel like I don't know what I'm doing."

So, what's next for Bauer and his 100-sub system? Video-on-demand, for one thing. "We now have a big pipe, and a computer that can do tremendous things," he notes. "Now that the network can deliver a huge amount of information, why can't that be real-time video? We can send out one movie one time to all our customers, who could store it on their hard drives. We are much closer to true VOD this way than by going to big file servers.

"Once we have the high-speed data connections to the home, we can look at the content. It's the first time a local operator can own his own content—and I'm not ready to give that up." Not on your life. CED

Bricking up the 'Net to make it safe for business

Digital certificates, firewalls and other safety measures

By Dana Cervenka

Among the more intriguing aspects of the Internet are the capabilities it provides to 'Net surfers to gain access to limitless information, visit exotic locales without ever leaving the safety of their keyboards and even interact with other people electronically, revealing only the information that they want to reveal about themselves, and in some cases, trying on new identities for size.

But it's also the anonymity of all of those people surfing the 'Net, and the voyeuristic qualities of the whole experience that make consumers more than hesitant to expose themselves, their credit card and financial data, and other personal and business-related information that will be key to making applications like electronic commerce and telecommuting a success. And if cable modems on broadband data infrastructures are to take off, they will need to be propelled by a public and a marketplace of vendors that feel secure about their use.

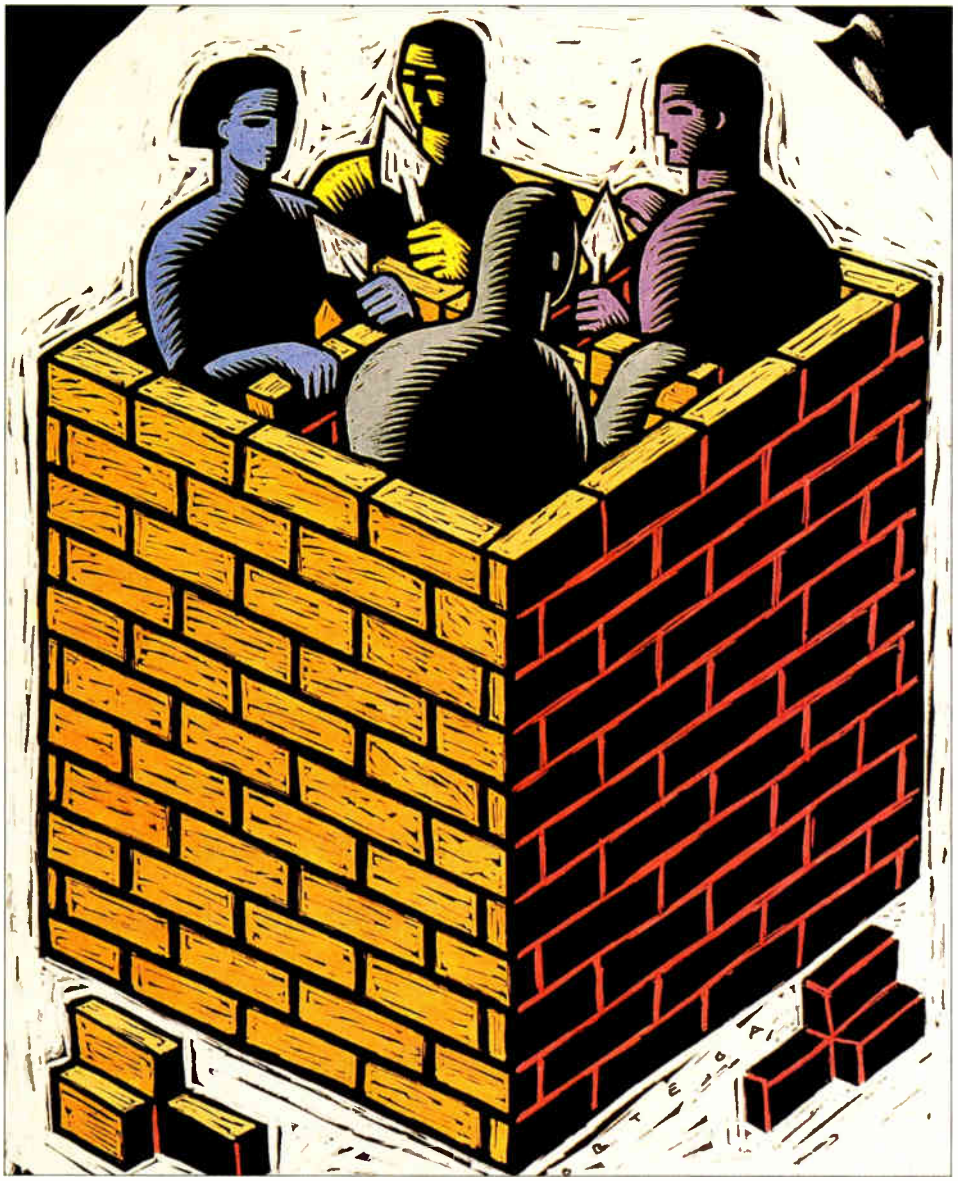


ILLUSTRATION BY JOSE ORTEGA, SIS

How secure is the Internet right now, and what's being done to make it a safer place to do business?

Safety is a relative term, says Milind Khare, program manager with Intel Corp.'s Architecture Lab, which has been involved with security issues as part of the efforts of the Broadband Link Team, a group that's helping make recommendations regarding standard cable modem specifications.

"The issue is not really technology, it's more of a perception issue," says Khare, "and it will take time to change perceptions.

"I'm sure that you ate in a restaurant in the last month where you handed your credit card number to a waiter that you had never seen before in your life. And you trusted that person with your credit card number for approximately five or 10 minutes."

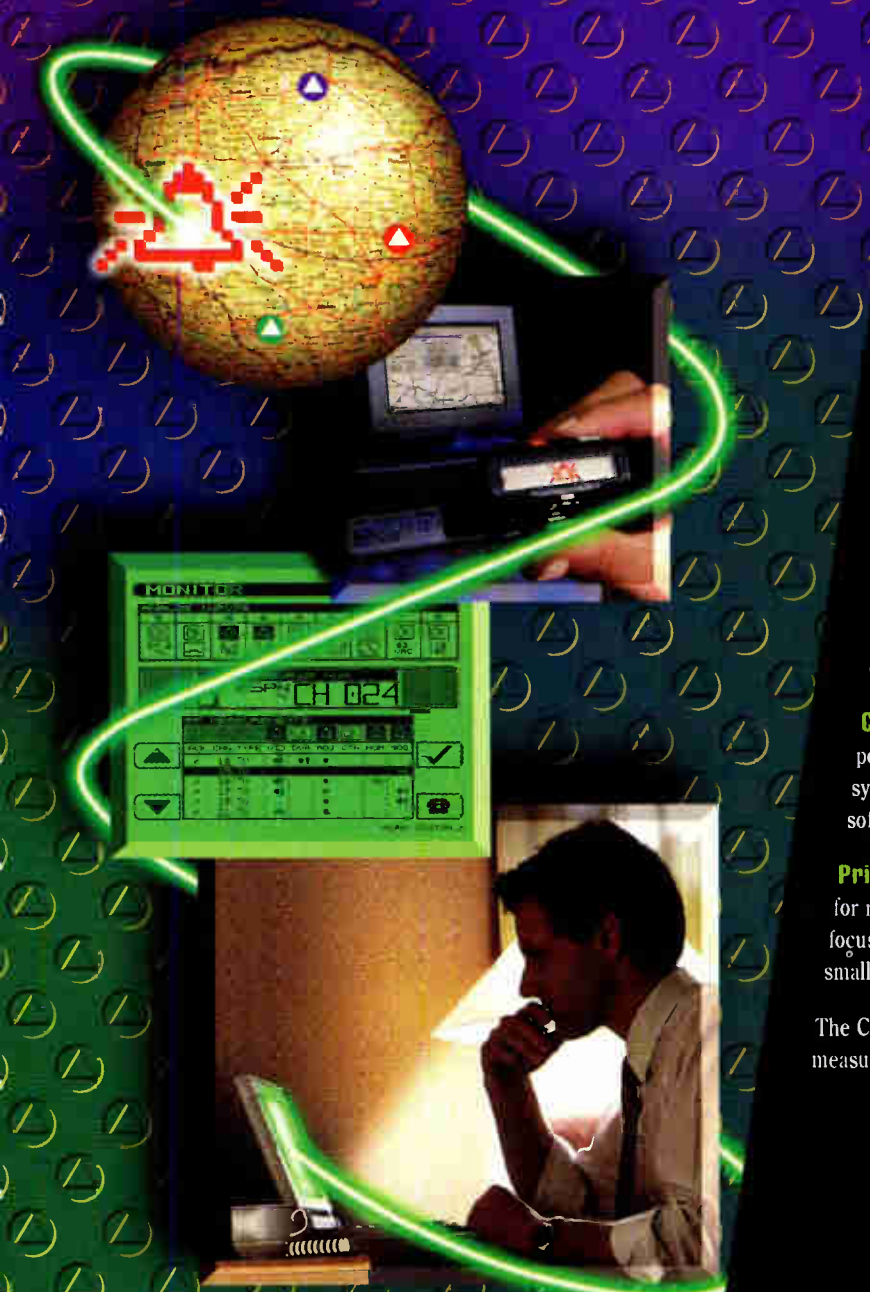
In an attempt to reach that same level of consumer and merchant comfort with electronic commerce on the Internet, there are currently several different approaches to credit card transactions. In a conventional approach, some vendors take orders over the network, but then require the user to dial into a regular 800-number in order to effect payment.

Other sites are using standards such as SSL, or the secure sockets layer, which is a standard set by Netscape Communications that has been adopted by a number of other players. SSL encrypts the session that takes place between the client and the server, encrypting the user's credit card number as it travels to a particular merchant, so that only a particular server can decrypt the information.

Essentially, SSL utilizes public key/private key cryptography to encode the data. With this method, a pair of mathematically matched keys is used to encrypt and decrypt the data. If something is encrypted with a particular public key, only the private key of that pair can decrypt the information, and vice versa. The beauty of the system is that the public key can be published without compromising the security of its other private half.

Companies like Visa and Mastercard are

Others Don't Remotely Come Close



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championing a specification called SET (secure electronic transaction) to secure credit card payments, which should go a long way in encouraging customers to use their plastic on the Internet. In the case of the SET protocol, a particular merchant won't be able to read the encrypted credit card number, but will contact its acquiring bank, which in turn, contacts the issuing bank that holds the customer's account. The issuing bank then verifies the credit card number.

Of course, there are security issues which go beyond protecting personal information. For one, in blind, electronic transactions, how can a consumer's—or a merchant's—identity be verified? In the electronic world, "digital certificates" take the place of a physical piece of ID such as a driver's license or a credit card which a consumer would present to verify his identity in the physical world.

The components of a digital certificate include the person's name, the public key and a digital signature, which verifies that the data is authentic. In essence, a user would "sign" some bits with their private key, while the merchant could verify the "signature" with the user's public key. Merchants would also use digital signatures to verify their identity on the Internet.

While these techniques represent only a sampling of the security measures being explored to shore up electronic commerce, there are plenty of security problems to overcome.

Data contamination and theft

Though the Internet has yet to become a major conduit for electronic commerce, it has already become the ultimate research library, with new pages on the World Wide Web springing up daily. The proliferation of companies, institutions and individuals placing their content on the Internet brings up another security issue, however, the contamination of data.

If companies are to protect content that resides at their Web sites, they must restrict access to that content. At present, that usually means that people must log onto Web sites with a user name and a password in order to gain access to a portion of the site. If you think that this seems problematic, it is.

An article recently posted on the Internet tells of the whopping security gaps revealed by the editors of CMP's *WINDOWS Magazine*, as they deliberately set out to uncover both corporate and institutional Web sites that were unsecured. The vulnerable locations, according to the article, included security gaps on sites produced by notables in both the financial, and the electronics communities.

The editors, using "popular" search engines, found sites that were sitting ducks: in many cases, a hacker could use a Web browser to obtain lists of files on the Web server's disks, or even copy the information in those files.

"In some cases, these problems would permit outside users to delete or modify files as well," according to information released by the magazine. The magazine's executive editor, David W. Methvin, called the results of the experiment "scary."

"We were able to find glaring security gaps virtually across the board," said Methvin.

Even more disturbing, some security measures that are in place may not be working.

One site that the editors visited utilized Secure HTTP (hypertext transfer protocol) to protect credit card information as it was used to make purchases via the Internet. "But security holes may have left credit card information wide open to thieves once it reached the server," according to the group's findings.

On the bright side, the article also lists strategies that companies crafting Web sites can adopt to protect their information, including cleaning out sample program files that can act as backdoors for would-be hackers, installing all security-related server updates released by vendors, and restricting access to individual directories.

There are, however, Internet security watchdog organizations which monitor the 'Net for major disruptions and specific types of hacker activity.

Cable's concerns

Moving outside of the borders of the Internet itself and into the access network, cable operators are faced with an additional security challenge in the structure of the cable bus architecture which providers supplying point-to-point connections are not. In the downstream, the same data, whether it's baseball stats, gardening tips, or the marketing strategies of one telecommuter's company, will be flowing past everyone's house that is connected to a particular node.

With that in mind, security is an issue which operators are not willing to compromise on.

"In the future, any modem that we look at will have to have some form of public key encryption," says David Fellows, senior VP Engineering and Technology with Continental Cablevision, which was due to receive a public key Link Layer Encryption enhancement this summer, in the form of a software download, to the LANcity modems the MSO recently purchased.

Cable operators will define data services based on elements like transmission speed, and class of security

To protect data at the data link layer, cable operators are pretty much of one mind that Link Layer Encryption should be used to bulk encrypt the data traveling between customers' cable modems and the headend. The data modem standardization process, however, is still in flux.

"Within the (cable) domain, it's pretty well-accepted that DES (data encryption standard) ...encryption will be used," notes Khare.

The DES chip in the customer's modem, and the DES chip in the headend, would exchange secret keys for privacy.

There is a hitch with DES 56-bit encryption, though: the U.S. government has banned the export of anything that uses keys of more than 40 bits in length because of security concerns. In fact, the technology is classified in the same category as munitions.

Governmental security agencies want to make sure that they can read any traffic that flows across the Internet, if necessary, to enhance law enforcement and U.S. intelligence activities.

The battle brewing between government and public interests has led to the creation of the concept of "key escrow," whereby authorities would allow the export of applications or

software that use encryption exceeding 40 bits, if the key is escrowed by the government, with the proviso that an escrowed key would not be opened without a court order.

That approach is not without problems, either.

"If you are a foreign government," says a source with one vendor, "and you are using software that is made by a U.S. company, but your key is escrowed with the U.S. government, I don't know how well that sits with you.

"We are still debating, along with other modem vendors, on how to deal with that: either leave out the encryption, or weaken it."

Firewalls

Moving farther up in the network, past the cable operator's headend, individual customer companies may want to take charge of their own security needs at the application layer, with an additional layer of encryption. At that point in the network, firewalls, which restrict access from the Internet, could be put in place by companies with telecommuters, for example.

A firewall is a piece of hardware and/or software that acts like a "choke point," says Khare.

"The firewall is your face to the Internet, and all the traffic comes in through it. If you wanted to allow specific employees to come in through the firewall, there are products that can set you up that way," he adds.

Digital Equipment Corp., a vendor which offers security solutions, has set up firewalls to protect its data and its employees as they interact with the Internet.

Digital is applying Web technology in two ways, according to Lois Levick, director of Digital's Cable Industry Network Competency Center. The first is what most people are familiar with, the Internet, which acts as a marketing and information resource for people inside and outside of the company.

The second is what can be called the internal Internet, or Intranet. The Intranet is designed for use and access by employees only; however, with Digital's tunneling software, the company can select certain partners and customers to access information in the Intranet, adds Levick.

In fact, Digital provided Internet security for companies which participated in CableNet '94 at the Western Cable Show. More than 45 companies had their data protected by firewalls and other security measures for the duration of the demonstration.

In the CableNet application, Digital's Screening External Access Link, a set of hardware and software components that control and monitor access among secure private networks and non-secure networks, acted as security enforcer.

As cable operators begin to provide different types of data services to their subscribers, says Levick, they will define those services based not only on elements like transmission speed, but also, on the class of security offered.

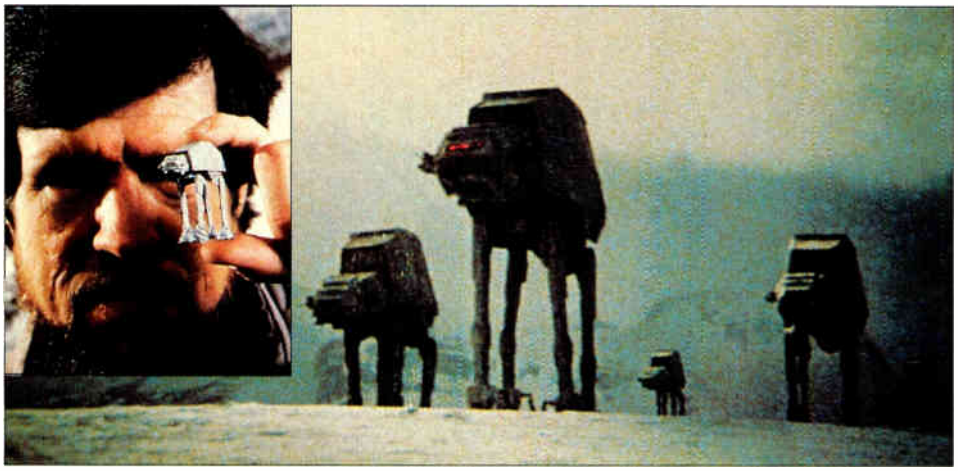
To determine the type of security solution to implement, cable operators need to closely evaluate the applications to be offered, and the business they're pursuing.

"What is the cost, and what is the value?" asks Levick. "What, as an operator, am I trying to accomplish?"

If it's gaining the public's trust and performing electronic commerce, then security will be key. CED

Demystifying asymmetric data networks

Revealing the facts behind the mystery



By carefully managing bandwidth, asymmetric networks can give the illusion that they're much bigger than life. (Photos: "The Empire Strikes Back." Credit: Lucasfilm. Courtesy of The Cobal Collection.)

By Ed Moura, Vice President of Network Systems, Hybrid Networks Inc.

One of the hottest debates within the cable modem industry today is the asymmetric vs. symmetric approach to high-speed data over cable. A more critical issue, however, is whether or not client/server based systems are superior to peer-to-peer systems for the last mile solution. Currently, symmetric cable modems in the market are peer-to-peer, while asymmetric cable modems are based on a client/server architecture. Before going any deeper on asymmetric vs. symmetric or peer-to-peer vs. client/server, let us first define asymmetric networking and give a historical perspective on the evolution of networks in general.

What is asymmetric networking?

Asymmetric networking is a new, innovative network system technology that offers significant cost/performance benefits in the area of Metropolitan Area Networks (MANs). This new system technology can be defined as follows:

✔ A client/server based network system with central control;

✔ A network system that features sophisticated bandwidth management, quality of service and remote user arbitration schemes implemented with central control;

✔ A system that can support independent upstream and downstream mediums and speeds;

✔ A system that can use wide bandwidth shared downstream broadcast channels and multiple narrow bandwidth shared or dedicated upstream channels;

✔ A system that can support different levels of channel sharing in the downstream and upstream directions;

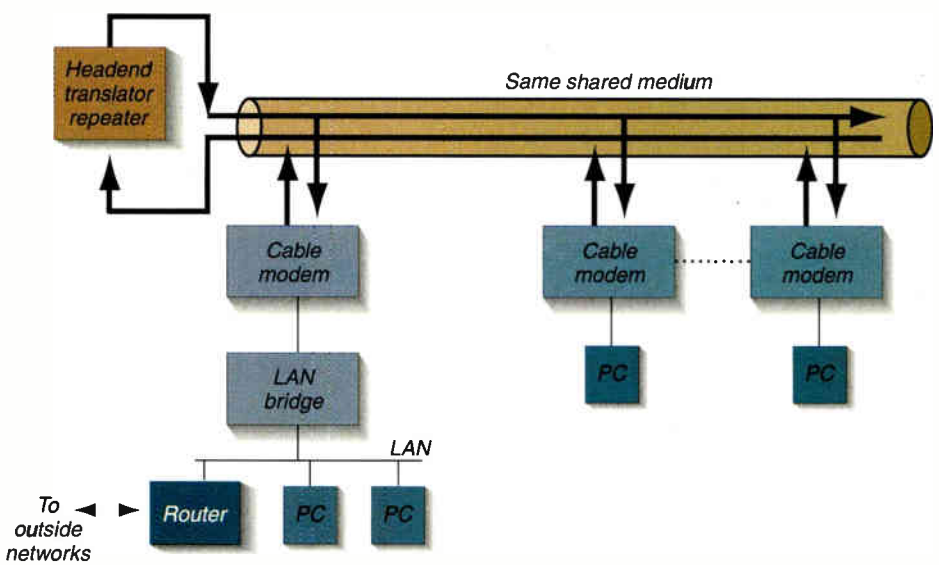
✔ A system where the downstream and upstream links can be scaled independently of each other. Therefore, the total number of downstream links can be different from the total number of upstream links.

In general, asymmetric networks will be more effective to bring "broadband" to the masses using the existing infrastructure than the traditional symmetric point-to-point switched networks or symmetric peer-to-peer shared networks.

The evolution of networking

Without going all the way back to the stone age of networking, we'll say that telephone networks and broadcast networks (radio and TV) represent the roots of all networks. These two types of networks are quite different, and yet, they have both been successful. At one end of the spectrum, broadcast networks are highly asymmetric. In most cases they don't even provide any means for an upstream channel. On the other end of the spectrum, telephone networks are highly symmetric. They were designed primarily for individuals, to carry one-on-one conversations. Whenever more than two individuals are added to the conversation (e.g., conference calls), symmetric networks become much less efficient. Essentially, only one person is talking while the other parties listen to the speaker. This is clearly a waste of networking resources. In contrast, broadcast networks are efficient for the dissemination of information, yet, the individual has no control over the content.

Figure 1: *Peer-to-peer symmetric architectures*



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Somewhere in the middle between circuit switched, symmetric telephone networks and non-switched, asymmetric broadcast networks, there are computer networks. The Internet/Intranet has emerged as the de facto standard for computer networks, and at the present time, it represents the strongest force in the networking industry.

Let's look into the Internet a little bit more carefully. A typical user of such a network is the personal computer (PC) user. In general, PC users' activity is highly asymmetric. They consume a lot more information than they generate. The vast majority, perhaps as much as 95 percent of existing PC user applications, are asymmetric. The only well-known symmetric application for the PC user is one-on-one video conferencing, which is not very typical today.

Packet switching, Local Area Networks (LANs) and Wide Area Networks (WANs) are concepts associated with data communication and computer networks. These concepts attempt to improve the inefficiencies associated with the dedicated circuit switched connections of traditional telephone networks. Data communications has evolved quite rapidly over the past 25 years or so. Today, the Internet is expanding exponentially, and with it, new concepts are being introduced at such a rapid rate that it is often difficult to keep up with the changes. MANs and asymmetric networking are two cutting edge examples of such new concepts.

Are computer networks symmetric? Yes and no. The fact is that even though most of today's networks have the same transmission speeds in both the downstream and upstream directions, the actual traffic being carried by most networks is highly asymmetric. Heavy traffic tends to flow primarily in the downstream direction (from the host computer or server toward the PC user). Of course, if one has servers widely distributed, the backbone WAN links that connect these various server locations need to be symmetric. On the other hand, the traffic going across a workgroup LAN designed to interconnect multiple PC users to a central server, is highly asymmetric most of the time.

So, why do existing networks have the same transmission speed (and medium) in both directions? The main reason is because, some time ago, computer network designers invented the concept of peer-to-peer networking. This concept lets computers talk directly to each other without requiring central control. On a LAN, this means that if one computer is transmitting at 10 Mbps and the second computer wants to talk directly to the first computer, then, the second computer has to be receiving at 10 Mbps. Now, if you have a third computer that also wants to talk to that second computer, it also has to transmit at 10 Mbps because the second computer's receiver was set to 10 Mbps to be able to talk to that first computer. This is how peer-to-peer LANs (e.g., Ethernet) work. Peer-to-peer networks have to be symmetric, or they do not work. This is the case regardless of whether or not the traffic being carried by these peer-to-peer networks is symmetric or highly asymmetric.

Another reason why today's LANs and WANs are usually symmetric is because, in general, people do not know where the servers are located. Therefore, this situation requires a symmetric design. On the other hand, if most of the host computers and the servers are centralized in a MAN, symmetric designs are not a requirement.

Going the last mile

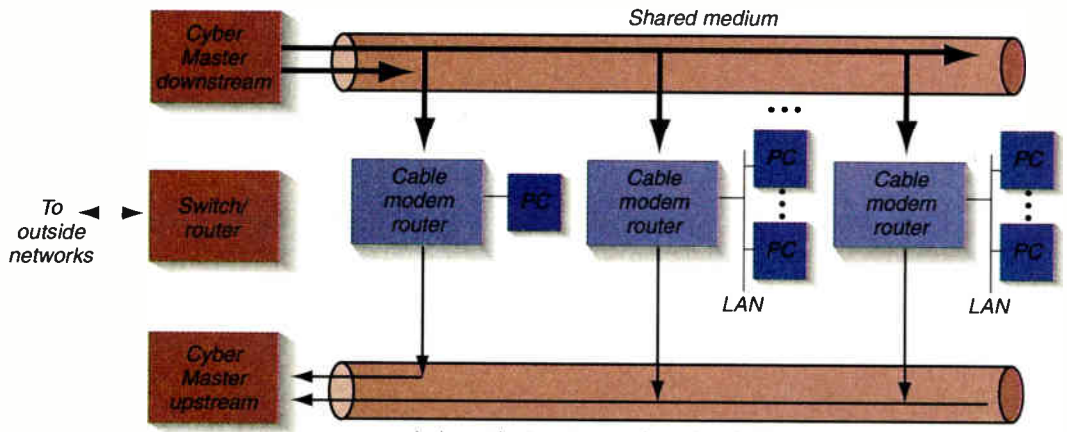
Extending symmetric peer-to-peer LANs to the last mile over cable TV networks has many disadvantages. Peer-to-peer networks do not have any central control, so any remote home user can dominate the data communications channel without giving the cable TV operator any control over the situation. For example, two home users can start continuous file transfers between their home PCs using up the entire capacity of the channels. Without central control, it is much harder to manage this situation. The cable TV operator would have to monitor the packet transmissions on the channel and set up a billing service that charges per packet. This won't be well accepted by customers, and will not stop power users from flooding the channels.

Another disadvantage is enforcing third-party service management. The issue of service management is crucial when offering a paid service. With peer-to-peer networks, the cable TV operators will not be able to manage the service providers. The concept of routing and service management is foreign to peer-to-peer networks. Essentially, anybody can become a service provider or a network manager from his home. For example, a customer could subscribe to the cable TV data channel at the lowest rate and then offer a cheaper on-line service to the rest of the cable TV subscribers at full throughputs. This would directly compete with the cable TV operators' on-line services. With peer-to-peer products, the cable TV operator has no way to prevent this from happening.

Another disadvantage of peer-to-peer symmetric LANs in the last mile is scalability. In order to scale this service, the cable operator must assign at least two or three sub-split 6 MHz channels for the peer-to-peer network to be able to scale. Most cable TV operators will not do that because they will need to reserve sub-split bandwidth for other services such as telephony and interactive TV services. In a peer-to-peer network, downstream channels cannot be added without using additional upstream sub-split channels. In other words, if you want to offer 30 Mbps (3 X 10 Mbps) in the downstream direction, then you also have to offer 30 Mbps upstream with the same modulation scheme. More sophisticated modulation schemes like 64 QAM and 8/16 VSB cannot be offered in symmetric peer-to-peer networks, because one is limited by the noise in the upstream direction. Again, keep in mind that symmetric, peer-to-peer networks have to be identical in the upstream and downstream direction.

Yet, another disadvantage of these networks is bandwidth utilization. Upstream traffic that is destined to go off-network travels

Figure 2: Client/server asymmetric architectures



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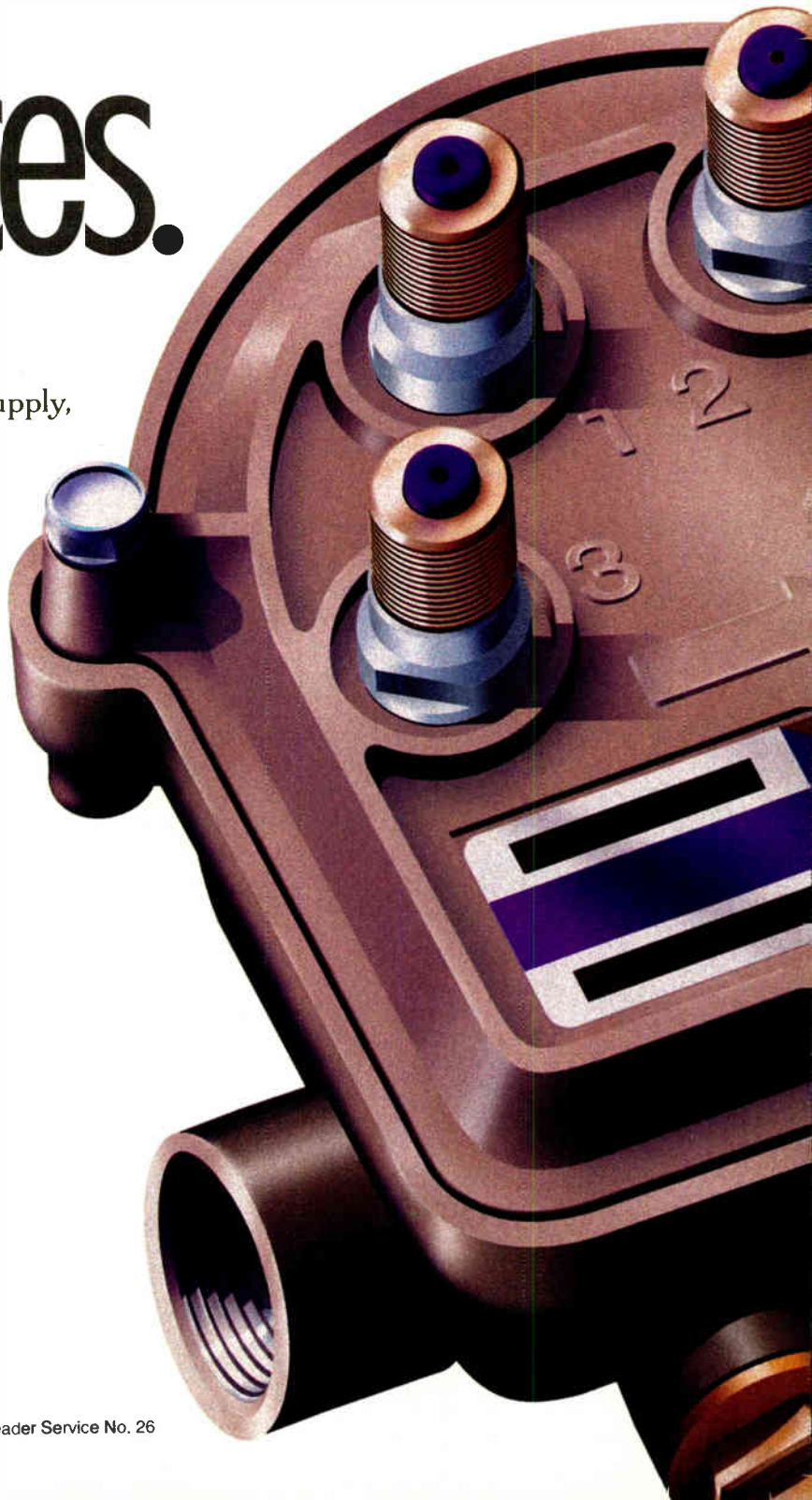

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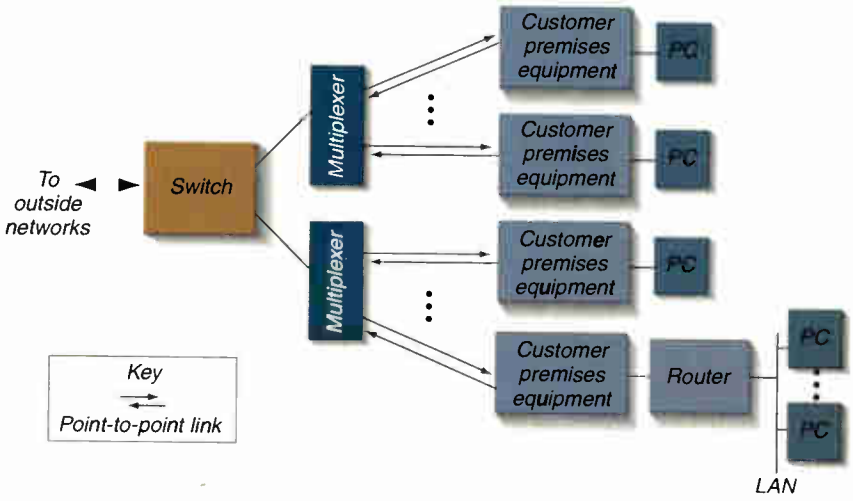
Figure 3: *Traditional point-to-point switched architectures*



back through the downstream channel. This prevents other subscribers from using the downstream bandwidth for their own applications. In addition, collision detection, no matter how efficient, reduces available bandwidth. Finally, requiring the use of 6 MHz in the upstream direction is also very wasteful for traffic that is primarily asymmetric.

Enter the asymmetric networks

Asymmetric networks were born four years ago and have since evolved quite rapidly to encompass several popular network configurations for the last mile. Essentially, these networks treat the downstream and upstream links as independent entities. The downstream link can go down through a particular medium (e.g., cable TV or wireless) at one speed, and the upstream link can go up through another medium (e.g., cable TV, wireless, ISDN, PSTN) at a different speed. If one computer needs to talk to another computer, it requests the appropriate network resources from a central controller. In other words, all upstream links terminate at the central site, and all downstream links generate from the central site.

These networks are not peer-to-peer, but client/server based. For example, the first computer can be listening (receiving) at 30 Mbps and transmitting at 2 Mbps, while the second computer can be receiving at 30 Mbps and transmitting at 512 Kbps. However, both of those computers can communicate with each other through the central site resources. These resources include multiple receivers that can operate at different speeds and also multiple transmitters that can also operate at different speeds. The central site equipment does the

appropriate speed matching and routing (among other things) between the different cable modems out at the various remote sites.

Client/server based asymmetric networks represent the next generation in network system design. Asymmetric networks can support multiple configurations and do not preclude the possibility of setting-up symmetric sessions through the asymmetric network. Essentially, symmetric is just a special case of asymmetric. In many cases, you don't even need to match the mediums in both directions.

One of the real benefits of client/server based asymmetric networks is that the bandwidth is managed in both directions. Peer-to-peer symmetric networks cannot do that because they do not have a central controller. As more and more simultaneous users connect to the shared peer-to-peer symmetric network, performance decreases. For example, we will compare 20 simultaneous PC users attempting videoconferencing over a typical symmetric 10 Mbps peer-to-peer network on cable TV, with videoconferencing over an asymmetric network with transmitters that operate at 1 Mbps and receivers that operate at 30 Mbps. We'll assume that in order to achieve full-motion quality videoconferencing (with audio) you need 1 Mbps of bandwidth in each direction for the session (note, however, that 512 Kbps per user is sufficient for most videoconferencing applications). In the symmetric case, the first four sessions (eight users) will do fine. Each session is 2 Mbps (1 Mbps per user) for a total of 8 Mbps in both directions.

However, when the next two users decide to set-up their own videoconference call, they will have problems because they will start creating collisions in the system and affecting the performance of the other eight users, including themselves. Finally, if two more users (12 total users) try to set-up their own session, they will bring the entire symmetric peer-to-peer system to its knees. Because the network operator does not have any central control, this can't be prevented

Let's now look at the asymmetric system. Each session is still 2 Mbps. Essentially, anytime another user enters the video conference, the central site resources assign another 1 Mbps channel in the upstream direction at a specific frequency and another 1 Mbps allocation within the shared downstream 30 Mbps channel. The asymmetric network will be able to support all of the 20 users doing symmetric videoconferencing applications, and it will still have another 10 Mbps in the downstream shared channel to support downstream multicast and/or web browsing applications. In addition, because there are no collisions in the client/server asymmetric network, no degradation will be caused at peak loads.

Furthermore, with central control, the network operator can enforce blocking at any stage that he wishes. When the asymmetric network is running out of bandwidth in either the upstream or downstream direction, the network operator, if he wants to, can prevent the "n+1" user from entering the network and affecting the performance of all the other previous "n" users that are already connected. As can be seen from this case, the asymmetric network not only could sustain more simultaneous symmetric videoconferencing sessions than its peer-to-peer symmetric counterpart, but it can run efficiently without affecting the performance of its users under heavy load conditions. This is why asymmetric networks can scale much better in the real world than their symmetric counterparts.

Asymmetric networks take full advantage of

the benefits of broadcast TV networks, shared LANs and most of the benefits of telephone networks. Therefore, it is not necessary to offer switched, symmetric, broadband point-to-point ATM networks to satisfy the requirements of remote PC users. Asymmetric networks are more cost-effective and less wasteful of network bandwidth for remote PC users. Even if the ultimate goal is to be able to provide dedicated full-duplex broadband bandwidth to subscribers, it is not necessary to deploy the more expensive symmetric ATM networks.

To compare broadband asymmetric networks with switched broadband symmetric networks such as ATM, today, most asymmetric networks use variable length packet switching and IP routing techniques to move data across the network. Because these are the current standard and practice, the operators can immediately deploy asymmetric networks. ATM networks are not broadly deployed, and their future deployment is still uncertain. With the quick evolution of IP routing, IP switching, Ethernet & FastEthernet switching and bandwidth management, cell switching is becoming much less important. Furthermore, ATM was designed primarily for switched point-to-point links which are very common in WANs. But, the concept of channel sharing, remote user arbitration, multicasting and broadcasting have never been a top priority for ATM. These concepts are critical to offering scalable and cost-effective broadband networks. As a result, most of the immediate cost/benefit trade-offs are in favor of asymmetric networks rather than ATM.

ATM is well known for its high-speed properties, quality-of-service offerings, multimedia capabilities and scalability. People usually compare ATM with Ethernet which is a peer-to-peer networking solution. This is not a fair comparison, because, as discussed above, client/server solutions are superior to peer-to-peer solutions for many reasons. Switched Ethernet or switched FastEthernet are better in terms of high speed and scalability, but, they still do not approach the benefits of ATM. On the other hand, for data communication applications, client/server based asymmetric networking has all of the ATM benefits plus many others. Like ATM, asymmetric networking can offer quality of service (bandwidth management) and multimedia. Quality of service can be provided because there are no collisions, and there is central control on a client/server based asymmetric network. Also, because the downstream and upstream channels are treated separately from each other, it is possible to scale downstream bandwidth independently from upstream bandwidth throughout the entire asymmetric network, something that ATM can only accomplish in the backbone between the switches.

A good reason for independent downstream and upstream scalability goes with the following example: Suppose a broadband operator's business is doing really well, and his customers are demanding more downstream bandwidth for streaming video (video clips) for either training, education, information or even entertainment. With asymmetric networks, adding more downstream bandwidth for streaming video, in either a unicast or multicast/broadcast mode, does not require the network operator to add upstream bandwidth. ATM may become cost-effective if the operator is planning to offer integrated voice, video and data as part of a full service network. But, until then, it does not give any other benefits that asymmetric networking does not.

The best migration scenario is to slowly

introduce ATM to the asymmetric network to determine whether or not it will in reality give any additional cost savings or other benefits. Slow ATM integration is recommended because ATM prices are still high, ATM standards are still in flux, the new ATM protocols are still not field proven and alternative switching techniques are becoming more popular. Again, ATM should initially be integrated from the WAN side into the central Point-of-Presence (PoP) which controls the server portion of the asymmetric network. Eventually, ATM traffic may even be carried all the way to the neighborhood node.

The power of asymmetric networking comes from the power of TCP/IP and split channel routing. Split Channel Asymmetric Networking (SCAN) lets downstream packets and upstream packets be routed through different network entry points which, in turn, let operators create cost-effective network topologies. SCAN is built primarily at the IP networking layer, and as such, evolves alongside IP. SCAN not only carries with it the power of IP routing (which is the main engine behind the Internet at large), but, it adds power of its own. Being able to optimize and scale the downstream links independently from the upstream links, as well as mixing and matching downstream and upstream links, are unique to SCAN.

The future is being able to live with and manage mixed media asymmetric networks. Telephone companies are also now starting to take a serious look at mixed media asymmetric networks. They are also looking at hybrid fiber/coax (HFC), wireless and many other architectures that include asymmetric concepts. Asymmetric concepts are also being applied to the more traditional networks. As a specific example, the excitement surrounding Asymmetric Digital Subscriber Line (ADSL) shows how important asymmetric concepts are even to the twisted pair based telephone networks. ADSL is a critical example of how asymmetric networking is really medium independent. ADSL can easily be integrated in a SCAN system since it shares most of the characteristics and properties of an asymmetric network. The main difference between ADSL and other asymmetric links is channel sharing. ADSL is usually associated with point-to-point links, but if required, it could also be deployed in a multipoint environment.

Many vendors are now developing their own versions of asymmetric networking. It is now critical for the industry to agree on the various modulation techniques, protocols and interface standards so that the vendors can continue to innovate and improve asymmetric networking within an open systems environment. This is a goal that is now shared by many vendors. Yet, since the industry is still very young in terms of product deployments and understanding of the real benefits of asymmetric networking, it is a lot more difficult to agree on standards. Nevertheless, asymmetric networking can be architectured and designed in such a way that the introduction of new standards is an integral part of the overall migration strategy from today's networks to tomorrow's networks without having to obsolete the entire system architecture. CED

Acknowledgments

The author would like to thank Craig Strachman, Jan Gronski and Ramesh Neelmegh at Hybrid Networks Inc. for their careful review and contribution to this paper.

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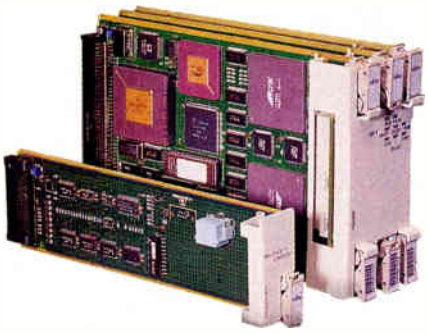

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Data bandwidth management requirements

How it's used is what counts

By Thomas W. Carhart, Product Marketing Manager, Motorola Cable Data Products; and Dawn D. Fitzgerald, Product Marketing Manager, Motorola Cable Data Products

The most frequently-asked questions about cable modems are, "How fast is your cable modem?" and "How much bandwidth does it use?" The answers are always the same: fast, very fast, and not much bandwidth at all. However, the more interesting question about cable modems is, "How does your cable modem use bandwidth?" The answer to this question reveals differences in cable modem system architecture and features that differentiate future product performance, robustness, service offerings, and system cost in a residential broadband data service.

This article examines the networking requirements for multiple applications in a residential broadband data service, and identifies bandwidth management requirements for a cable data system. This close analysis of cable data system traffic requirements suggests that the way bandwidth is used for a residential data service is far more important to a cable operator than the raw amount of bandwidth and throughput that is applied.

Traffic requirements

To form a foundation to evaluate how bandwidth should be used in a high-speed residential data service, it is necessary to understand individual subscriber traffic requirements. Table 1 identifies the primary subscriber applications and traffic requirements for this type of service.

"Downstream" refers to data flowing from the headend toward service subscribers. "Upstream" refers to data flowing in the opposite direction.

World Wide Web (WWW) browsing

Browsing the Internet (using software such as Netscape Navigator) may be the most frequently used application in a broadband residential data service. This application, which uses the Transmission Control Protocol (TCP), enables subscribers to view both Internet and locally stored and cached WWW content that may be part of a residential data service.

WWW usage by subscribers typically involves short downstream data transfers that consist of HyperText Markup Language (HTML) content displayed on a subscriber PC as a WWW page. As shown in Table 1, both high downstream throughput and low upstream latency are required of a data network to support high-speed WWW browsing. High downstream throughput enables the rapid downstream transfer of information to a subscriber computer. However, the requirement for low upstream latency is equally as critical, as upstream TCP acknowledgments must exhibit very low delay to fully utilize a high-speed downstream channel. See sidebar for an explanation of TCP flow control.

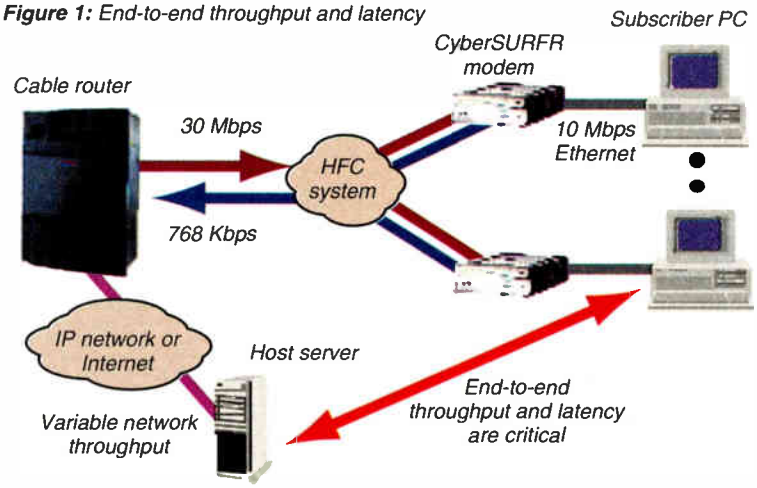
File transfers

Many types of information content, such as audio and video clips, are transferred over the Internet as file transfers. This application consists of a high-speed downstream data burst of moderate duration depending on file size. Similar to WWW browsing, many forms of file transfer use TCP. Therefore, support for high-speed downstream file transfers (using TCP) requires that a network's upstream latency also be very low.

Table 1: *Individual subscriber traffic requirements for a residential cable data service*

Application	High downstream throughput	High upstream throughput	Low downstream latency	Low upstream latency
WWW browsing (Local & Internet content)	✓			✓
File transfer (Audio/video clips)	✓			✓
Multicast audio/video (Streamed audio/video)	✓			
Desktop video conferencing	✓	✓		
Interactive games			✓	✓
Home-based WWW pages		✓	✓	

Figure 1: *End-to-end throughput and latency*



Multicast audio/video

Multicast services, consisting of text, audio and video, are a broadcast message or data stream sent to a group of subscribers. These services may consist of text (such as a ticker tape application), audio (such as a Real Audio music concert), or video (such as a video newscast). This subscriber application utilizes the User Datagram Protocol (UDP), instead of TCP. UDP does not use upstream acknowledgments, and hence, does not require low upstream latency to enable high-speed downstream multicast data services. Instead, the only net-

work requirement for this type of application is high downstream throughput.

Desktop video conferencing

Emerging desktop video conferencing applications enable subscribers to use their computers for near real-time video conferencing over the Internet. These applications, such as CU-SeeMe, provide data compression and buffering to compensate for the absence of delay guarantees over today's Internet Protocol (IP) networks, while still providing a quality video signal and tolerable interchange delays. The key network requirement and major factor in this application's performance is high-speed throughput in both upstream and downstream directions, to quickly transfer the high volume and continuous stream of audio or video information. This type of desktop video conferencing is accomplished with upstream and downstream transmission speeds of up to 150 Kbps. This application also uses UDP, and therefore, does not require the same low latency return path used by TCP applications.

Interactive games

Interactive network games are a popular application for high-speed residential data services. This application requires low latency transport of subscriber joystick or key click information between subscribers and host servers. Low latency is required so that users realize instantaneous response times. Because the volume of information transferred with multi-user games is small, high throughput (at least for upstream data) is not important. This is evidenced by the growth of multi-user games over today's dial networks (which provide low throughput and latency).

Home-based WWW pages

Using home-based WWW pages is similar to WWW browsing, except that HTML content is stored on subscriber computers rather than servers directly attached to the Internet or headend network. This application requires as high an upstream throughput as possible and low downstream latency for TCP flow control. It is not believed to be widely important to cable operators, as it is more likely that individual subscriber WWW pages can be more cost-effectively stored and accessed at higher speed on centralized Internet or local content servers.

Key traffic management features

High-speed throughput

There is no question that high-speed throughput is an important feature of cable data systems. High downstream speeds of up to 30 Mbps are possible (for cable data systems) and appropriate for emerging multimedia content. Applications such as WWW browsing and file transfer benefit from the maximum possible downstream throughput. With desktop video conferencing and multicast, only a minimum amount of downstream throughput (such as 150 Kbps) is required, and throughput capability beyond this minimum threshold is not used.

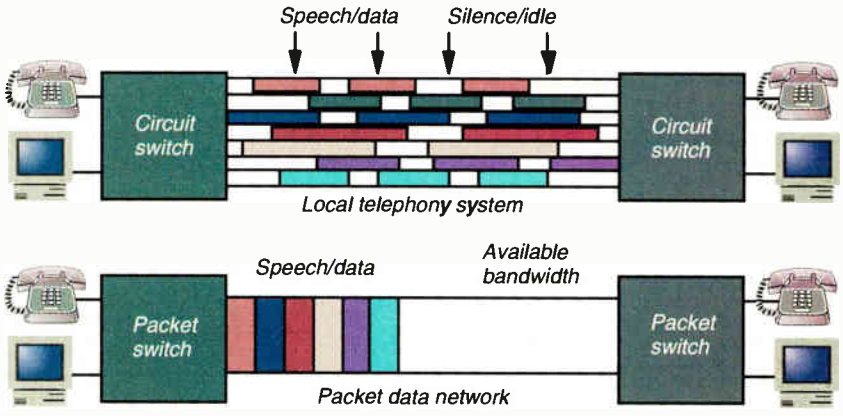
The following are additional traffic and bandwidth management requirements for a cable modem system that are of critical importance to cable operators:

High end-to-end throughput

It is end-to-end throughput in a residential data system, rather than speed of the cable modem, that is important for a high-speed data service. This is the throughput observed by a

subscriber. As shown in Figure 1, end-to-end system throughput depends on the processing speed and interface of the host server. It also depends on the design, configuration, capacity, and loading of network components between the host server and the headend location, and the processing speed and local Ethernet performance of the subscriber computer. System testing of today's cable modems suggests that end-to-end downstream throughput of 500 Kbps to 5 Mbps is achievable with installed subscriber computers and planned residential data networks.

Figure 2: *Packet data networks capture and reuse available bandwidth between users and provide high burst throughput*



Low end-to-end latency

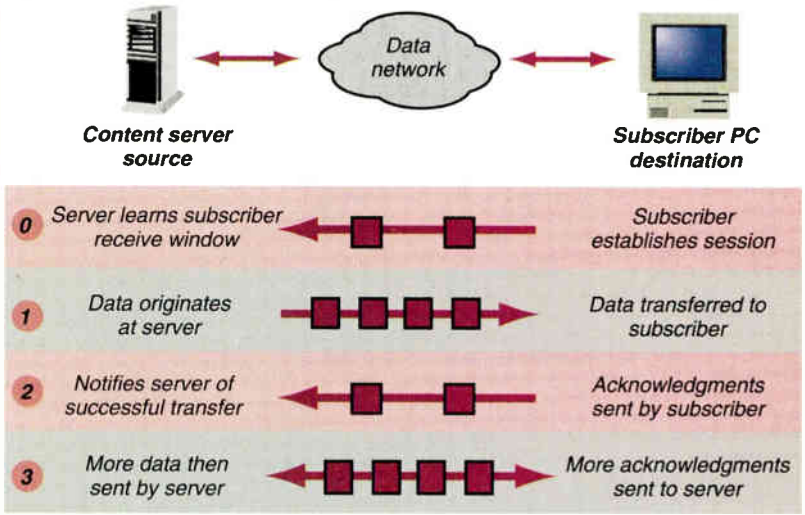
Low end-to-end upstream latency, as indicated in Figure 1, must be achieved to enable high downstream throughput for applications such as WWW browsing and File Transfer, which use TCP (see sidebar). In addition, low latency is required for interactive games with fast response times. Network latencies introduced by the subscriber's computer, host server, cable modem system, local Ethernet, and all other intermediate networks are cumulative. The sum of all these latencies is what determines the ultimate downstream throughput. Hence, network design and the speed of attached computers are as significant as the cable modem system for achieving network performance.

What is TCP and TCP Flow Control?

The Transmission Control Protocol, or TCP, is a protocol used to control the rate of information transfer and ensure reliable delivery of data between two computers. This protocol is one of several well-defined and commonly used languages of the Internet. TCP is used by all computers on the Internet for many types of networked applications.

When TCP is used by two computers to communicate with one another, this protocol controls the rate (or flow) at which data is transmitted between computers, as shown in the figure. TCP allows content servers to transfer data as fast as possible, depending on the speed of all interconnecting data networks and the maximum speed of the subscriber computer (or receiving computer host.) When data is transferred too quickly, or is lost in a connecting network due to congestion or noise, TCP automatically slows the transmission rate or retransmits subscriber data to ensure reliable data delivery and selects the optimal transfer rate.

Figure A: *TCP flow control between subscriber computer and content server*



The above figure illustrates the process with which TCP controls the flow of data between two networked devices. Initially (Step 0), the subscriber computer establishes a session with the content server. During this session setup, the subscriber computer indicates to the server its TCP receive window, among other things. The receive window is the maximum amount of data that can be received by the subscriber computer at any one time. Data is then (Step 1) sent from the content server to the subscriber computer. As the subscriber computer receives this data reliably, it sends TCP acknowledgments back to the content server (Step 2). These acknowledgments, small data packets that are sent to the content server, are used (by the content server) to learn whether any downstream data has been lost and requires a retransmission. In addition, the content server uses this information to determine whether and how much additional data may be sent to the subscriber computer (depending on the size and availability of the subscriber computer receive window). The continuous interchange of data and acknowledgments (Step 3) acts as the flow control mechanism for a high-speed TCP application.

When a network and subscriber PC are fast, TCP acknowledgments are transferred quickly (with low latency or delay) to the content server, enabling a rapid data transfer. If either the subscriber PC or interconnecting network is slow, (due to either a low throughput downstream or high latency upstream) the content server will slow the transmission rate to a more acceptable level, one that does not cause network congestion or overrun the subscriber PC receive rate. –TC & DF

High cumulative upstream latency is one of the primary reasons computers cannot fully utilize a high-speed downstream Internet connection. It is for this reason that local caching (storing Internet content locally, or on a server within a cable operator's headend) of Internet content is becoming popular and an important component of a high-speed residential data service. When a subscriber requests this content, it can be downloaded from a local server (in the headend) with low latency, allowing the subscriber to achieve a high download speed. Even though this same content might be available via multiple high-speed network connections along the Internet, the subscriber could not access this content at the same high-speed across the Internet because of the cumulative latency of multiple serial network connections.

Bandwidth used by cable modem systems should be shared by multiple users simultaneously

Minimum upstream throughput

While downstream throughput per subscriber should be as great as possible for a residential data service, upstream throughput per subscriber need only support a minimum level. Again, desktop video conferencing is the only supported application that requires any type of high upstream throughput. (Home-based Web pages are more likely to be stored on Internet servers than home computers.) Because desktop conferencing does not use greater than 150 Kbps (in some cases 384 Kbps), upstream throughput need not be as high as possible. Rather, upstream throughput per subscriber should meet at least the minimum requirement to support desktop video conferencing.

Shared cable media

Bandwidth used by cable modem systems should be shared by multiple users simultaneously. This is common among many types of packet data networks, including Ethernet LANs, the Internet, and public Frame Relay services, but differs significantly from more widely used telecommunication networks, such as local telephony systems. Data networks are designed to transfer periodic bursts of information between users, whereas the telephony system is designed for a more continuous (but lower speed) information flow. Local telephony systems, which require dedicated bandwidth between users for the duration of a connection, do not provide the high burst throughput of a packet data network. Furthermore, the nature of data communications allows for statistical gain in the local access network, as shown in Figure 2, and sharing of infrastructure equipment among attached subscribers.

Improved performance and reduced installation and operating costs are the ultimate benefit to cable operators of using a shared media cable modem system.

High bandwidth efficiency

Bandwidth efficiency is one measure of a cable modem system's cost-effectiveness. Upstream and downstream data channels are shared by multiple users, and highly efficient systems allow more users to share the same amount of bandwidth than less efficient sys-

tems. In other words, highly efficient cable modem systems allow operators to apply more system bandwidth to other revenue generating applications, such as downstream video. The key condition in which bandwidth efficiency is important is under high network loads. Since network bandwidth is designed for peak usage conditions, this is when bandwidth efficiency counts most.

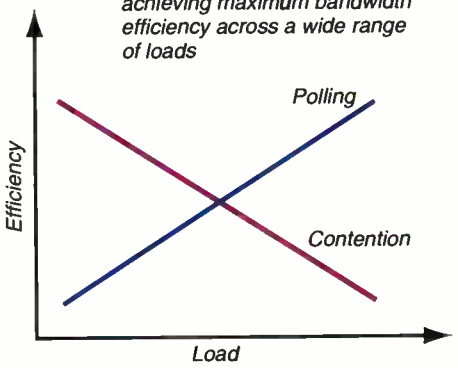
Cable modem vendors employ multiple types of access control, including polling and contention, to make highly efficient use of bandwidth over a wide range of loading conditions, as shown in Figure 3.

The use of multiple types of access control also enables low latency over a wide range of loading conditions. This approach to access control, which minimizes bandwidth usage, enables operators to maximize the revenue of an HFC system.

Flexible bandwidth scalability

A critical element of cable modem systems is flexible scalability of upstream and downstream bandwidth. Upstream and downstream data channels and bandwidth should scale independently of one another to provide operators with the greatest freedom to allocate use of system spectrum. While some critics may discuss the merits of asymmetrical vs. symmetrical cable modem systems, this is not the real issue. A superior approach, with independent scaling of upstream and downstream data channels, enables operators to select just the right amount of upstream and downstream bandwidth independently, when

Figure 3: Multiple access methods for achieving maximum bandwidth efficiency across a wide range of loads



they need it and where they need it. As penetration increases and subscriber applications' profiles change, operators have the flexibility to readjust capacity only where it is required. This is not only cost-effective, but also allows the operator to avoid having to predict his future bandwidth needs.

Furthermore, with this capability, the throughput of any single upstream data channel is not really significant (subscribers only achieve a fraction of the channel's aggregate throughput) as long as it is always in excess of what any single subscriber ever requires. Aggregate upstream and downstream throughput is limited only by system spectrum. This suggests that a system with narrower data channels that can be easily scaled is more effective than a system with high-speed (wide bandwidth) data channels that do not scale upstream and downstream bandwidth independently.

Bandwidth robustness

Overcoming existing noise environments in two-way HFC systems is a challenge to cable modem systems. The reverse spectrum in these systems has never been fully controlled (as there was no reason to manage this spectrum),

and as a result contains transient and continuous carrier ingress as well as additive thermal noise from upstream amplifiers. Cable modem vendors use a range of techniques to communicate reliably in this hostile spectrum.

Because of continuous carrier interference from marine, amateur, and broadcast radio, narrower upstream data channels (lower bandwidth) provide less sensitivity to noise than wider channels. The author's company uses an empirical optimum data channel which is wide enough to support high-speed upstream throughput requirements, but narrow enough to avoid much continuous carrier ingress noise. Wider bandwidth data channels are better only if there is not serious compromise in their robustness.

If any portion of a wider channel is hit with ingress noise, the entire channel may become jeopardized. In addition, vendors use signal processing techniques, such as Forward Error Correction (FEC), to compensate for transient ingress interference, and ingress cancellation to correct for discrete frequency ingress interference.

Because some cable systems contain more noise than others, cable modem vendors support adjustable FEC, which enables an operator to select the optimal amount of error correction and minimize unnecessary FEC overhead, improving performance for HFC plants with cleaner upstream noise environments.

Finally, most cable modem systems provide for frequency agility. Frequency agility performs two functions. First, if a region of upstream spectrum cannot be used even when FEC and ingress cancellation are employed, an upstream data channel may be instantaneously moved to a new frequency. This is transparent to the cable operator and all subscribers. An important second function of frequency agility is load management. When multiple data channels are used to serve a group of subscribers, load management is used to move individual subscribers across data channels to eliminate or minimize network congestion on any one data channel.

The combination of narrow channel bandwidth, adjustable FEC, ingress cancellation, and frequency agility provide a robust means to compensate for hostile upstream noise in two-way HFC systems.

How a cable modem uses bandwidth is more important than how much bandwidth it uses, or how fast it works. Operators who are aware of these differences will make better decisions in their deployment and operation of a high-speed residential data service that will eventually lead to superior business results. CED

Bandwidth hunger driving high-speed datanets

Schools, homes and offices want two-way data, and lots of it

By David J. Freeman, Senior Consultant, Digital Equipment Corp.

The continuing explosive growth of the Internet and the U.S. Telecommunications Act of 1996 have kicked into high-gear plans, pilots and development of high-speed data networks to homes, schools, offices and many other institutions.

An applications-driven market is developing with an increasing need for connectivity and greater bandwidth. This need is driving the cable industry to provide high-speed data networks with bandwidth capacities to satisfy the full-scale delivery of video, voice and data. Electronic commerce, telemedicine, knowledge acquisition through the electronic delivery of educational and training materials, video-on-demand or near-video-on-demand, home entertainment, electronic home shopping and a host of other applications are finding their way into cable industry-based data networks.

A different animal

These data networks are totally different from networks which deliver television programming to homes and schools. To enable interactive applications, cable-based data networks using either coaxial cable, hybrid fiber/coax (HFC) or all fiber must have the capabilities of providing a two-way data stream along with delivering regular television programs. They use segments of both the forward and reverse channels for the receipt and transmission of data. To ensure the activation of the return path, network sizing, network management and data security must be carefully considered by the MSO during the design phase of any such network.

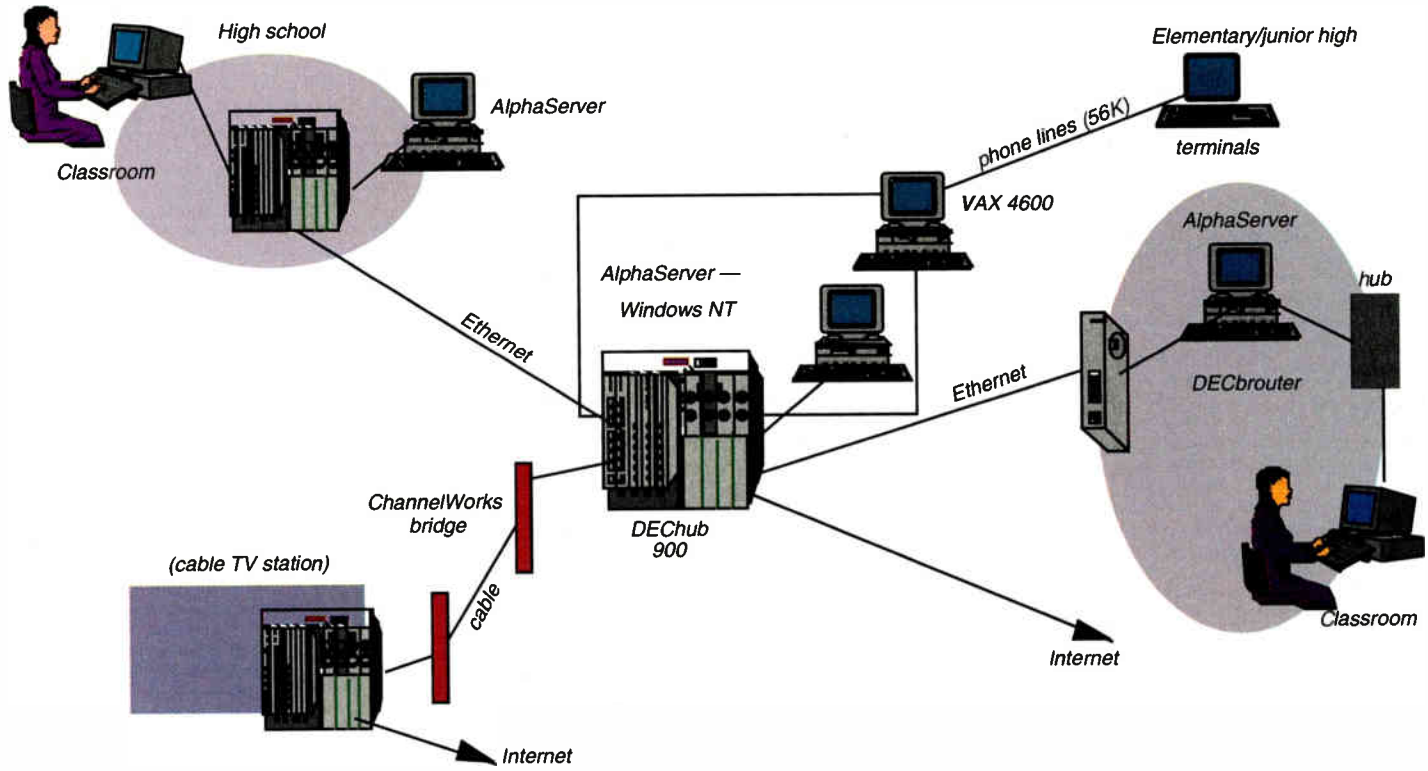
Enhanced connectivity needs

Powerful PCs require dependable high-speed access to these high bandwidth data networks that V.34 cannot satisfy. This has provided MSOs with a business opportunity to support the enhanced connectivity needs with cable modems, both for LAN-to-LAN and residential deployment.

Many of today's current cable modems have different approaches to delivering data, and varying capabilities. Computability and interoperability problems may possibly be solved by conversion to baseband Ethernet at a cable headend router. The IEEE 802.14 Standards Committee, as well as some other organizations, is driving toward an industry-wide cable modem standard.

In the meantime, MSOs must ensure that network subnetting, data path management

Figure 1: *School district-Broadband network example*



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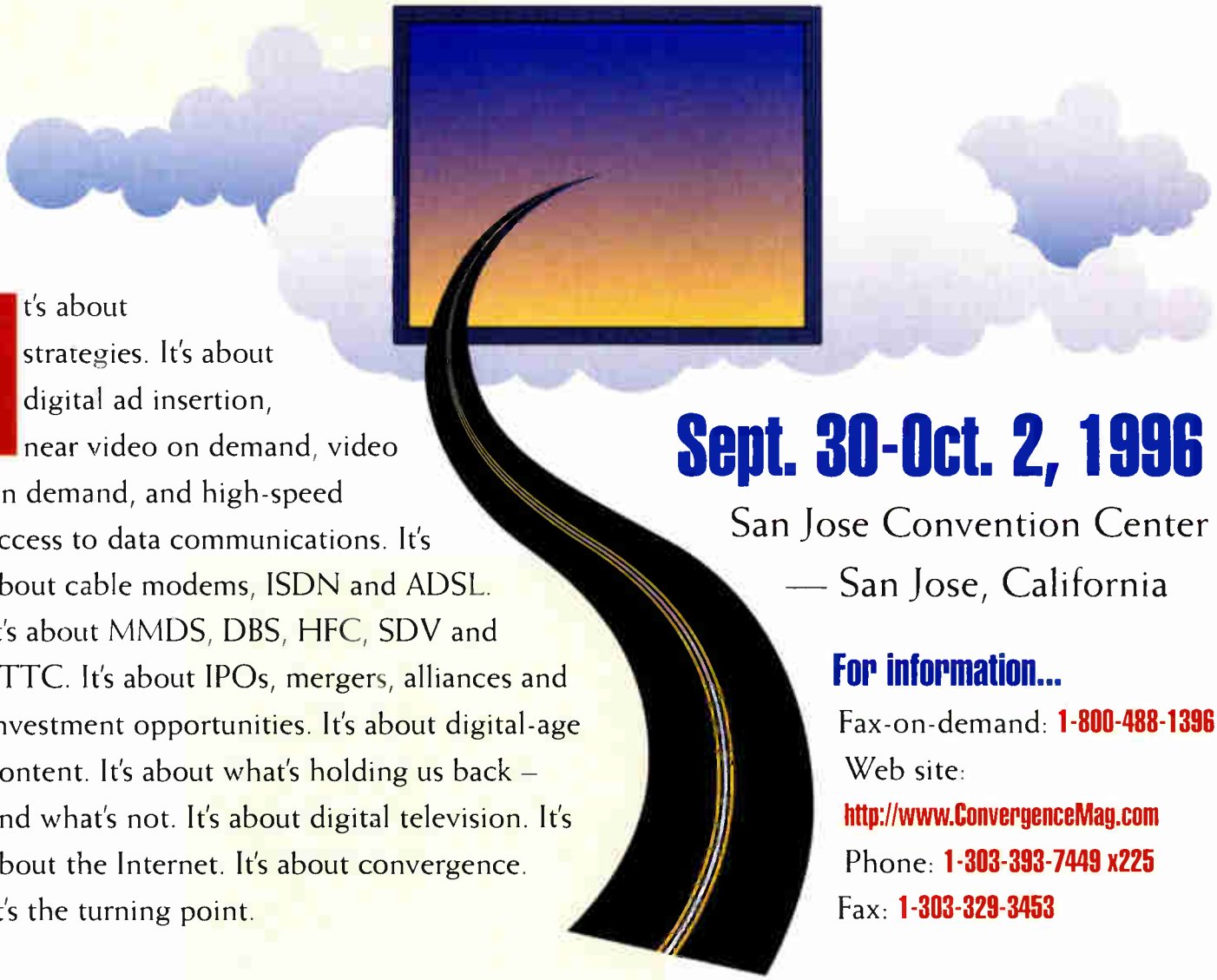

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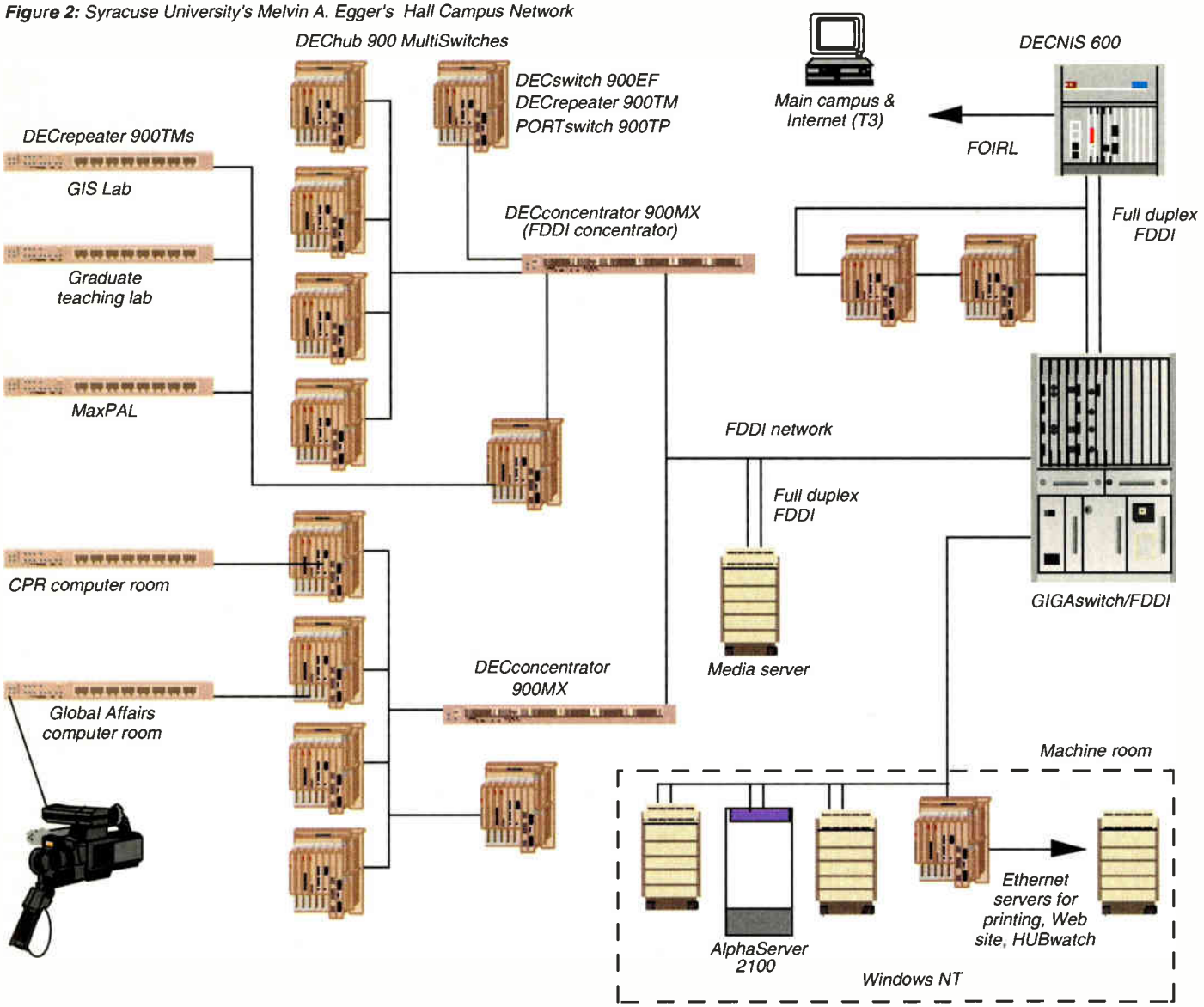
Figure 2: Syracuse University's Melvin A. Egger's Hall Campus Network



and other incompatibility issues are carefully planned for to protect their current or future investments in cable modems prior to the agreement on final standards.

Many MSOs are currently planning, designing and implementing high-speed data networks for telephony, on-line services and Internet access.

This process, which began a few years ago, has had some notable and successful implementations, including:

✔ Schools in Hawaii have been working closely with Oceanic Cable, a Time Warner subsidiary, that is providing inter-school data communications as it upgrades the network. This program will eventually connect 360 schools located on six islands. The broadband data network interconnects schools and libraries to facilitate distance learning, videoconferencing and Internet access.

✔ Michigan State University (MSU) in East Lansing, Mich. needed to network 67 medical group practices located within a 15-mile radius of MSU. The university's bandwidth-hungry applications featured graphical interfaces, medical imaging and patient record keeping.

To support these applications, MSU approached TCI Cablevision of Mid-Michigan, which had a rebuilt fiber optic cable system. Trials, which began two years ago, involved a system integrator and product supplier.

This network is growing and accommodating other high-speed data networking needs throughout the MSU community, including school connectivity and Internet access.

✔ Last summer, MCI Telecommunications and Colorado Springs Cablevision conducted a telecommuting trial connecting a number of employees in a 62-mile area. The remote LAN access program connected 26 MCI employees working at home to their company's sophisticated computing environment with high-speed access over cable TV lines. It provided data speeds equal to what the employees had become accustomed to in their offices.

MSOs considering joining the data wave should review some key issues, including:

✔ Does a good business case exist for the

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new venture?
✔ Is there adequate financing?
✔ When will the plant be upgraded?
✔ Is there a plan to become an Internet service provider (ISP)?
✔ What knowledgeable technical resources exist or are available through partnerships and alliances?
✔ What is the rollout plan?

School district connectivity

A large number of cable operators are working on school district connectivity programs. Some are leveraging this investment to offer broadband networking services in health care, commercial and government sectors, to name but a few.

Funding of these independent school district (ISDs) data networking programs is mainly obtained through federal or state grants or through educational bonds. These bonds are primarily funded at a town or city level and paid for through local taxes. They are targeted at providing enhanced technology capabilities and Internet access for the schools.

Many towns and cities manage this process through technology forums. Still others enlist the services of independent technology consultants or system integrators who guide them through the technology choices, service options, investment decisions, rollout plans, implementation and ongoing customer support.

Payment for bandwidth

An issue of critical importance to the ISDs is how they pay the service provider for acquiring the required bandwidth for these networks. In some instances, funds from the bond or grant partially pay for the placement of fiber to the schools, providing, in essence, a private network for the school district. In other cases, multi-year "bandwidth leases" are signed with the service provider.

By entering into a multi-year lease agreement upfront with grant money or bond money, the school guarantees a certain usage at a known rate with reduced ongoing operational costs.

The down side for the ISD could be, if the funding proves inadequate, that the school may not have the money to fully implement all the applications that could be supported over the network. In the case of the MSO, not only does it provide a new and immediate revenue stream, but the relationship may also enhance the potential of offering data networking service to other customers. (See Figure 1.)

Throughout rural America, there are numerous examples of community-based networks. They are growing like a prairie fire. Some towns in Arkansas and Kansas have fully operational 10 megabit per second (Mbps) cable-based data networks connecting colleges, schools, libraries, hospitals, clinics, small businesses, town buildings and providing a source for Internet access.

These networks started off as LAN-to-LAN configurations; however, with the emergence of home cable modems, multiple system operators are well-poised to start residential deployment.

Community-based networking programs have already started to show some major benefits in the sharing of resources: MSOs have found that adjacent franchises can be networked together, thereby saving headend operational costs; MSOs are becoming ISPs; and small towns are networked, sharing assets such as libraries and medical centers.

The headends must accommodate connectivity via ISDN, frame relay, Analog V.34 and others

Cable operators as service providers are faced with the challenge of designing and providing data networking services over their cable plants, most of which have varying capabilities.

Many of these cable plants are now in the process of being upgraded. Among the tasks that cable operators face is their ability to create cable headends which act as a point of presence for multiple communication connections to the Internet and other on-line services.

These cable headends, if they are to be effective in providing community-based services, must be able to provide connectivity to on-line information services such as America Online, CompuServe, the Microsoft Network and Prodigy. The headends must accommodate connectivity via ISDN, frame relay, Analog V.34, 10 Mbps and others. MSOs must ensure maximum network performance is achieved, interoperability issues are addressed, and above all, provide a secure, firewall-protected environment for their subscribers.

The number of technology offerings is immense. The MSOs, like the independent school districts, will need help in understanding these high-speed data networking technologies as they emerge. Knowledge and experience of how to apply these technologies will be necessary in order to develop and provide appropriate solutions for their needs. MSOs are already developing, partnering with, or are in the process of obtaining the services of experienced system integrators.

Having access to, or partnerships with these key integration resources will no doubt be critical.

An example of this can be seen in the pilot which is being conducted by Singapore Cablevision in conjunction with several high-tech organizations. The cable network could be scaled up to interconnect as many as 240,000 homes over the next five years. In Singapore, every home is wired for cable, regardless of whether the resident is a customer or not.

Forerunner of the Internet

The National Science Foundation Net (NSFNET) was founded years ago through the collaborative efforts of a number of organizations. NSFNET, the forerunner of today's Internet, has set an example of cooperation which continues today. Many colleges and universities are developing and fostering consortia relationships with industrial partners, national laboratories and other institutions in an evolving and ever-changing educational arena.

The primary objectives are to create a better educated workforce for the future through the creation and delivery of multimedia educational and training curricula. Some of these consortia are being sponsored and funded directly by NSF or through state Information Infrastructure, NSF and other state and national initiatives.

An example of this is at the University of Texas in its Automation and Robotics Research Institute (http:\\arriwww.uta.edu\arri\arrihp.html) that links together higher education, R&D and defense related technology providers and suppliers.

The latter organization is engaged in the transfer of R&D to the commercial sector. It is creating and developing new business practices for aerospace manufacturers, suppliers and small manufacturing enterprises.

It is also entering into joint development programs with high-tech prime contractors and government agencies and leading the way for the public sector to promote economic growth.

All of these activities will require sophisticated communications solutions. High-speed, cable-based data networking may well be one of these.

Electronic Commerce Net

Another example of MSO, educational and industrial collaboration is the Electronic Commerce Net (ECnet). This Metropolitan Area Network (MAN) initiative was conducted in Phoenix a couple of years ago by Times-Mirror (now owned by Cox Communications). The pilot program connected government prime contractors to their suppliers at speeds of up to 10 Mbps. The network facilitated collaborative real-time engineering, white boarding, videoconferencing across multiple sites and a secure data environment.

Colleges, by and large, have a wealth of computer expertise, and many of them are creating high-speed campus and inter-campus networks. Some of these collegiate networks are ATM-based solutions that support the delivery of voice, video and data for distance learning programs. Distance learning is now being viewed as mandatory as the student population is becoming "virtual."

The school can view certain cable programs and digitize portions of the content for use in presentations

New collegiate networks provide connectivity to the MSO's HFC or fiber-based cable plants for off-campus and Internet connectivity. Products with multi-switching capabilities can provide a flexible, multi-gigabit platform for building these switched virtual networks.

Taking advantage of ATM

These products can create the basis for technology independent backplane design. They allow network managers to create, monitor and reconfigure networks using popular technologies such as standard Ethernet, Token Ring, and FDDI, and provide high-speed data networking performance at 100 Mb Ethernet and ATM speeds.

Digital Services has planned, designed, and implemented numerous major networking projects including many at educational institutions. At Saint Anselm College in Manchester, New Hampshire, a fiber optic campus network connects buildings spread over 44 acres. The new high-speed data network will embrace voice, video, data, satellite links and Internet connectivity over the same cable infrastructure to serve a population of 2,000 students and faculty.

Memorial University in St. John's, in Newfoundland, Canada, has built a high-speed enterprise network designed to alleviate poor network performance and to provide extra capacity for a future generation of data-intensive applications and multimedia educational tools.

The network features 9,000 connections in 27 buildings throughout the university, each linked to the campus wide backbone using ATM switching technologies. The network uses a variety of technologies including Dedicated Ethernet, Fast Ethernet, Switched Ethernet and FDDI.

The Memorial University network takes advantage of ATM in a Wide Area Network where long distance connectivity is a requirement. This ATM-based network may eventually connect as many as 11,000 users.

Syracuse University

The Maxwell School at Syracuse University in central New York has a sophisticated multimedia network with fiber optic, Ethernet and cable TV connections. Voice, data, videoconferencing and Internet access are available for students and faculty. Under arrangements with Adelphia Cable Communications, the school can view certain cable TV programs and digitize portions of the content for inclusion in PC-based presentations. Students and faculty are applying technology to share ideas and information on campus.

The author's company designed and installed the network under a technology partnership with the Maxwell School, which this year was named by *U.S. News and World Report* as America's best graduate School of Public Administration (see Figure 2).

Cooperation will be required by service providers, vendors and customers as new technologies and applications emerge. Collaboration is the key to future successful full-scale deployments as the high-speed data market expands.

About the author

David Freeman is a senior consultant with Digital Equipment Corp. and is based in Dallas, Texas. He has been with Digital for 23 years, and formerly managed a consulting organization for the company. CED

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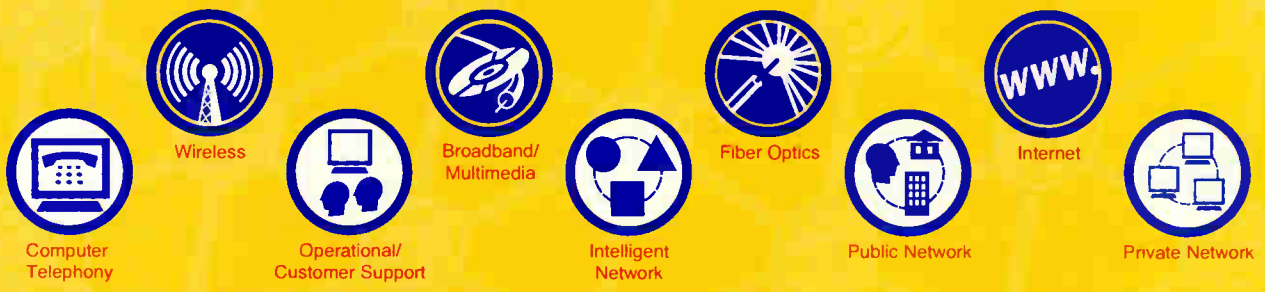

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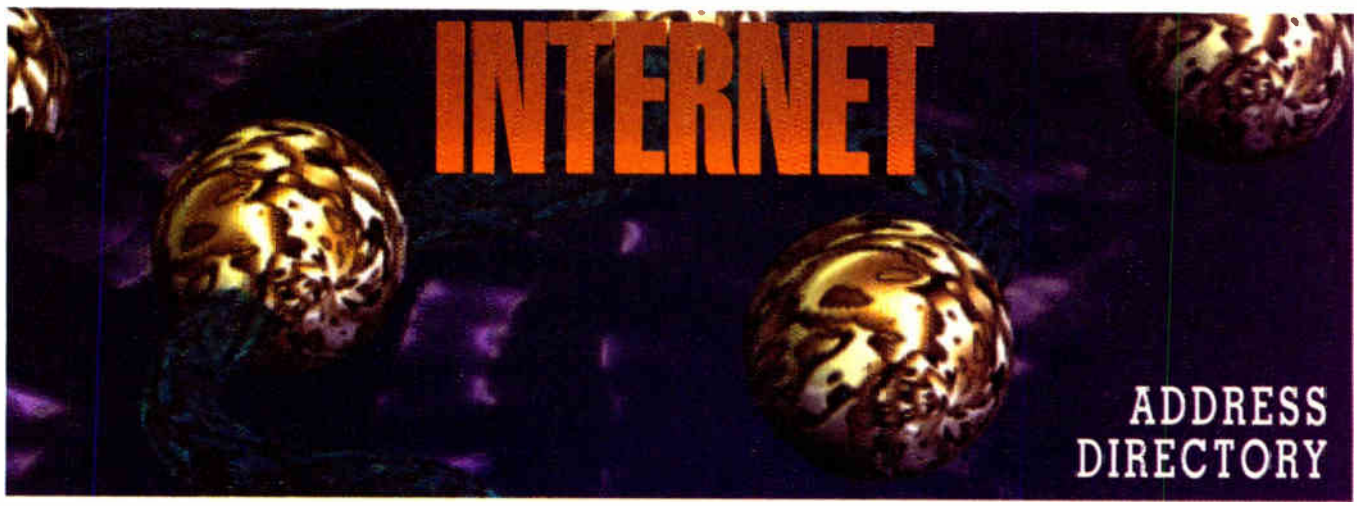

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Cable modems: The tortoise versus the hare

Low-speed modems are generating revenue today

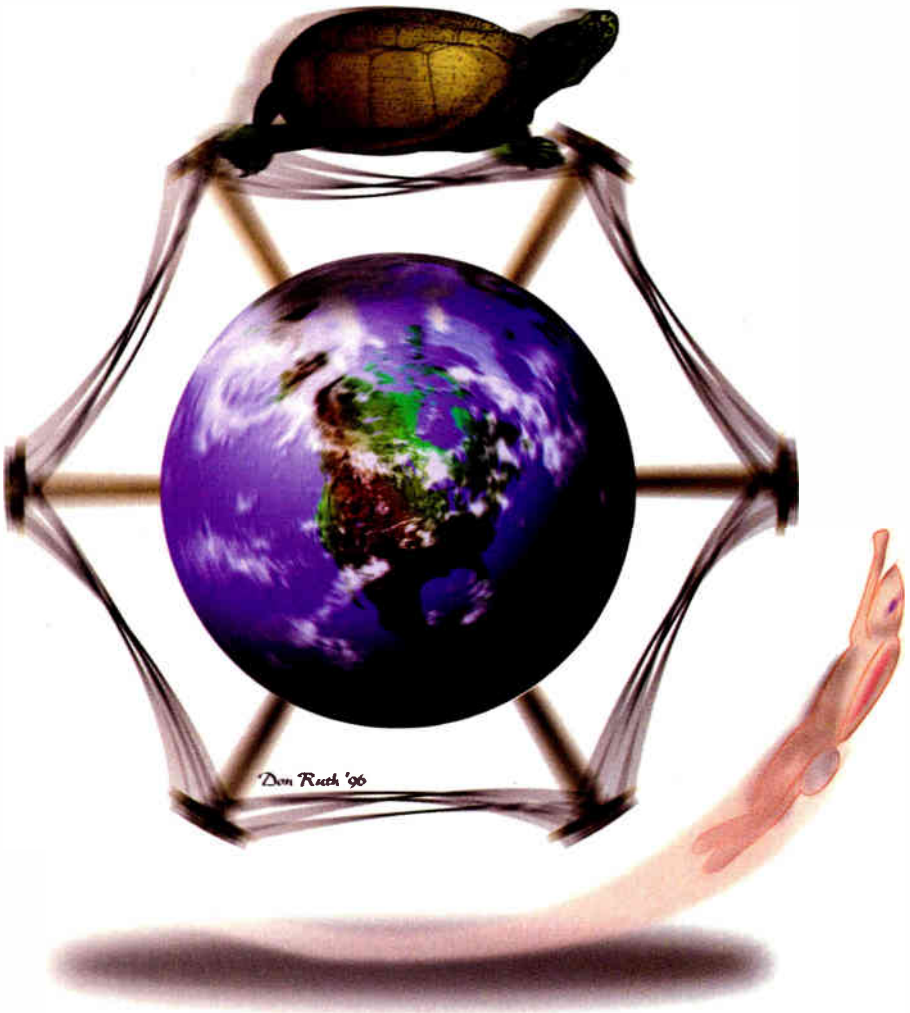
By Michael Wright, President, MediaLink International; and William F. Karnes, President and CEO, ISC Datacom Inc.

Mention cable modems today in any gathering of cable television folks, and operators start to dream of huge profits from new digital applications. The ability to send data on cable at rates of 10, 20, 30 or even 40 megabits per second will create an exciting new day for the cable industry and its customers.

Applications made possible by high-speed cable modems will create new incremental revenue for the cable industry by adding to its service scope and enhanced information venues. New services like Internet access can be offered, and other services still in the idea stages will be made possible. Some systems are providing Internet access to their subscribers already, and growth of this new market should follow an exponential curve in the coming months. The cable industry is moving rapidly toward standards for these new services, and is testing new hardware and software needed to make these services a reality.

While all of this development, testing, experimentation and marketing is happening, some operators may be overlooking significant revenue streams and operational facilities available today through the application of RF cable modems.

This article explores the real possibilities available today, using RF modems at data rates of 64 kbps and lower. These data speeds require very narrow bandwidth dedication, as compared to the high-speed devices mentioned above. A single 6-MHz television channel can provide as many as 120 (in some cases 240) data channels at a 19.2 kbps data rate. This ability allows cable systems to manage a significant amount of data today, with a comparatively small investment in hardware and dedicated spectrum resources. Here are just a few examples of applications using low-speed RF-data modems on cable as solutions for digital communications needs.



Cable plant management

Delivery of multi-channel video, data and telephone services has become a highly competitive environment. System executives realize the need for excellence in customer service as an absolute "must-have" option to enhance their market position. Simultaneously, operating costs, including vehicle operations and personnel costs, keep escalating.

These two factors combine to make the use of automation in system architecture not just desirable, but mandatory. Cable equipment vendors recognize this need and have developed systems for status monitoring, vehicle management, trouble-call dispatch and other management elements. Work is continuing to enhance these systems to make them more effective in helping system managers meet their needs for efficient operations.

Leaders of the cable industry are defining the standards for network management protocols. It is anticipated that standards will be defined over the next several months and that these standards will include the use of RF modems handling data at a maximum rate of 64 kbps requiring 50 to 100 kHz of allocated bandwidth. The complete network management system requires modules to interface with various cable industry equipment vendor hardware, RF modems to communicate upstream and downstream with the modules installed at each hub (or other remote site), and network management software and hardware. Such sys-

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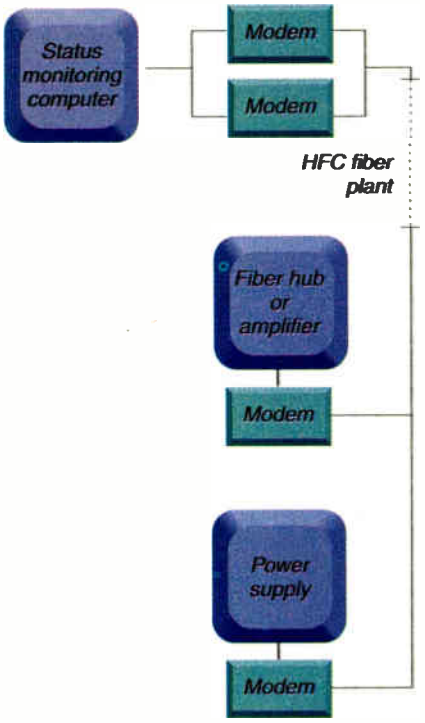
Figure 1: Cable plant monitoring status



tems are available from equipment vendors as well as third-party system designers. The complete system will include a rack of modems controlled by a network management computer located at the system headend or telephone company central office–as dictated by system design and management desire.

One of the major elements of cable plant management is the continuous monitoring of the operating parameters of system equipment. This capability or facility is generally referred to as status monitoring. Cable plant status monitoring systems typically monitor power levels, cabinet closures, signal levels and other important electronic and mechanical functions in anticipation of potential failure, thus allowing technicians to pinpoint problems (and take proper corrective action) within the system and attend to the problem in rapid fashion. Each manufacturer of status monitoring systems has determined the parameters that are considered important to their particular operating philosophy. Many of the measurements are common to all monitoring systems, while other concerns may apply to only one or two approaches. Considerable effort is currently being expended toward developing a set of measurement standards that can be included in all such monitoring systems and eliminate any potential confusion.

Monitoring is accomplished by installing the required measurement devices at their proper points. These measurements are usually analog, and are translated into digital form and transported from the measurement point to the operations center. Transport is accomplished through the RF modem upstream over a return cable. Frequencies for transport are chosen according to the system design, and may be in the sub-, mid- or high-frequency range.

At the operations center, which may be the cable system headend or the system office, another modem receives the upstream signals and transfers them to a computer programmed to accept the data and take certain actions. These actions may include simply printing out the received status information, sounding alarms under prescribed circumstances, or even automatically dispatching service personnel to a location where trouble is detected.

Status monitoring systems can be used as early-warning predictors of system failure under some conditions. While this facility cannot determine when a component may fail, it may well decide when signal deterioration is occurring. If, for example, the status monitoring equipment detects low input signals to an amplifier location, it may be programmed to check output signals from the preceding station. If the system finds those output signals low, it may then check input levels to the station and find them normal. In this case, the status monitoring system could notify a service technician of an impending failure. Such a system probably does not exist today, but could be accomplished using available technology.

Network management

Network management, as differentiated from cable plant management, encompasses many elements of cable system operations not included in plant operations themselves. Such elements as billing, pay-TV authorization, customer records, FCC reports, franchise tax calculations and others could be combined into an overall network management system.

An element of network management is failure prediction. As described above, if the monitoring system observes a steady decline in the input signal levels to a given amplifier location and a corresponding decline in the output levels of the preceding amplifiers, it may be reasonably assumed that the amplifier is losing gain and should be checked and/or replaced. This kind of measurement capability allows equipment maintenance before total failure and can thus reduce the number of subscriber calls for service.

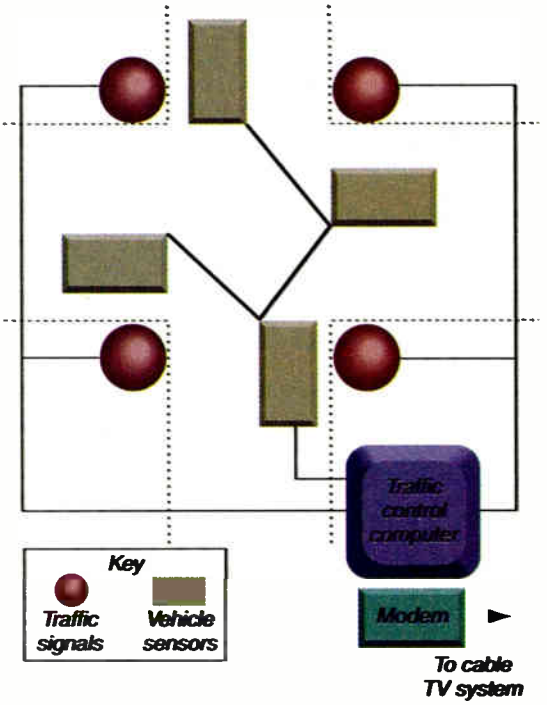
The network management system can further be designed to interpret certain measurement conditions and automatically determine the proper corrective action. In the above example, the corrective action appears to be replacement of an amplifier. The system could print a service request and automatically dispatch a technician to the appropriate location.

In similar fashion, deterioration of power supply voltages, excessive enclosure temperatures, improper enclosure openings, and other such operational aberrations may be interpreted by the management system, and automatic responses accomplished with limited human intervention.

An example of network management is a status monitoring system that features a headend modem and a remote RF modem which enable two-way data transmission and thus allow the relay of vital measurement parameters required in the operation of their systems. These modems operate at a comparatively low data rate of 19.2 kbps and thus facilitate the relay of data. Several thousand of these modems are in service installed in various locations (see Figure 1).

Another developing application for low-speed cable modems is in the transfer of data from traffic intersection control equipment to the master system computer, and the reply data back to the control equipment. A number of cities, including New York; Richmond, Va.; Dallas and Plano, Texas; Portland, Ore. and

Figure 2: Typical traffic intersection control arrangement



others are using cable TV facilities as the transfer medium for this kind of data.

Other cities are evaluating this method and will probably move their data from existing radio and telephone facilities to cable because of cable's greater bandwidth capabilities and comparative low operational cost. Cable's ability to serve large numbers of data points with limited bandwidth requirements makes the use of cable for this application extremely cost-effective. Use of telephone lines to accomplish the same objective could require large numbers of discrete copper pairs. Likewise, the use of radio links for this application would require many discrete frequencies (see Figure 2).

Off-site telephone integration

While the cable industry is rapidly beginning to provide telephone service for commercial and private application, a somewhat lesser-known opportunity exists. This opportunity involves the interconnection of small corporate and government multi-site telephone facilities utilizing digital techniques and data transmission via cable TV. Such a system is being tested in a county in Virginia. This system accepts the analog voice information from each telephone instrument in a particular location, digitizes and compresses the signal and connects it to an RF modem operating at 56 kbps.

Each modem can accommodate nine telephone circuits and transmits those signals through the cable system within a 100 kHz channel. The system provides four-digit dialing from each of eight county offices to any other office and produces voice quality equivalent to or exceeding standard telephone lines. The dollar savings using cable instead of leased or dial-up toll facilities in this instance are projected to return the entire investment within 36 months.

Other possibilities for use of cable facilities to deliver data could be school interconnections, business-to-business data transmission and even such unusual applications as in the case of one of the country's more picturesque gambling locations. In this application, the modems are used to transmit progressive slot machine information to a central location for monitoring of payoff data.

As can be seen by the above examples, the applications for data on cable, using tried and proven solutions available today, are limited only by the imagination of cable operators. The equipment is available today–there is no need to wait for hardware or software to be developed, tested and then finally delivered. As cable systems individually and collectively seek sources of incremental income, low-speed data should be considered and implemented where practical. CED

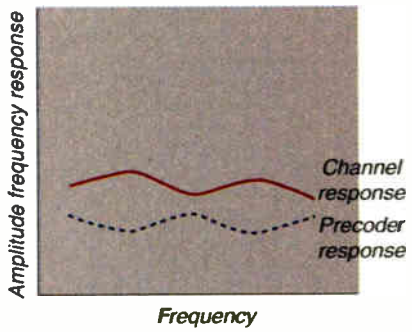
Synchronous-CDMA: The solution for high-speed data

Countering noise in the upstream path

By Shlomo Rakib, President and Chief Technology Officer, Terayon Corporation

Synchronous Code Division Multiple Access (S-CDMA) solves the major problems of noise and capacity in the upstream path of two-way, HFC systems. S-CDMA provides robust transmission and a full 10 Mbps (megabits per second) per 6 MHz channel

Figure 1: Equalization

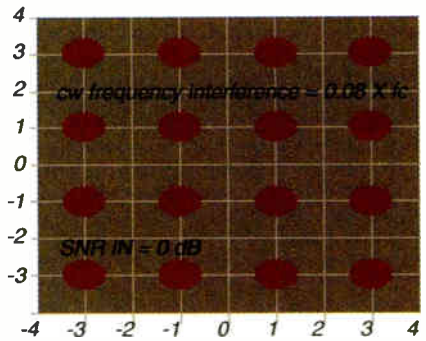


upstream and downstream over HFC. Unlike conventional CDMA, S-CDMA uses 6 MHz bands, and the signals do not interfere with, nor do they affect other adjacent channels. S-CDMA has a number of other advantages over such technologies as FDMA and TDMA in terms of capacity, scalability and bandwidth allocation.

The ability of cable companies to provide two-way, high-speed data services over hybrid fiber/coax networks (HFC) can be hindered substantially by the problems encountered with sending data in the upstream direction (5 MHz to 40 MHz). The two most serious problems with this reverse path are the obvious capacity constraints in this limited portion of the spectrum, and the presence of a large amount of noise and interference. Ingress from home electronic devices (hair dryers, TV sets, etc.) as well as impulse noise and narrowband interference, seriously impair the ability to deliver reliable transmission of data in this upstream direction. Impairments that degrade transmission quality in the upstream also represent problems for the downstream, which is dependent on the upstream for messaging, and which will be throttled if upstream performance degrades dramatically.

Synchronous-CDMA allows for 10 Mbps throughput over each 6 MHz channel. By using spread spectrum techniques, S-CDMA makes the upstream transmission very immune to noise (narrowband interference and impulse noise), as well as laser clipping (see Figure 4). This technology can also coexist with other technologies on the same HFC network, because the 6 MHz S-CDMA channels will not interfere with adjacent channels using other modulation schemes such as quadrature phase shift keying (QPSK). Other benefits which are inherent in S-CDMA

Figure 2: Signal constellation with narrowband interference



include dynamic bandwidth allocation, privacy and scalability.

S-CDMA technology

Standard, IS-95 code division multiple access is a form of spread spectrum which works by coding and spreading the information to be sent over a wide band. While the idea of using conventional (asynchronous) CDMA for high-speed data has been proposed in the past, this technique has limitations which are solved using a synchronous implementation. The most profound problem with asynchronous CDMA is so-called self-generated noise: the users of an asynchronous system are not aligned with each other, thus losing orthogonality and creating a high degree of mutual interference. This in turn raises the noise floor and reduces capacity.

Synchronous CDMA minimizes mutual interference by ensuring that the remote unit (cable modem) codes are orthogonal and synchronized with each other as they send information upstream. Also, channel interference issues associated with wideband, asynchronous CDMA (which sometimes uses a 30 MHz band) are solved by using 6 MHz S-CDMA channels, so that other channels separated by guardbands will not be affected by the S-CDMA data.

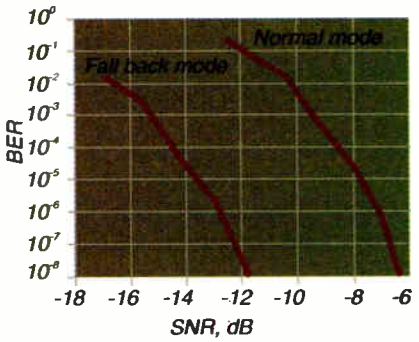
In one such system, total capacity of each 10 Mbps per channel payload is sent in multiple streams of data, each comprised of 64 kbps. Each data stream is Trellis coded, interleaved and spread over 6 MHz using its own individual spreading code.

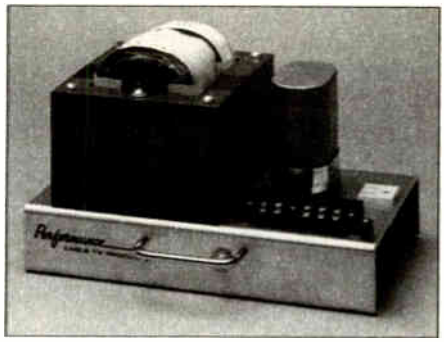
By enhancing the signal spreading with forward error correction and interleaving, the data streams are made very immune to such impairments as impulse noise, narrowband interference and wideband Gaussian noise. Trellis coding adds a 4.8 dB coding gain, interleaving enables handling long duration impulse noise (up to 100 microseconds without incurring errors) and spreading provides another 22 dB processing gain. These techniques achieve an interference rejection of a total of 27 dB, allowing the system to operate in negative CNIR (carrier-to-noise plus interference ratio) (see Figures 2 and 3.) The author's company combines S-CDMA with time division to make the system scalable.

Capacity

The high capacity provided by S-CDMA technology is a result of maintaining orthogonality of the spreading codes, and this is achieved by two processes: ranging and equalization. Ranging guarantees time align-

Figure 3: BER performance with AWGN (Added White Gaussian Noise)





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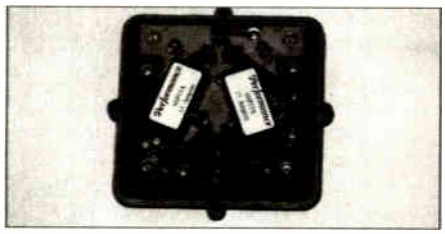

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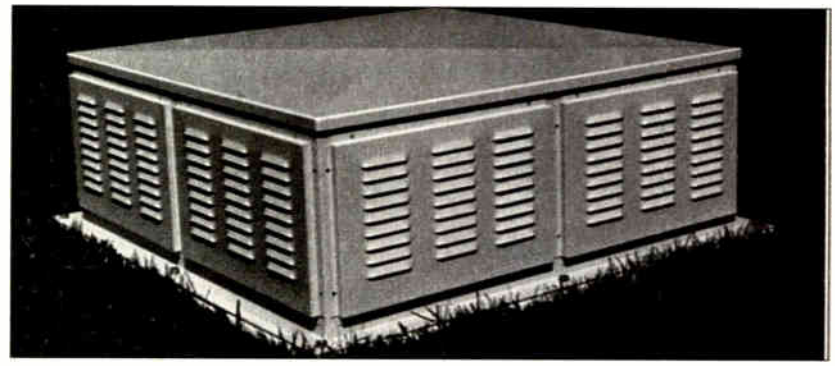

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ment. In other words, all codes must arrive at the headend at the same time. Ranging is based on continuous distance measurement between the client side and the headend in order to account for cable expansion/contraction resulting from temperature changes. This process is transparent to the traffic carried over each 6 MHz channel.

Equalization is achieved by measuring the channel response from each user to the headend and adjusting a precoder at the transmitter to invert the channel. In Figure 1, a channel response is corrected with the precoder response by inverting the channel. By maintaining orthogonality, S-CDMA minimizes mutual interference between users and provides greatly increased capacity over asynchronous CDMA (see Figure 1).

Multiple applications

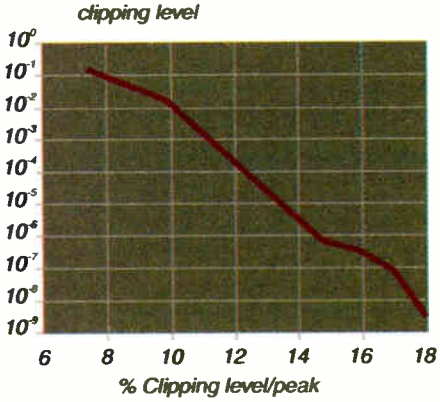
CDMA allows for constant bit rate (CBR), variable bit rate (VBR) and available bit rate (ABR) bandwidth allocation to support services of various traffic types. Bandwidth allocation supports different applications with various amounts of guaranteed throughput, and this feature is achieved by allocating different data streams for different types of services.

Individual 64 kbps data streams may be allotted to telephony, while multiples of these may be allocated to applications like video conferencing and high-speed Internet access, all of which may be provided over the same coaxial cable.

Bandwidth allocation is centrally managed at the headend, and bandwidth can be guaranteed on request. Using S-CDMA, while bandwidth can be guaranteed to certain users, others with more bursty traffic may contend for the remainder of the 10 Mbps payload. Having one integrated system with these features obviously provides advantages for cable TV companies wishing to segregate users and vary their price structures accordingly.

Time division multiple access (TDMA) and frequency division multiple access (FDMA) are two other schemes proposed for high-speed data over cable, and both have some limitations. With TDMA, different users are assigned to different time slots. Therefore,

Figure 4: BER (before FEC) as a function of clipping level



TDMA requires fast acquisition, which makes the data sensitive to narrowband interference.

Below a certain threshold of signal-to-noise ratio (SNR), a TDMA system may totally fail to perform. Another problem with TDMA is contention in a certain channel, and contention affecting adjacent channels, as the accumulation of power from different contenders causes an overloading of amplifiers. This can cause severe throughput and performance problems in a two-way data network.

With FDMA, different users are given different frequency slices to use for upstream transmission. As each user occupies a specific narrow channel, the data is vulnerable to noise, because narrowband interference can enter the channel occupied by a user. To address this, FDMA systems usually try to avoid noise by frequency reallocation techniques whereby the data in a noisy channel is moved to another section of the spectrum. Because of the dynamic nature of interference, avoiding noise by constantly moving channels necessitates more intelligence and a more expensive system in general.

Throughput is also affected by the dynamic reallocation of data because nothing is sent while the system is moving to another channel. FDMA transmission is also sensitive to nonlinearities and frequency misalignment, and the performance is not optimal due to guardbands required between the channels.

S-CDMA provides a solution to ingress interference and impulse noise in the upstream path, the most serious problem of two-way, high-speed data over HFC networks. Rather than trading off throughput for noise immunity, the spreading and coding functions of S-CDMA provide 10 Mbps upstream with high robustness. The benefit of bandwidth allocation gives cable operators the ability to provide guaranteed data rates, enabling ABR, CBR and VBR traffic.

S-CDMA systems are not contention-based systems; thus, they are very scalable. As more users join an S-CDMA system, they do not compete for limited bandwidth at peak times, thus avoiding collisions and sluggish network performance. Also, an S-CDMA 6 MHz channel does not interfere with adjacent channels (that may use other techniques such as QPSK). CED

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Some Items in Limited Supply

Telcos, DBS take the blocks, prepare to race

Carriers are gearing up for competition

By CED *staff*

If industry trade shows are a reflection of what's happening with the service providers, it's clear that the competitive spirit is beginning to take over the telecommunications industry, judging from the size and tone of June's Supercomm show in Dallas.

While the show floor wasn't dominated with TVs and vendors shouting "video" at every turn like it was two years ago, equipment vendors nevertheless were hawking gear that would allow traditional telephone companies to more readily compete with established cable operators, DBS providers and others who are deemed competitive threats.

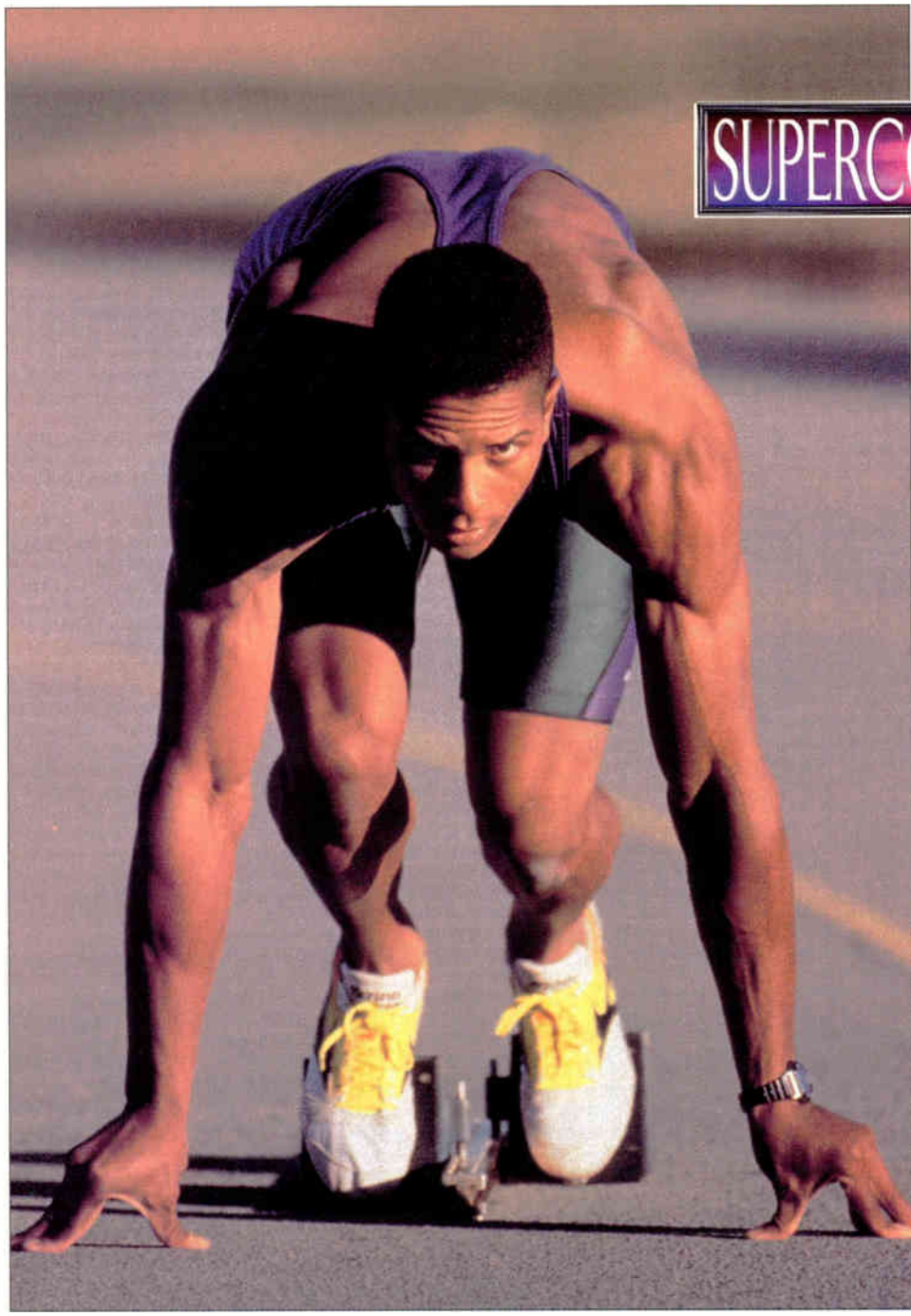


PHOTO BY DAVID STOECKLEIN, THE STOCK MARKET

But perhaps the biggest difference from past shows wasn't in identifying who the competition is, but in the applications that need to be immediately supported. At seemingly every turn through the convention center, ADSL reared its head as a way to offer fast Internet service. In fact, the emphasis on most everything was speed–an important concept for telcos to beat back the threat posed by high-speed cable data modems while taking advantage of the huge installed base of copper plant the telcos have deployed. (For more detailed information about ADSL and its advances, see "Telecom Perspective" on page 94.)

ADSL

AT&T Paradyne chose Supercomm as the venue to release an enhanced version of its GlobeSpan ADSL modem technology that can now achieve transmission speeds over 7 megabits per second (Mbps).

Earlier versions of ADSL transceivers have been able to transmit data and video to the user (downstream) at 2 Mbps, and 64 kilobits per second (Kbps) from the user to the network (upstream). This new chipset increases downstream rates to over 7 Mbps, and upstream rates to 640 Kbps.

Telco providers are viewing ADSL as one way to offer multiple channels of high quality video for broadcast and video-on-demand television, and data services over standard phone lines, while getting a competitive jump on cable TV companies.

ADSL-based products will support interactive TV services, such as video-on-demand and distance learning, real-time broadcast of news, sports and weather, video teleconferencing, standard ISDN Basic Rate Interface services, Internet access, and remote connections to corporate networks and Intranets.

With ADSL in place, a single phone line could simultaneously support a standard telephone call, a movie, a video teleconference call and high-speed access to the Internet.

The transceiver technology is available today, and licensees can begin incorporating it into products. Pricing will be established by equipment manufacturers and service providers as they begin offering new high bandwidth services.

Meanwhile, Motorola's MOS Digital-Analog Integrated Circuit Division (MDAD) debuted its "CopperGold" Discrete Multi-tone (DMT)-based ADSL transceiver that features an adaptive rate mode to ensure the highest data throughput possible.

During initialization, the CopperGold transceiver can be configured through the host processor interface as an adaptive rate modem that can adjust the data rate to within 32 kbps of the maximum throughput the line is capable of supporting. Upon line start-up of the rate adaptive DSL (RADSL) mode, CopperGold determines the line condition and transport capacity of each specific line, and then operates at the best data rate possible for each line. Alternatively, the telco can predetermine the rate. Data rates are from 64 kbps to 1.0 Mbps bidirectional, 32 kbps to 8 Mbps downstream.

The transceiver operates with low power consumption, using approximately one-third of the power of today's system, and will be available in early 1997.

Westell offered up a new ADSL PC card modem, called FlexCap, along with sophisticated software that offers transmission speeds of 1.5 Mbps. The PC card is "plug and play" in that it complies with the Intel/Microsoft standard. Westell intends to roll the product out on a controlled basis this summer and make it generally available later this year.

Simultaneously, Westell announced that UUNet of Canada will be using the card modem to offer Internet access at speeds 100 times faster than a 14.4 baud telephone modem. The trial will include 400 corporate customers.

UUNet is an Internet service provider to the Microsoft Network, which will use Microsoft software that is being developed to allow the modems to interoperate with Windows NT.

Alcatel Telecom combined ATM technology with DMT to create the Alcatel 1000ADSL (Release 2.0), which also offers both speed and power rate adaptations. With DMT, the product allows a user's modem to adjust its speed according to line conditions and reduces power when it encounters interference to avoid degrading existing services.

Following a similar theme, StrataCom, Cisco Systems and PairGain Technologies collaborated to demonstrate DSL technology combined with Internet routing and ATM switching to provide high-speed Internet access. The demo showed voice, video and data being sent at rates ranging from 384 kbps to 6 Mbps.

PairGain's Megabit Modems that feature high bit-rate digital subscriber line (HDSL) technology operating at 768 kbps symmetrically were tied to Cisco routers feeding into StrataCom ATM switches.

Not to be outdone, Orckit Communications showed its "FastInternet" Broadband Access System that supports all types of DSL transmissions, including ADSL, SDSL and VDSL from 384 kbps to 8 Mbps. The system features a fully-integrated POTS splitter to allow users to talk on the phone at the same time they are connected to the Internet.

The system also supports both asymmetric and symmetric transmission at different data

rates. For example, symmetrical transmission can be done at 384-, 640-, 780-kbps, or at either 1- or 2-Mbps. Asymmetric transmissions at 4 Mbps or 8 Mbps downstream with a 640 kbps return channel are also supported.

Nuko Information Systems integrated ADSL technology into the "fully integrated video services network" it demonstrated during the show. This network utilized digital MMDS, HFC, fiber-to-the-curb, DBS and Internet via ADSL.

Specifically, the demo showed film that was encoded using Nuko's 4:2:2 encoder and sent via telephone lines to a PacBell central office. From there, it was sent over a Vyvx line to a SBC Communications central office in Dallas, where it was transmitted to the Dallas convention center via a digital MMDS link and ADSL links provided by both Westell and Nortel.

Amati Communications Corp. announced a new version of its Overture 8 ADSL/DMT modem, specifically designed to meet system needs for Internet access.

Key to the new design, says the company, is the Amati Core ADSL/DMT technology that enables Internet access at data rates as high as 8 Mbps downstream, and 640 Kbps upstream, roughly 60 times faster than basic rate ISDN, and up to 250 times faster than existing dial-up modems.

The company also announced an ADSL/DMT Modem Module Set, a board-level modem design product for ADSL services that use Discrete Multi-Tone (DMT) technology.

HFC demos

Meanwhile, there were also a handful of demonstrations of video and data being sent over HFC networks, as well. Siemens Stromberg Carlson teamed with Zenith Electronics Corp. to provide voice, video and data over such a network. Compatibility between the "CoAxiom" telephony-over-cable system Siemens has developed with Scientific-Atlanta and Zenith's high-speed cable modems was shown, making the argument that telephony and data over HFC networks can be approached modularly.

Additionally, Siemens worked with Pyramid Technology to offer "Video on Time," a near-video-on-demand system. Pyramid contributed its headend video server, while command and control software from PowerShift Systems and digital to analog conversion was performed by equipment from Vela Research.

As a way to get more bang for the fiber buck, Pirelli offered up a dense wave division multiplexing system that promises to greatly increase the amount of traffic a single fiber strand can carry. The company's new 32-channel D-WDM product is compatible with both OC-48 and OC-192 transport systems, and with optical amplifiers, transport nodes can now be spaced 1,200 kilometers apart–about twice the distance of previous systems.

The new product complements the company's already existing four- and eight-channel systems. The 32-channel version will be available in 1997. One company that can't wait to evaluate it is Sprint, the long distance carrier. "We look forward to our continued relationship with Pirelli as we evaluate their 32-channel system," said Marty Kaplan, senior VP and chief technology officer at Sprint.

Alcatel Telecom combined ATM technology with DMT to create the Alcatel 1000ADSL (Release 2.0).

The system works by carving the signals into very narrow linewidths. For example, the 32 channels are loaded on the fiber between 1530 and 1560 nanometers.

Fiber to the you-name-it

Deploy fiber, whenever possible, wherever possible, seemed to be the message many were conveying at Supercomm.

Among those companies promoting fiber solutions, Optical Solutions Inc. introduced its broadband fiber-to-the-home network, known as the SL² platform, which delivers voice, data and image services by interfacing optical fiber with subscribers' existing home wiring. The optical-to-electrical interface takes place in the company's Universal Demarcation Point (patent pending) (UDP), which mounts on the subscriber's home.

"We developed the SL² Platform because rural America needs to be able to participate in the information age just as much as urban America does," said Jeffrey Carlson, president and co-founder of Optical Solutions.

Currently, three rural telcos are using the SL² Platform.

Siecor Corp. introduced its new FlexWay System, a broadband access system providing application solutions for network infrastructure from the service provider through the outside plant to the subscriber location.

At the Service Provider Access, the system includes products such as Siecor's 216-fiber Ribbon Riser Cable, FREEDM Cables, 1440-fiber High-Density Optical Splice Enclosure, 1440-Fiber High-Density FiberManager System, OptiCon Fiber Manager Software, Intelligent Patching System, FuseLite Termination System, UniCam Connector and OTDR Plus Multitester.

Positron Fiber Systems (PFS) announced that its OSIRIS line of Sonet access multiplexers will allow carriers to upgrade from OC-3 to OC-12 in the field, without affecting customer service. OSIRIS now supports both OC-3 and OC-12 on the same platform, allowing carriers to upgrade by plugging in OC-12 optical cards.

Ciena Corp., which prior to Supercomm announced three additions to its MultiWave 1600 product line of dense wavelength division multiplexing technology, featured the technology in a live demo at the show. The new additions consist of a 40-channel (100 Gbps capacity) terminal, an optical add/drop multiplexer (ADM) and a TMN-compliant native Q3 interface for network elements.

The company's technology, "including precision optical sources, narrowband optical filtering and ultra-flat optical amplifiers," enables it to "provide 40-channel DWDM systems with extremely narrow channel spacing," according to Steve Chaddick, vice president, product development of Ciena.

Earlier this summer, Sprint announced that it had deployed the Ciena MultiWave 1600 system in its network. The technology uses 16 window Wave Division Multiplexing technology, which allows Sprint to increase the capacity of its fiber network by a factor of 16, without installing more fiber optic cable.

The MultiWave 1600 system has been deployed along a 200-mile route in the Midwest and is being installed in other key routes throughout the company's network.

Fujitsu exhibited its products under a new

moniker, Fujitsu Network Communications Inc. The entity was formed earlier this summer when Fujitsu Limited combined its telecommunications transmission and switching subsidiaries into a single concern.

The company's demonstrations included connecting three FLASH-192 systems in a unidirectional path switched ring to show the ease of upgrading an OC-48 system in service to OC-192.

The company also featured its ATM switching products in demos that showcased the FETEX-150 ESP switch, the SMX-6200 ATM service multiplexer and the ATM Universe Switch for local area networks.

And Fujitsu's new LAN interconnection product, FASTLANE, was used in a desktop video conferencing demo.

Announced at Supercomm by Fujitsu and Bay Networks Inc. was an expansion of cooperative efforts to offer integrated data solutions for public network service providers. The solutions include support for native LAN interconnection services over a Sonet backbone, Internet access over a Sonet/ATM network, Frame Relay service over a Sonet/ATM backbone and data communications networks for operations systems.

BroadBand Technologies Inc. introduced its FLX PC Adapter card, a PC Interface card jointly developed with Intel Corporation. The adapter card supports two-way Internet and World Wide Web access at speeds greater than 1,000 times that of currently available high-speed PC telephone modems. It delivers fast Internet access to home computer users via high-speed residential fiber-to-the-curb connections.

The adapter, which runs on the company's fiber loop access (FLX) second generation SDV platform, was part of a demonstration of a switched digital broadband services platform which included telephony, and digital broadcast entertainment as well as data. The adapter portion of the demo enabled show attendees to browse the Internet, and download data and files over dedicated bandwidth at 52 Mbps.

Tackling the return path

Manufacturers are still focusing on ways to manage the return path for the implementation of advanced services.

ADC Video Systems introduced a new Targeted Services Distribution Shelf (TSD) High Output Return Path Receiver as part of its Homeworx family of analog video transmission products. The receiver provides the highest digital video signal output level currently available, according to the company, at 44 dBmV. The high output allows cable operators to significantly increase the signal output for additional services located on the return path such as video-on-demand, telephony, high-speed data and Internet access.

Signals can be transported with the addition of one plug-in module that is inserted into the Targeted Services Distribution Shelf (TSD).

The receiver operates in conjunction with existing HFC systems.

ADC also announced a new Block Conversion System for its Homeworx line of video transmission products, a technology that allows operators to increase return path capacity for interactive services such as telephony, VOD, Internet access and high-speed data by 300 percent, while using up to 75 percent less fiber in the HFC system, says the company.

The Block Conversion System consists of three block upconvertors and one pass-through, with controls that are plug-in modules into the ISX optical node, and the block downconvertor in the headend.

Harmonic Lightwaves Inc. announced that Tele-Communications Inc. selected its PWRLink narrowcasting DFBs, interactive return path receivers and NETWatch element management system for the MSO's San Francisco Bay Area Region. TCI has plans to provide services including high-speed Internet services, telephony and digital video to the Bay Area. Installation of the equipment has begun and is ongoing.

Philips Broadband Networks Inc. introduced the new RSS series return signal switch module, designed for use in the Diamond Net optical station, and geared to provide turnkey management and control of upstream return traffic.

The RSS module, which accepts broadband analog or digital signals from up to four individual return paths, is a tool for isolating and controlling noise ingress in upstream traffic, for enhanced signal clarity and improved system integrity. When used with the FOTO-DN module and PBNI's Diamond Diagnostics element management system, the module provides individual control of each return leg.

In conjunction with that announcement, Philips also introduced the Diamond Net optical node amplifier (6-DNA), featuring four active power doubling outputs that allow the operator to reduce overall active count, improving system reliability, lowering life-cycle cost and reducing capital investment, according to the company.

Test equipment

GN Nettest, Laser Precision Division introduced the new FiberWizard TD-1000/1001 series of Mini-OTDRs at Supercomm. The FiberWizards have initial reflective deadzones of three meters for singlemode versions and 2.5 meters for multimode versions.

"By using a higher bandwidth and a shorter pulsewidth, we are able to significantly improve operating performance," according to Nancy Lee, director of marketing for Laser Precision's Instruments Group. "Our customers now have the ability to see virtually all events–no matter how closely spaced."

Each FiberWizard also contains FAS (Fiber Analysis Software), which helps to ensure accurate, fast analysis and display of trace information.

Tektronix announced enhancements to its Sonet test equipment at Supercomm, and followed up with news of a seminar series designed to help its customers get a better handle on new, full service network technologies.

The Oregon-based company announced two new options for its ST112 Sonet testing platform to meet the need for high bandwidth communications test technology. The new options include the ST112 Option 08, which provides high-speed OC-12C capability, and the ST112 Option 5R, which provides 1550 nm optics testing. Both options were developed by the Microwave Logic product line of Tektronix, a developer of Sonet and jitter test products.

The company also previewed two new, high-performance laser options for its ST2400, a 2.4 Gbps portable Sonet/SDH test set. One option includes a high performance 1550 nm laser, which makes the ST2400 suited for testing wavelength division multiplexing network elements. The other option adds dual switchable lasers for testing hybrid networks carrying a mixture of 1310 and 1550 nm traffic.

Also new is Version 3.0 Firmware for the company's CT-100, to meet the testing needs of the ISDN installation tech, as well as a new DS-3 fiber transceiver card for the Video and Networking Division's multichannel J Series video codec system.

Finally, the Video and Networking Division announced the VideoTransport SC Series integrated videoconferencing site controller, designed to simplify access to the application (VideoTransport is the telecom unit of Grass Valley).

And in the realm of education, Tektronix' convergence symposium series is designed to help managers and engineers in the telecommunications, cable TV and video industries better understand and manage measurement challenges in delivering broadband, video and wireless services. The sessions are centered around three application areas: video, telecommunications and mobile communications. Titles include "MPEG Video Compression Technology Overview" and "Digital Video Standards and Testing" (See "What's Ahead," page 100, for dates and contact information).

Monitoring and powering systems

Objective Systems Integrators released both NetExpert version 3.4, as well as VisualAgent version 1.2. NetExpert 3.4's application development environment eliminates the need for professional programmers, according to OSI, and provides benefits including accelerated development of service management solutions,

'96 DBS Summit: "You ain't seen nothin' yet!"

While the headline quote may not have been uttered word-for-word during the recently completed Global DBS Summit '96, it certainly summed up the mood of the annual Denver-based conference held June 26-28. Drawing almost 600 attendees from around the world, nearly a ten-fold increase over the 62 who attended the first conference in 1994, the 1996 Summit was a decidedly upbeat confab for the burgeoning satellite television industry.

As part of its design, the Summit served as a forum for DBS service providers to tout what many believe are their considerable accomplishments.(See Table 1 for year-end predictions.) It also gave them the opportunity, as their ranks continue to expand, to distinguish themselves from their DBS peers. Yet, it also provided those same companies the opportunity to take clear aim at what most see as the real competition—cable television. (The most notable, and expected, exception to this was the cable-owned PrimeStar Partners spokespersons who tended to dodge, bob and weave around the issue whenever it reared its uncomfortable head.)

Much of the buzz around the conference centered on EchoStar's recent $199 promotion that targeted specific markets, particularly those experiencing double digit cable rate hikes. The promotion, which "sells" EchoStar's DISH equipment for $199 if subscribers buy one year's worth of programming ($300) up front, put an interesting spin on conversations whenever competition, either inside or outside the industry, was discussed.

The growing attractiveness of DBS to cable subscribers was underscored repeatedly during the conference. Two of the most widely-attended sessions included a wide-ranging executive roundtable with major DBS executives and a keynote luncheon address by Eddy Hartenstein, president of DirecTV.

One of the first topics to be discussed by the roundtable was, not surprisingly, pricing. Carl Vogel, president of EchoStar Communication's Corp.'s DISH Network, reported the $199 promotion had generated "lots of excitement" and a healthy boost in subscriber sign-ups. Dennis Wilkenson, senior vice president of marketing and programming for PrimeStar Partners, noted that EchoStar's entry into the market "made it a more price-sensitive industry" and it's "now a hard fought retail marketing fight."

Revenues also received attention when Stanley Hubbard, president of U.S. Satellite Broadcasting (USSB), claimed that a monthly $50 subscriber level is "easily sustainable" in large part because of the fact that their subscribers were switching their video viewing to DBS. PrimeStar's Wilkenson concurred, noting that "customers are consuming premium services at a much higher rate."

During his luncheon address, DirecTV's Hartenstein chimed in on the same theme when he touted his company's pay-per-view rates as "nothing short of phenomenal." He went on to claim that DirecTV had sustained an overall 200 percent buy rate for six months in a row, i.e., every subscriber (1 million and counting) had averaged two buys per month

***Table 1:** When asked to project subscriber totals by year's end, DBS corporate executives made the following predictions during the Global DBS Summit.*

Predicted DBS subscriber gains in 1996

DBS provider	Current (7/96 - Approx.)	End of 1996 (Predicted)
DirecTV Inc./USSB	1.6 million	2.5 million
PrimeStar Partners	1.3 million	2 million
EchoStar Communications	70,000	350,000-400,000
AlphaStar Digital TV	Service launch: 7/1/96	150,000-180,000

improved performance and improved ease of use.

NetExpert is a rules-based expert system with programmerless editors which enable rapid deployment of distributed provisioning, fault, performance and billing management applications for service providers and enterprise networks. VisualAgent allows non-programmers to create graphical user interfaces for network topology and interactive data presentation and entry.

New features in NetExpert 3.4 include extensions to the NetExpert rule language in order to speed application development, and run-time enhancements.

OSI, in conjunction with Wiltron Telecom, also introduced Tapestry, Version 9.0 of the Wiltron CMTS (Centralized Maintenance Test System) fault management OS (Operating System).

Applied Innovation demonstrated AppliedView, a system for monitoring, managing and provisioning multiple AISwitch units, which provide network element to operational support system communications. AppliedView provides graphic and text displays of the AISwitch inventory and its connections to network elements and OSS, essentially keeping an eye on the OSS network.

Keptel, a division of Antec, aims to make telephone companies lives easier with the introduction of the RRAPS (Remote Restoration and Provisioning Switch) network interface device, that will allow telcos to perform switching and installation services without dispatching a service technician. The RRAPS NID, which is mounted at the demarcation point at the customer's home, includes the remote-controlled switching function and an auxiliary pair to be used to add another phone line or temporarily restore phone service to the home.

The company also introduced the LG 100, a splice enclosure that can house up to 36 single-fusion or 144 ribbon-fiber splices, as well as displayed Digicon, an improved "F" connector.

RELTEC Corp.'s Lorain Products Division introduced its Vortex Power Platform, an integrated power solution capable of serving the needs of DC-powered wireline and wireless applications.

The platform is a microprocessor-controlled system of power conversion units, modular distribution, local and remote access capabilities and proprietary software, including Lorain PDQ, Vortex Link and Vortex Manager. It utilizes a building block approach for incremental upgrades, which can help to control initial costs, according to information released by the company.

The Division has also announced a power product for telephone company and PCS remote terminal applications including cabinets, huts and digital loop carrier applications. The Lorain V75CAB rack-mounted, -48 VDC power system is based on the division's Vortex Power Platform.

ATM

The New Brunswick Telephone Company, Ltd. (NBTel) has begun to deliver multi-megabit-speed interactive services and Internet access to home PC users, utilizing technology developed by Northern Telecom (Nortel).

Nortel's Interactive Broadband suite of access hardware and networking software products is seeing its first deployment as NBTel's Living Lab progresses from its wide deployment of narrowband services toward full implementation of a broadband multimedia network.

In a controlled phase-in approach, a number of NBTel employees and customers now have access to an initial suite of high-speed interactive services.

Nortel's system combines end-to-end ATM, high-speed access technology, standards-based network and control interfaces and service control software that is able to work with a variety of vendor's products.

Nortel also used Supercomm as a platform to target telephone service providers with equipment for Internet opportunities. The manufacturer introduced three new capabilities of its AccessNode system which enable carriers to offer new data services to their customers, as well as to safeguard their switched-based network from unnecessary bottlenecks. The company's Sonet-based AccessNode system–with Data Direct, LAN Module and AccessNode Rings–was also on display.

Microware Systems Corp. and NEC America Inc. announced and demonstrated ATM technology to carry MPEG-2 video to consumer electronics devices such as set-top decoders, for the "intelligent" residential home using NEC's new Broadband Access System (BAX).

NEC's BAX System is coupled with Microware's DAVID system software used in digital interactive set-tops developed by NEC Corp. to provide consumers with access to an array of ATM-based multimedia services. CED

for the past half a year.

When the roundtable conversation turned to DBS' lack of local coverage, the DBS executives laughed it off. Saying it was nothing more than "a feel-good issue for cable operators," USSB's Hubbard noted that 75 percent of their customers get local channels free by patching antennas through their DSS equipment. Murray Klippenstein, president of AlphaStar Digital TV, which began service July 1, agreed, saying it was "more of a chest-beating issue" in the cable industry and one that was the easiest to overcome, especially with the new generation of off-air antennas now available.

Another criticism, DBS' inability to hook up multiple television sets in the home, was readily admitted by roundtable participants. James Ramo, executive vice president for DirecTV Inc., acknowledged the problem and suggested it be addressed by the industry as a whole. But he discounted its overall severity or impact on sales. He believes the solution lies either through technology or marketing and pricing. Dennis Wilkenson concurred, noting that PrimeStar offers its subscribers a second box for $14 or $15 a month, an offer that 15 percent of its customers have already accepted. Wilkenson said future solutions may include wireless video relay services, IR or UHF remotes, or even dual tuner satellite receivers.

Another problem was addressed by Hartenstein during his luncheon speech. In responding to a question about DBS cracking the MDU (multiple dwelling unit) market, he noted that DirecTV had tripled the staff in its engineering and development department, and that one of their primary tasks was coming up with a NMDU solution. Claiming DirecTV would become a leader in this market, he said the company would be revealing the results of its efforts in this area within "the next two to three months."

Hartenstein went on to describe how DirecTV and its various partners were preparing for battle. He noted that DirecTV will have 11 consumer electronics manufacturers churning out DSS products by the end of this year. He also described how the initial launch of a massive marketing program with AT&T had gone so well that the national rollout of the campaign had been moved up to this coming Labor Day. For their part, i.e., DirecTV, USSB, AT&T and the 11 electronics manufacturers, Hartenstein predicted they would be spending "in the neighborhood" of half a billion dollars on marketing and promotion this year.

That's some war chest by any standard. The notion of all that money, as well as the combined resources of the other DBS providers, being targeted at potential subscribers seemed to create a current of excited anticipation in the audience that continued to reverberate throughout the conference.

–Michael Lafferty

Global DBS Summit '96

Boldly entering the high-speed data revolution

Success at Rogers, Cox and UCSD

By Kathy Wolfe, Division Vice President, Zenith Network Systems

Working in the cable television business at this point in time is paying us all a rare benefit–the opportunity to participate in an industry going through a kind of rebirthing process. Cable operators are stretched out along a very long spectrum of development and investment in system architecture, marketing, data packaging and customer service, among many other issues.

They come to vendors for cable modems to unleash the two-way data communications capabilities they have already equipped themselves with, or are reengineering to achieve.

Cable operators' stories of reinvention and growth are fascinating and educational. There is triumph and struggle in everything from strategic new business planning to system architecture design to successfully meeting quite varied, and sometimes unknown, end-user needs.

In many cases, the cable operator is investing in architectural improvements and related marketing initiatives ahead of the crest of consumer demand, actually seeking to stimulate interest in two-way data with successful beta site programs. In other instances, end users have asked for services, and the telco competition is so potent the cable operator is jumping into the market with a new service package ranging from Internet access to work-at-home transmission.

As food for thought, here are the experiences of three cable systems working to meet the needs of quite varied existing and new customers. But while they are responding to the demands of different environments—from higher education to work-at-home—they are also serving the common goal of access to new data services through very high-speed, two-way technology.

The high-speed access revolution is really just starting. That's because general awareness of and desire for the Internet and other two-way data, despite all the current excitement, is just beginning to spark, particularly as more and more homes get PCs, and LANS and WANs permeate business.

At UCSD, it's not academic

When cable data transmission and the world of higher education combine, it's because universities are typically the place where great ideas are generated and fostered, and so naturally, there's a huge demand for information. From the MIS standpoint, the academic world is particularly exciting because the population's interests and goals are so entwined. Progressive administrations are willing and eager to embrace data transmission as both a service and recruiting benefit for students, professors and staff.

For the University of California at San Diego (UCSD), there was nothing academic about its system architecture decisions as far back as 1984. Because of the vision of its staff at the time, the university made a business-like move to invest in cutting-edge technology which would not only service the existing population, but which would give UCSD the kind of system infrastructure it could grow with in the future.

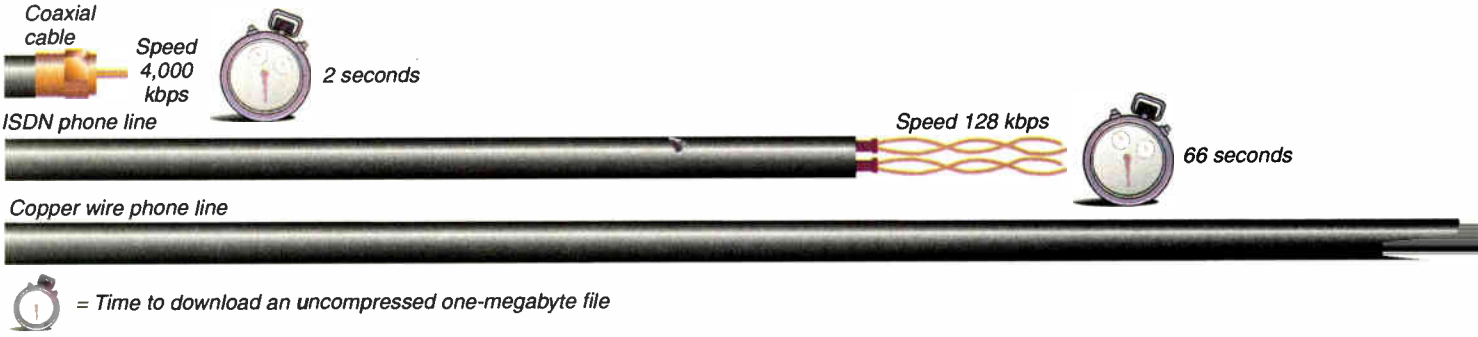
Today, UCSD's private hybrid fiber/coax (HFC) system–it was among the first universities with hybrid architecture—has a mid-split design with in-bound width of up to 112 megahertz and outbound width of up to 550 MHz.

The system's current star architecture replaced bus coaxial architecture for better frequency reuse among the individual cable systems on campus. Star has also made for reliable transmission and better images at UCSD, as it has reduced the number of active components between the campus headend and the user from hundreds to about eight, according to Bob Green, manager of cable services.

Today, UCSD's architecture is still evolving. But with the installation on campus this summer of high-speed, 4 megabit modems, UCSD already has 50 apartment buildings and residence halls interconnected and linked to the Internet.

Beyond the Internet, this network gives students complete E-mail services, connection to the mainframe at UCSD for homework assignments, two-way live conversation with each other and connected professors, access to local Web pages and, in the future, the possibility of on-line class enrollment and live video broadcasts. In addition, students can, if they want,

Figure 1: *The speed advantage of cable modem technology. Examples depict the amount of time necessary to download a one-megabyte file of data, graphics or video. (Note: The timeline is not to scale.)*



hard-wire their cable TV channels into their PC monitors for quicker access.

This is the result of some 12 years of system evolution at UCSD. It started in 1984 as a plan to construct a broadband cable system to transport the Ethernet over longer distances around a huge campus to support up to 3,000 clients. By 1985, UCSD had four channels of Ethernet transported over coaxial broadband, along with one terminal service channel. In the late 1980s, the university started considering moving to fiber optics as the cost of the technology moderated, making it more feasible to install. So the process of adding fiber began, and UCSD started rolling data off its broadband coaxial architecture and onto fiber.

The multiple, interrelated communities at the university, including both academic and business, wanted more aggressive two-way data transmission and communications, particularly including dormitory rooms. So by 1992, Green had supervised the installation of a test bed to see what could be provided, and how well it would be accepted. The test included UCSD's 300-bed Thornton Hospital and the campus' Warren residence halls. The headend was situated in the hospital because of its timing of construction, location and resistance to earthquakes.

In the early '90s at UCSD, video transmission was the most widely appreciated benefit of the cable installation, rather than data access. Students still relied on telephone modems to access information. However, the proliferation of interest in the Internet changed all that.

Rogers has put in place a work-at-home program, WAVE@work, with a group of IBM employees

Demand for more data bandwidth to the UCSD system has greatly increased, leading the campus to its present-day hybrid fiber/coax architecture, its purchase of cable modems and the expansion of its network to include many additional residence halls and apartments. Also fueling the continuing transition is the continued reduction of the cost of adding fiber optics.

Pioneering vision in business

Like UCSD's experience, foresight in anticipating future uses for a broadband hybrid network and responsiveness to customer needs are also behind the successful, pioneering work of Rogers Cablesystems.

Rogers is Canada's largest cable company, with a subscriber universe concentrated in Ontario and Vancouver. It's one of the originators of the hybrid network concept, and with a new role in providing two-way data transmission and Internet access, today has some 2.5 million cable subscribers. It blankets virtually every major market in Ontario and includes some 500,000 users in Vancouver.

Since the company launched its Rogers WAVE@home high-speed access to the Internet and a variety of multimedia information services in Newmarket, Ontario last year, its "portfolio" of subscribers has been expanding rapidly from video entertainment TV to those who want to participate daily in the information age.

Today, Rogers' system architecture and marketing goals are structured to deliver the Rogers package to customers in markets well outside Newmarket. Later this year, subscribers in select markets will be able to use a high-speed cable modem system to access the Internet, and other forms of content. Users are situated at home and in schools.

In a related effort, Rogers has put in place a work-at-home program, WAVE@work, with a local population of IBM employees in Newmarket, reports Frank Cotter, vice president of operations and general manager for Rogers.

In 1989, Rogers' leaders had the foresight to

make it one of the first companies to develop an HFC architecture. There were already early needs for two-way communications, and the network let the company push the system much farther geographically.

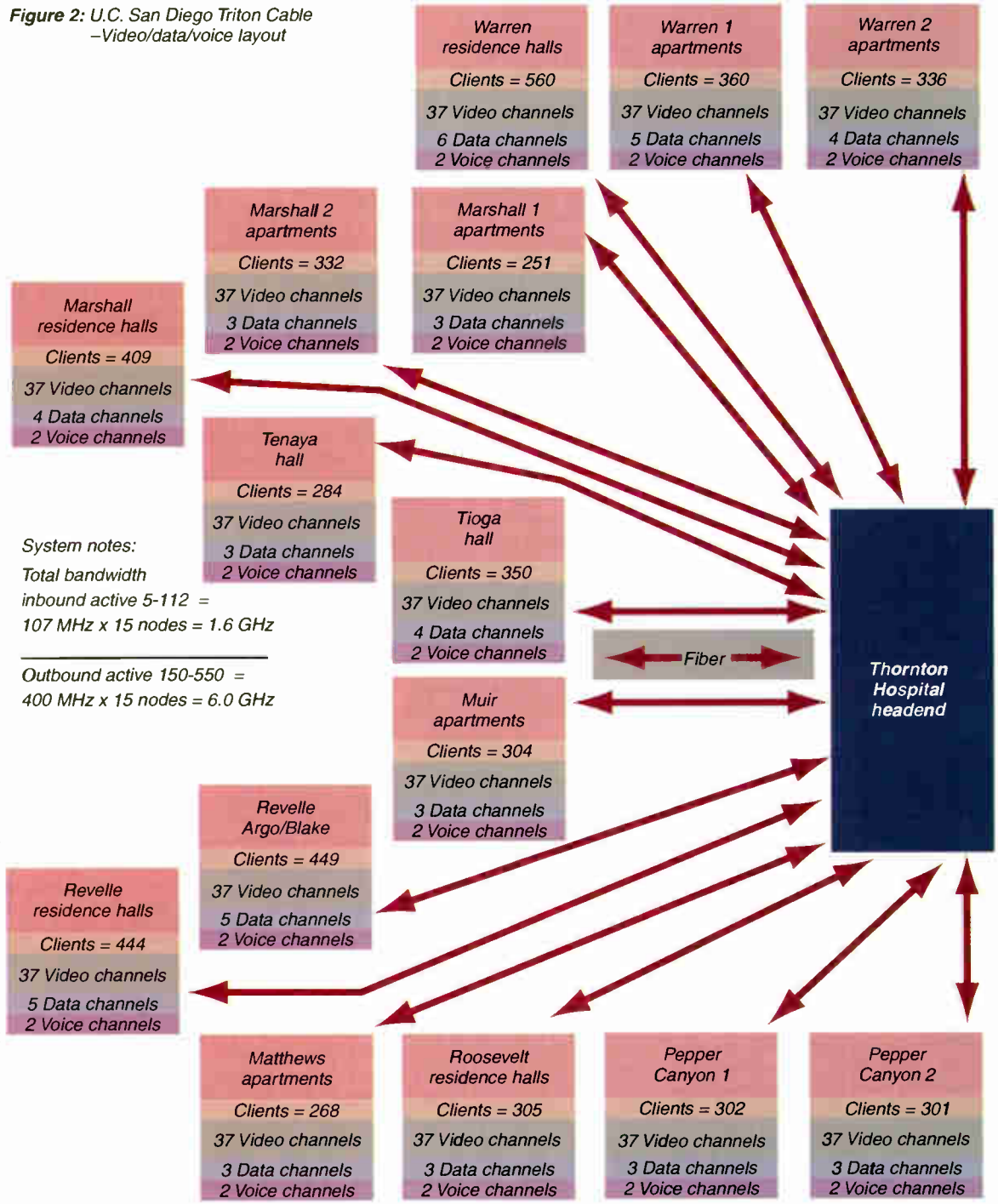
"Even in the late '80s, we were trying interactive services, including video games, and were running two-way industrial applications, like traffic-light control in Brampton and London, as well as status monitoring, which allowed us centrally to 'talk' to our trunk amplifiers," Cotter explains.

So with the very rapid growth of interest in multimedia services and the Internet, it was a logical and evolutionary step for Rogers to create a subscriber package with the cable modems, high-speed links and the required software.

Rogers is in the midst of a system architecture capital rebuilding program with several clearly defined goals.

Demand for on-line services is expanding so fast that it was an easy decision for Rogers to enhance its architecture with additional investment and then market it more concertedly, although Cotter reports consumer interest is so great that "word-of-mouth" is advancing the business significantly.

Figure 2: *U.C. San Diego Triton Cable –Video/data/voice layout*



In addition to its WAVE@home program, Rogers has diversified through a significant push with cable modems in the educational arena, known as WAVE@school, providing the Internet and multimedia services to elementary and high schools. The company's beta installation in a school was in 1994, and since then, some 40 additional facilities have been connected. But the big push, says Cotter, is just beginning. Rogers has earmarked some $5 million for a three-year period to bring as many as an additional 560 schools into the system in Ontario.

One step back, and three steps forward

In Spokane, Wash.,—like Rogers Cablesystems in Ontario and the University of California at San Diego—forward-thinking people at Cox Cable saw the data transmission needs and opportunities the future held and made some smart business developmental moves.

However, Cox's system architecture had to be revisited and retrofitted so the company could then take its "three steps forward" into new business development. And one interesting program the Cox investment almost immediately led to was a local work-at-home initiative with Guardian Life Insurance Co.

Somewhat like Rogers' work-at-home program with IBM, Cox and Guardian Life began talks in 1994 (after Cox's system upgrade to HFC was completed) about telecommuting for

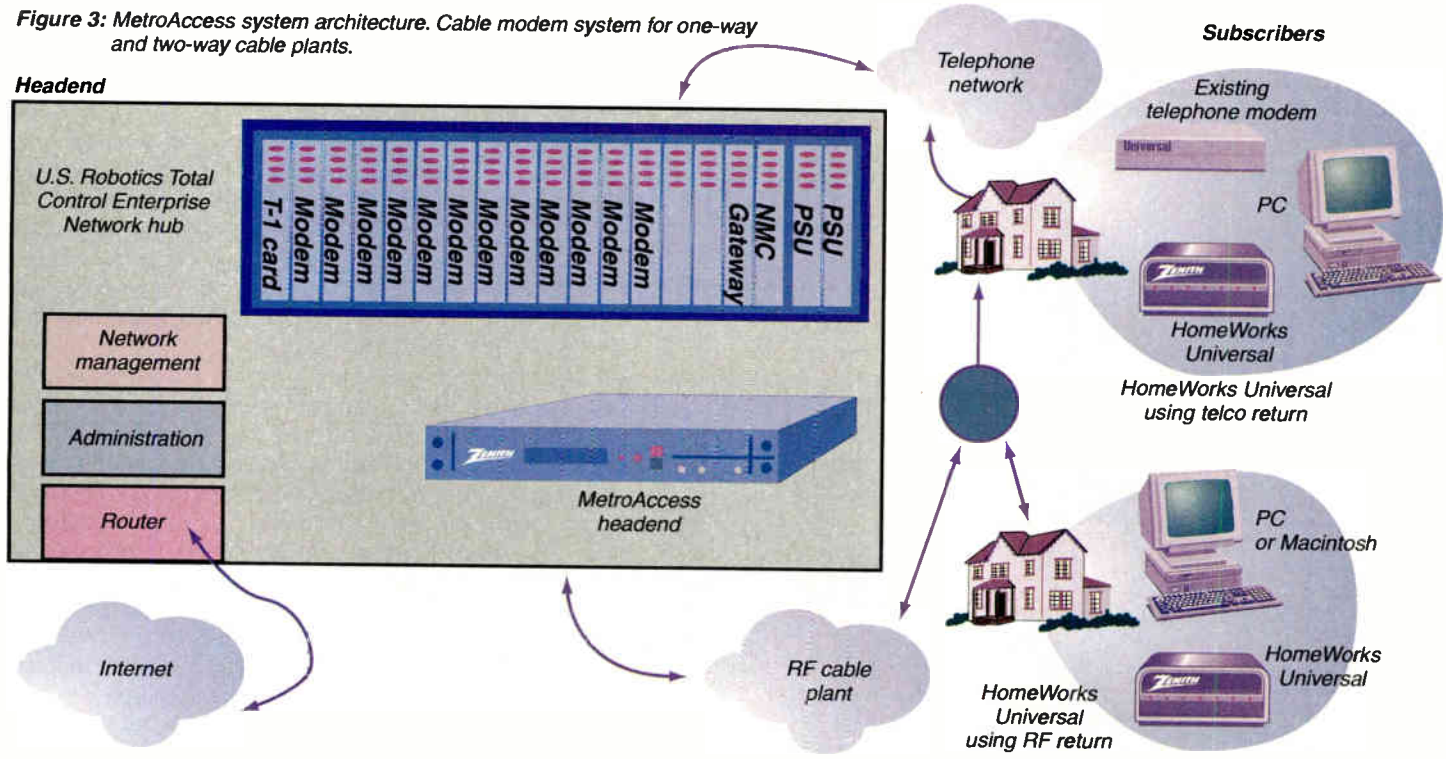


Figure 3: MetroAccess system architecture. Cable modem system for one-way and two-way cable plants.

some of its claims processors. For Guardian, it was a chance to reduce capital costs and comply with state work-at-home laws. For Cox, it was a chance to market its new architecture and capabilities in a cutting-edge application.

According to Charles McDowell, Cox Cable's director of network development in Spokane, the feedback from Guardian has been excellent. "The processors are happy participating in a Wide Area Network with high-speed cable modems that let them have access to all the data they would normally need in a central office but allows them to work in the home setting," says McDowell.

And Guardian was able to save the cost of a new building when space was at a premium in 1994. The company had to add more claims representatives, but had no place to put them. However, the national health care reform debate was well under way, and the danger was that if the cost of a new building hit the books at the same time that reform increased spending costs, there could conceivably be a need for workforce reduction.

Work-at-home was the ideal solution, and simultaneously helped Guardian comply with state laws mandating private sector improvement in the number of people commuting to offices—laws designed to address concerns ranging from pollution to traffic density. The Guardian telecommuting program has approximately doubled over the last 15 months in terms of the number of claims representatives working remotely.

For Cox, the Guardian program clearly allowed the cable company to test its new investment, improve its bottom line with additional revenue and profit dollars and, according to McDowell, "to jump in and get our feet wet so we could see how the system architecture could be applied to other new technologies in the future."

The Guardian program has also been helpful in allowing Cox to give front-line field training to its technicians, and in getting them ready for the advent of telephony services.

The three-year project cost some $20 million

Cox's system upgrade is one becoming more and more familiar to any traditional cable company seeking to participate in the Internet, multimedia services and work-at-home programs. In Spokane, Cox. in the early '90s, had a 100 percent coaxial tree-and-branch architecture supporting 36 cable channels.

McDowell says that while the need for data didn't yet exist, the system did have a small, two-way application for closed-circuit video transport from the city government and local colleges to the headend, and then for retransport to homes.

With a video customer in mind, the physical plant was upgraded by 1994 to include fiber optics, with outbound bandwidth of 550 MHz and a 5-30 MHz return capability. The three-year project cost some $20 million. But the Internet explosion occurred, and new data applications like Guardian's unfolded. So Cox's investment in its HFC system, combined with the power of cable modems, has now given the architecture a tremendous leveraging opportunity from a marketing standpoint.

Success stories

These stories show how already successful cable operators who want to embrace interest in the Internet, two-way multimedia and work-at-home have been provided with an ideal cable modem solution. By making the right capital investments in system architecture in a quick and efficient manner, and then matching the system with state-of-the-art cable modems and access to the right menu of services, cable companies can expand their business portfolio and build off of their existing reputation for traditional video transmission.

Perhaps the best part is that there's already intense demand from customers, whether in homes, offices or schools. For new companies, or new initiatives, this kind of eagerness eliminates a big barrier to profit—the cost and effort usually required to create consumer interest and awareness. For the cable industry, clearly, two-way data transmission is already programmed for success. CED

Telcos craft data gameplan to counter cable

Carriers evaluating ADSL

ILLUSTRATION BY GARY NICHOLS, SIS

By Fred Dawson

Local exchange carriers' prospects for delivering broadband data services to consumers next year have improved significantly in recent weeks, thanks to new technology innovations and the rising credibility of the competitive threat from cable.

Vendors report they are negotiating deals with telcos that will expand field testing of ADSL (asymmetrical digital subscriber line) for high-speed data applications to include every major carrier by year's end. Where many telcos' top executives were on the fence about moving to large-scale tests when US West and GTE made trial announcements earlier this year, today, they feel they have no choice but to proceed.

"ADSL will be deployed along a lot quicker curve than ISDN (integrated services digital network), first, because the competitive environment is a lot different now than it has been, and second, because the telephone companies are a lot smarter about how to go to the consumer market," says Jeffrey Weber, director of product development for Southwestern Bell Telephone Co., one of the companies that has yet to go public with its trial plans.

Citing consumer demand and the threat of cable modems as "significant drivers," Weber says SWB will focus on the service, rather than the technology to win consumers over. "At Southwestern Bell you'll never see the term 'ADSL' used in our marketing and advertising efforts," he adds.

But while carriers are beginning to formulate offensive strategies, it's clear the industry as a whole has a long way to go before gameplans are widely in place, which could cost carriers in the competition with cable operators. "The real incentive is they don't want cable modems to capture the business," says Benjamin Berry, vice president of marketing for Amati Communications Corp., a supplier of ADSL equipment. "So far, it's more a preventive effort than one built on an offensive strategy."

Amati, which has begun shipping modems that operate over standard telephone lines at up to 8 megabits per second downstream and 384 kilobits per second upstream, will have no trouble keeping up with demand in the months ahead, Berry says, adding wryly, "Our comfort level is based on the fact that the telcos have to learn how to offer the services before they can begin giving us orders for high volume shipments."

Tough choices

IBM, with plans to roll out a cable modem by fall as part of a major marketing push on the cable side, has a similar take on the state of the telcos' strategic preparations. "Some LECs (local exchange carriers) want to be ISPs (Internet service providers); others want to be a non-competing transport provider to all ISPs," notes Michael Reene, vice president for telecommunications and media at IBM. "Things are still very fluid for them strategically."

It's a tough choice for LECs. On the one hand, the marketing efforts of national media companies who are ready to exploit the broadband pipeline combined with the benefits of local content development suggest a coherent, in-house piecing together of all the content and transport elements, much as cable is doing, might be the way to go. On the other hand, throwing open the gate and letting ISPs battle for customers without the threat of telco dominance might produce much higher returns then any labor-intensive in-house ISP initiative.

The good news for telcos is that, assuming they can come to terms with fundamental market strategies and pursue them aggressively, there appears to be nothing stopping them from getting commercial services off the ground as soon as they complete their field and market trials, which, combined, can run anywhere from six to 18 months. US West and GTE are shooting for mid-'97 launches in a limited number of markets if they can get

the test results they're looking for. Some carriers may skip market trials altogether in order to get underway commercially before the end of '97.

Certainly the telcos, with a vast reservoir of technical expertise, should be able to put together much of the organizational field and customer service support they need by the time they begin introducing high-speed data services commercially. But first, the key to moving forward is the viability of the technology as it goes through the field tests.

Industry confidence that ADSL field testing will soon be widespread rests on several advances that have come to light in recent weeks, starting with the capability of ADSL modems to automatically adjust the speed of service to fit field conditions. Where earlier generations of gear required the telco to set the speed as a function of the length and condition of the loop serving any given user, the new systems self-adjust to speeds of anywhere from 1.5 Mbps at distances of up to five miles to 7 or 8 Mbps at about one-and-a-half miles or less, depending on the vendor.

"Ninety percent of all phone lines fall within these parameters," notes John Cioffi, chief technical officer at Amati.

Cioffi also cites the ability of the recently standardized discrete multitone (DMT) modulation technique to overcome impulse noise in the lines as a factor in the growing support for ADSL. "The single most difficult problem in the phone loop is impulse noise, which can result from something as innocuous as a refrigerator door opening," he says. "DMT smears the noise out across the line and eliminates the need for bit error correction, which saves money."

AT&T Paradyne, using a competing modulation technique, has been quicker to market with ADSL chip sets than anyone and is now offering its own version of adaptive rate ADSL. "The adaptive rate system allows the telephone company to manage the data speeds however it wants," says Clete Gardenhour, director of business development at AT&T Paradyne. "You can let it operate automatically, setting rates according to user line parameters, or you can fix the rates at different levels and offer them as different tiers of service."

Adaptive rate technology goes a long way toward overcoming doubts that ADSL could be made to work across all segments of the local distribution network, where age and gauge of plant can vary from neighborhood to neighborhood. As a result, the equipment issue is shifting from concern over technical viability to cost concerns. Insiders report one reason more tests haven't been announced is that telcos are looking for lower unit prices for large market trials and earlier commercial deployment than vendors are willing to offer.

These trials, spawning orders in the hundreds or even thousands of units, are not enough to drive costs down to targeted levels for commercial deployment, Berry asserts. Presently, Amati and other vendors are shipping units at a cost of about $2,500 per line, including the modems at both ends, while telcos are calling for costs in the range of $500 to support service pricing at about $30 per month.

"To get to the economies that support those prices we need to see orders for tens or hundreds of thousands of units," Berry says. By mid-'97, prices could be down to "$600 or $700 per line," falling to $500 by year's end if the volume orders come in, he adds. This cost estimate includes $250 per port at the central office and "between $250 and $350 for the subscriber modem."

In contrast, some cable modem vendors are shipping units and supporting headend gear at a cost of $500-$600 per user for scheduled deployments this year. Cable plant upgrade costs can add another $27-$100 per home passed, which, depending on data service penetration, can translate into well over $100 per customer. Nonetheless, the total cost nut for cable appears to be a year ahead of the same cost point for the telcos.

As ADSL modems begin to hit telco performance and cost requirements, there are other technical issues that must be resolved before high-speed data over copper links can be delivered as a mass product, starting with the question of how to overcome a congestion problem that is already straining the switching capacity in many areas. Because Internet users typically stay on line much longer than the average voice call, heavy data traffic wreaks havoc with the circuit contention ratios that underlie allocation of switching resources.

"Mass rollout for ADSL is probably going to be significantly ATM-based"

Industry undecided on ATM

One answer to the problem is to use ATM (asynchronous transfer mode) technology to move the data traffic off the switched circuits, which adds a costly infrastructure component to preparations for high-speed data service. While several vendors have introduced ATM-based solutions with concentrators that minimize switching costs at the central office, the industry is undecided on the question of whether to wait until the local ATM platform is in place before launching high-speed services and where to terminate the ATM signal once the routers are installed.

"There is a strong, strong feeling among telephone companies participating in the (ADSL) Forum that, over time, they want to base high-speed data access on the emerging ATM infrastructure," says Forum chairman Kim Maxwell.

Bill Rody, vice president of marketing for Westell Telecommunications, a leading supplier of ADSL gear, concurs. "Mass rollout for ADSL is probably going to be significantly ATM based," he says. "Fast Internet and on-line access can be introduced over the IP (Internet protocol) network, but the grand vision among all of us is a seamless multimedia network imbedded in the ATM architecture."

Telcos anticipate that by the "latter part of '97" the preferred approach to offering data services will be to link ADSL and other access connections through the central office to largescale ATM switches that might support up to 20 central offices in a given LATA (local

access transport area), Maxwell says. "The big question we're addressing now is how far you should carry the ATM signal into the local loop," he adds.

In Berry's view, telcos are better off settling on Ethernet for now, using T-1 circuits to support routing of high-speed data to the ADSL links at a ratio which some proponents say could be as high as 50 subscribers per circuit. "Not all telcos are looking for an immediate ATM solution," Berry says. "Those who are moving to get started as soon as possible will probably use Ethernet."

Maxwell agrees that the most aggressive telcos will probably get started over the Ethernet link, but adds that this is a very limited service, with problems attending delivery of full-motion video over Ethernet and the need to link multiple service providers offering local as well as national content, not to mention the delays that would be encountered as time on line per user goes up. While it now looks as though telcos will pursue a 10BaseT connection between the modem and the PC, whether or not they go to ATM in the distribution path, this approach might not hold in light of the introduction of network interface cards supporting ATM to the PC, which would further complicate decisions about how to deploy ATM in the distribution plant.

"It's a very strange and difficult problem to determine how we migrate transmission and premises hardware out of the Ethernet environment into ATM," Maxwell says. If it looks like an ATM NIC will be available at mass consumer prices of $150 or less by '98, telcos are likely to push very hard for an ATM solution all the way to the PC, Maxwell notes. But, if the ATM-to-the-PC option is further out, they might want to have ATM terminated at the end of fiber links, where a single conversion multiplexer can serve multiple users.

Further complicating the issue is the fact that the ATM Forum is "bogged down" in addressing residential access issues, Maxwell says. "How you manage ATM in the distribution and premises portion of the network is a very important issue," he notes, adding that there isn't enough support from the operating companies for ADSL to drive a solution from inside the ADSL Forum.

Adding to the telco uncertainties surrounding implementation of ATM is a gap between the approach taken by the ATM Forum, which is preferred by the ADSL Forum, and the approach taken by DAVIC (the Digital Audio Visual Council), the ad hoc organization attempting to arrive at protocols for the interfaces in end-to-end digital systems. Where DAVIC specs assume the premises box is a passive recipient of ATM cells, the other two forums believe "the modem should be treated as one end of an ATM link, with the ability to look at cells, recompute the cell header, throw cells away and perform other ATM-related tasks," Maxwell says.

Assuming the competitive drumbeat from cable continues to drive telcos to act, it may turn out that waiting for a solution to the ever-more complicated ATM issues is not something most carrier executives will opt for. Assuming ADSL works as billed, and they're willing to live with Ethernet, the one ace they have up their sleeves against cable is they don't have to upgrade their networks to deploy the services, which could go a long way toward overcoming the one-year lag between cable's first commercial launches and those of the telcos. CED

PRODUCT/SERVICES SHOWCASE

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SATELLITES

TEST AND MEASUREMENT

Modem link demarc enclosure

ELYRIA, Ohio–Multilink has introduced a residential subscriber plastic demarcation enclosure, designed for cable modem links for use on the outside of subscribers' homes. The company also plans to develop MDU enclosures that rack cable modems for subscribers in multiple dwelling units. Multilink expects cable systems to locate cable modems externally on subscribers' homes for ease of access.

Circle Reader Service number 61

Agile demodulator family

POTTSTOWN, Pa.–Videotek Inc. has launched a range of units and models in its demodulator family. The DM-145, introduced at the SCTE's Cable-Tec Expo, is a 154-channel, agile cable-ready demodulator which lends itself to the monitoring of broadcast and cable channels and provides simultaneous Stereo Audio and Second Audio Program (SAP) outputs. Features include 154-channel tuning with agile tuning capability, synchronous detection and two baseband video outputs.

Members of Videotek's demodulator family include the DM-145, DM-154 and DM-192

Another addition is a new version of the DM-154 demodulator, a 154-channel, cable-ready agile demodulator, which lends itself to broadcast video testing due to its Zero Carrier Chopper Mode, ICPM quadrature output, IF loop capability and its composite audio out for stereo testing or remodulation. It's also suited for cable FCC proof of performance tests and industrial video measurement requirements. New features and functions consist of a new composite audio output: this audio out is user-selectable via internal jumper to 4.5 MHz aural or wide-band audio outputs.

And finally, the DM-192 is a 192-channel, cable-ready agile demodulator that is suited to broadcast and cable TV video services and testing. The unit has a selectable, synchronous or envelope detection mode, Zero Carrier Chopper mode, Quadrature output, IF loop capability and a composite audio out for stereo testing or re-modulation.

Circle Reader Service number 62

Portable locators upgraded

RAYTOWN, Mo.–Rycom Instruments Inc. has upgraded its Pathfinder/Pathfinder II Portable Locators (models 8840 and 8850) to include the availability of a peaking antenna in the receiver which allows the user to easily identify the cable/pipe path in the peaking mode.

The Pathfinder Locator receivers have been designed to pick up signals at waist-height and feature built-in probes to eliminate dangling cords. The locators pinpoint underground cable and pipe using a peak/null meter that also features a new variable pitch audio tone which gives the user a better indication of 30 Hz. Use of pulsating DC charging technology enhances battery life.

Circle Reader Service number 63

Low-profile power

ROSWELL, Ga.–Performance Power Technologies has announced the MAGNUM UPS, a 60/72/90 volt centralized powering system. This HFC power node features a true on-line double conversion UPS operating from a bank of 14 batteries which enables it to have a run-time of eight to 10 hours. The low-profile enclosure contains all components of the power supply (including the batteries), mounts on a concrete slab with access through a hinged lid, and is designed to have minimal impact on its surroundings and on the environment.

MAGNUM UPS centralized powering system

The UPS is power factor corrected and delivers 1440 VA (volt amperes) in the form of alternating direct current (ADC) at a frequency

Combo TDR, fault locator

Model 1270 TDR

LINCOLN, Neb.–Riser-Bond Instruments has introduced the Model 1270, a combination TDR designed for companies which use both twisted pair and coaxial cables. The unit, which features front panel BNC and Banana Jack connectors, combines the sensitivity and length readability of coaxial TDRs with the multiple testing modes of twisted pair TDRs.

Circle Reader Service number 64

75 ohm connectors

SAN DIEGO, Calif.–RF Connectors, a Division of RF Industries, has introduced a series of coaxial connectors which includes 75 ohm BNC adapters and cable connectors. The connectors are available with both nickel

Pathfinder/Pathfinder II Portable Locators now include a peaking antenna

tion of the meter setting.

Both Pathfinder models operate on low frequency for optimum path and depth locating accuracy, as well as greater locating distance from the transmitter. The Pathfinder II has the added capacity of operating at high frequency, which sends a stronger signal over shorter distances when directly connected, and also provides for no contact inductive transmitter coupling.

The Pathfinder Locators offer three types of accurate depth locating. This includes "45 degree triangulation" from either the left or right side of the cable path, and the "straight lift" method, where the receiver is placed on its side and lifted straight up until the meter gives the correct response reading.

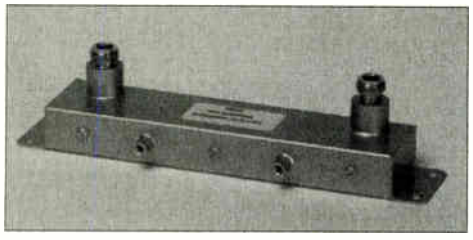
Circle Reader Service number 60

and silver plating, Delrin and Teflon dielectric, and all feature gold-plated, captivated center contacts.

Circle Reader Service number 65

Bandpass filters

EAST SYRACUSE, N.Y.–Microwave Filter Company has introduced two new bandpass filters. The model 11286-23 Bandpass Filter preselects high-speed wireless data frequencies



The model 10241 Bandpass Filter

broadcast via microwave radio in the 21 to 23 GHz range. The model 10241 Bandpass Filter protects the Electronic News Gathering receive band (1990 to 2110 MHz) from harmonics caused by UHF and MDS/MMDS broadcast. The model 11286 boasts an insertion loss of less than 2.5 dB at center frequency, with less than 0.5 dB roll-off at +/-25 MHz from center frequency. Rejection is greater than 70 dB at +/-280 MHz from center frequency. Return loss is 25 dB minimum over the entire +/-25 MHz band. A variety of mechanical configurations are available and can be customized for specific mounting requirements.

The model 10241 has a passband loss of 1 dB maximum at the center frequency and 1.5 dB at the band edges. Rejection is 20 dB minimum at the center frequency +/-80 MHz, and approximately 50 dB at 2500 to 2700 MHz. Impedance is 50 ohms, and connectors are type N female.

Circle Reader Service number 66

MPEG-2 decoders

CLEARWATER, Fla.–Vela Research Inc. has introduced new four-channel, MPEG-2 decoders for ad insertion and near video-on-demand that allow insertion from a server in analog streams.

The NVOD board has been designed for enhanced pay-per-view, training or hospitality delivery services. The ad insertion board has been designed with a genlock input to allow locking the video output to an external video source.

The boards accept MPEG-2 data and device control commands from a SCSI-2 fast/wide interface, and each play-back channel is addressable via a SCSI Target ID and Logical Unit Number. The boards decode images from SIF to ITU-R-601 (CCIR-601) with NTSC or PAL outputs. The decoders are packaged in standalone, rack-mountable, IU chassis with a swappable power supply and fan.

Circle Reader Service number 67

Digital multimeters

SAN DIEGO, Calif.–Wavetek Corporation has expanded its line of hand-held, clamp-on digital multimeters (DMM) with three new models. Models AC60 and AC65 DMMs measure AC current to 600 amps, AC voltage to 600 volts, resistance to 40K ohms and have a quick continuity check function. The model AD105 is a hall-effect, high-range, AC and DC ammeter which measures both to 1,000 amps, and will also measure frequency to 10 kHz.

Wavetek's clamp-on digital multimeters

The three meters feature 4000-count LCD displays, autoranging, True-RMS measuring, wide measuring ranges and data-hold buttons. Each has been designed to withstand drops of up to four feet without damage.

Circle Reader Service number 68

Information display system

SALT LAKE CITY, Utah–FrameRateLabs Inc. has added to its line of information display systems with the introduction of its new Chameleon, which maintains many of the features of its Millennium system. This includes the ability to create, schedule and display multimedia content over broadband cable television networks, as well as interface to weather systems, VTR controls and enterprise information systems.

The Chameleon system is contained in a single computer assembly. It is based on Intel and Microsoft technology standards so that content can easily be shared among workstations and imported for display. The system has been designed so that it can be easily upgraded to increase capabilities and add features.

Circle Reader Service number 69

Loop extender with gain

LACONIA, N.H.–Wilcom Inc. has begun offering a new loop extender with gain that is designed to extend the signaling range of two wire loops by applying a boost voltage in series-aiding with the C.O. battery.

Wilcom's loop extender

The 3/6A-LEG unit is a bi-directional 2W-2W repeater that has been designed to solve long loop signaling problems encountered at the central office or a remote SLC or DLC. It features 24V/60V selectable battery boost, surge and short circuit protection and switch selectable gain for voice frequency gain, as well as signaling boost.

The new loop extender ensures a minimum of 23 mA loop current on loops up to 4000 ohms (with 24V and 60V battery boost). Built-in overload and gas tube protection circuitry prevents damage from high currents and voltage surges.

Circle Reader Service number 70

Lithium niobate modulator

NORTHBOROUGH, Mass.–Ramar Corp. is now offering a high-speed, lithium niobate phase modulator. The Series 300 Phase Modulator has a 3 dB bandwidth of 7 GHz, and the modulation curve is resistively matched and flat to DC. The fiber-to-fiber insertion loss is under 4.5 dB. The Series 300 modulators are available at four standard wavelengths: 800 nm, 1060 nm, 1300 nm and 1550 nm. The input and output pigtails are typically polarization maintaining fiber, and may be terminated with PM FC/PC connectors as an option.

Circle Reader Service number 71

AUGUST

6-8 Fiberworks: Digital Networks Training (DNT), produced by Antec. Location: Antec Training Center, Denver, Colo. Call (800) FIBER ME.

6-9 Fiber Optic Training, produced by The Light Brigade. Location: Chicago, Ill. Call Pam Wooten (800) 451-7128.

9 Design, test and installation of cable TV systems technical seminar, produced by Multicom Inc. Location: Orlando, Fla. Call (800) 423-2594.

12 Broadband Network Overview, produced by General Instrument. Location: Hatboro, Pa. Call Lisa Nagel at (215) 830-5678, or fax (215) 830-5602.

12-13 SCTE Regional Training Seminar. Topic: Introduction to Telephony. Location: Jackson, Miss. Call SCTE headquarters (610) 363-6888.

12-23 Fiber Optic Technician Training, produced by FiberLight International. Location: Dublin, Calif. Call (970) 663-6445.

12-16 Broadband Communications Network Design, produced by General Instrument. Location: Hatboro, Pa. Call Lisa Nagel (215) 830-5678 for more information.

Trade shows

September

8-12 NFOEC '96. Location: Denver, Colo. Call US West Communications (303) 965-2367.

18-21 PCS '96, produced by PCIA. Location: Moscone Center, San Francisco, Calif. Call the Personal Communications Industry Association (800) 727-6870, Ext. 131; or (703) 739-0300 for program details.

23-25 The 1996 Eastern Cable Show, produced by the SCTA. Location: Atlanta, Ga. Call (404) 252-2454; or use FastFax for information (888) 814-0303.

September/October

9/30-10/2 *Convergence* magazine's Digital Television & Internet Conference & Expo. Location: San Jose Convention Center, San Jose, Calif. Call Fax-on-demand at (800) 488-1396, or Gary Lemons at (303) 393-7449.

October

13-15 Atlantic Cable Show. Location: Baltimore Convention Center, Baltimore, Md. Call SLACK Inc. at (609) 848-1000.

13-14 Activating and Troubleshooting the HFC Return Path, produced by Scientific-Atlanta Institute. Location: Atlanta. Call (800) 722-2009, press "3," to register.

14-16 SCTE Regional Training Seminar. Topic: Technology for Technicians II. Location: Jackson, Miss. Call (610) 363-6888.

18-20 Heart of America SCTE Chapter, Technical Seminar. Location: Tan-Tar-A Resort, Lake Ozark, Mo. Call David Clark (913) 599-5900 for more information.

19-22 Fiber Optic Training, produced by The Light Brigade Inc. Location: Idaho Falls, Idaho. Call Pam Wooten (800) 451-7128.

26-29 Hands-On Fiber Optic Installation for Outside Plant Applications. Produced by Siecor Engineering Services Training. Location: Hickory, N.C. Call Lynn Earle at (704) 327-5539, or Phyllis Townsend at (704) 327-5560.

27-30 Fiber Optic Training, produced by The Light Brigade. Location: Helena, Mont. Call Pam Wooten (800) 451-7128 for more info.

SEPTEMBER

9-20 Fiber Optic Technician Training, produced by FiberLight International. Location: Estes Park, Colo. Call (970) 663-6445 for more information.

10 T-1 Technical Seminar, produced by ADC Telecommunications Inc. Location: Edmonton, Alberta, Canada. Call (800) 366-3891 to register or for info.

11-13 Operating Hybrid/Fiber Coax Systems, produced by the Scientific-Atlanta Institute. Location: Atlanta, Ga. Call (800) 722-2009, press "3."

17-19 Cable Television Technology, produced by C-COR Electronics Inc. Location: Denver, Colo. area. Call C-COR Technical Customer Services at (800) 233-2267, ext. 4422.

23-24 Fiberworks: Compressed Video: Concepts and Transmission (CVCT), produced by Antec. Location: Antec Technology Center, Atlanta, Ga. Call (800) FIBER ME.

24-26 Broadband Communications Technology, produced by C-COR Electronics Inc. Location: Fremont, Calif. Call C-COR Technical Customer Services at (800) 233-2267, ext. 4422.

25 T-1 Technical Seminar, produced by ADC Telecommunications Inc. Location: Seattle, Wash. Call (800) 366-3891 to register or for info.

30 Broadband Network Overview, produced by General Instrument. Location: San Diego, Calif. Call Lisa Nagel (215) 830-5678 for more information.

The issue: Making two-way work

Interactive TV isn't the driving force it appeared to be a year ago. Instead, it's high-speed modems, and for some, telephony over cable. But to make those services work, a cable network has to be two-way active.

Getting that return plant working well can be a tricky proposition, especially in large networks. We'd like your thoughts about upgrading to two-way.

The questions:

1. How important is it to the management of your system that high-speed data or some sort of interactive service be offered over your system?

❑ Very important ❑ Somewhat important

❑ Not important ❑ Don't know

2. How soon do you think services like interactive shopping, games and other services will be offered over your cable system?

❑ 1-2 years ❑ 3-4 years ❑ 5+ years ❑ Don't know

3. Is your system presently real-time, two-way active?

❑ Yes ❑ No ❑ Don't know

4. If not, are there any plans to activate the return path? If yes, when?

❑ Yes ❑ No ❑ Don't know

When?_____

5. How difficult do you think it will be to fire up the return plant and keep it "clean" enough to offer services like telephony and data reliably?

❑ Difficult ❑ Slight problem ❑ No problem

6. Do you think your system will have to use an advanced modulation scheme like spread spectrum to make the return path more usable?

❑ Yes ❑ No ❑ Don't know

7. Seven years from now, do you think people will be spending more time interacting with the TV–or with a personal computer?

❑ TV ❑ PC ❑ Don't know

8. If you offered true video-on-demand services today where movies cost $5 each, what percentage of your subscribers would buy them each month, in your opinion?

❑ Less than 5% ❑ 5-10% ❑ 10-30% ❑ 30+%

9. If you offered high-speed data and Internet access at $40 per month today, what percentage of your subscribers would sign up, in your opinion?

❑ Less than 5% ❑ 5-10% ❑ 10-30% ❑ 30+%

10. Has your system added fiber optic technology to help break the system up into smaller "cells"?

❑ Yes ❑ No ❑ Don't know

11. Overall, of the following choices, which has the highest priority with your system's management right now?

❑ Data delivery ❑ Telephony

❑ Interactive TV ❑ Plain old TV

Your comments:

Fax us at 303-393-6654

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

*Every month, we'll pick one response from those we receive and award $50. See official rules below.

Names won't be published if you request your name to be withheld, but fill out the name and job information to ensure that only one response per person is tabulated.

Your name and title

_____

_____

_____

System name:

_____

Location:

_____

Your MSO:

_____

Your job function:

_____

Daytime phone #:

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 September 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 October 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.

Drake VM2552A EAS Ready Stereo Video Modulator

Enhance your system with stereo audio and bring your system up to FCC regulations with the Drake VM2552A Stereo Video Modulator. The VM2552A modulator incorporates BTSC stereo encoding providing significant cost savings when compared to purchasing separate components. The VM2552A is EAS (Emergency Alert System) "ready," meaning that you can be prepared to meet the FCC regulations governing emergency alert broadcasts. The frequency agile VM2552A features frequency coverage up to 500 MHz. For more information, contact Phil Hawkins, **R.L. Drake Co.**, (513) 847-4523.

Circle Reader Service No. 86

Drake TSM1000 TV/SAT Signal Meter

The Drake TSM1000 TV/SAT Signal Meter provides installers with a quality portable test and measurement instrument for troubleshooting, maintenance and adjustment of all types of TV systems. The TSM1000 measures signal levels of satellite delivered programming to ensure accurate signal levels and proper operation of the receiving system. The TSM1000 also measures signal levels associated with off-air TV systems, as well as cable TV installation. **R.L. Drake Co.,** (513) 847-4523.

Circle Reader Service No. 87

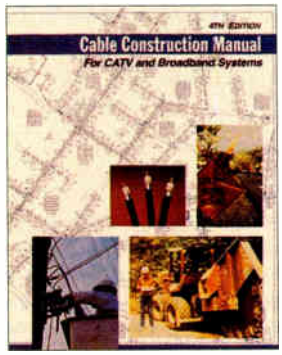
FREE Handbook

The FREE pocket size Cable TV Power Supply and Battery Handbook contains 125 pages of information for installers, maintenance technicians, system designers and cable TV engineers. Subjects such as power supply evaluation, plant layout, installation, maintenance and common problems encountered in the field are fully covered. Included is a special section on battery selection, management and testing. **Performance Cable TV Products,** Roswell, GA 30077-0947, (800) 279-6330. E-mail to jud.williams@industry.net

Circle Reader Service No. 88

Cable Construction Manual for CATV Broadband Systems

CommScope is now making available a revised and updated edition of its widely distributed and used Cable Construction Manual for CATV and Broadband Systems. The new manual includes sections on storage, testing and construction procedures for coaxial trunk and distribution cables in aerial and subsurface applications, fiber optic cables as well as safety procedures. For more information, call **CommScope/GI** at (800) 982-1708.



Circle Reader Service No. 89

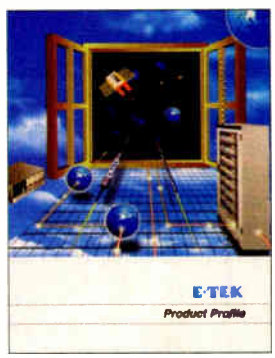
FONS Corp. Cable Assemblies

FONS Corp. is a leading manufacturer of fiber optic communications products, including patch panels, cable assemblies, adapters, attenuators, fiber management software, and transmission products. Operating primarily in the cable television, telecommunications, and data communications markets, we supply regional and national cable systems, RBOCs and large corporations with engineered solutions for flexible, modular, easy-to-install, and cost effective communication systems. For more information, call **FONS** at (508) 393-4268.

Circle Reader Service No. 90

E-Tek's New Product Profile

E-TEK's new color catalog describes products including optical isolators, couplers, splitters, WDM, combined optics, attenuators, laser source, active/passive components, optical switches, laser amplifiers, controllers, production and test equipment. E-TEK combines innovative excellence, affordability and fast delivery for a wide range of fiber optic applications. Call for more information or for individual product data sheets. **E-TEK Dynamics, Inc.,** 1885 Lundy Ave., San Jose, CA 95131, (408) 432-6300, Fax (408) 432-8550.



Circle Reader Service No. 91

NCTI Spanish/English CATV Illustrated Dictionary

The National Cable Television Institute (NCTI) offers a new Spanish/English illustrated dictionary of cable television and broadband technology terms. The first section presents English terms with Spanish translation and Spanish definition. The second section offers Spanish terms with English translation and English definition. Cost $29.95 plus S/H; quantity discounts. Please contact: **NCTI**, 801 West Mineral Ave., Littleton, CO 80120-4501, (303) 797-9393, Fax (303) 797-9394.

Circle Reader Service No. 92

FREE 1996 Fiber Optic Test Equipment Catalog

Noyes Fiber Systems announces its new FREE 1996 Fiber Optic Test Equipment Catalog. The full color catalog provides an overview of the products and services offered by Noyes Fiber Systems including Optical Power Meters, Light Sources, Loss Test Sets, Return Loss Test Sets, OTDR's, Fiber Scopes, and Fiber Identifiers. Call Noyes Fiber Systems, P.O. Box 398, Laconia, NH 03247, (603) 528-7780,. (800) 321-5298 or Fax (603) 528-2025.

Circle Reader Service No. 93

Network Monitoring Software

BARCO's ROSA software provides head-end and network performance monitoring and provides control for automatic service restoral. ROSA operates through an easy-to-use Windows graphical environment, controls both BARCO and non-BARCO network equipment, and interfaces to most leading database packages. The system generates alarms to alert the operator when problems occur and can automatically initiate switching to backup equipment, maintaining signal continuity and maintaining subscriber satisfaction by minimizing out-of-service time. **BARCO, Inc.** 1235-A Kennestone Drive, Marietta, GA 30066, (770) 590-7900, Fax (770) 590-8836.

Circle Reader Service No. 94

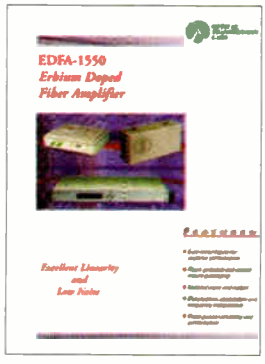
Alpha Introduces New System Solution Power Supply

Alpha Technologies has introduced the industry's first fully integrated system solution power supply. Named Genasys, this new line incorporates fully uninterrupted, user-selectable output voltages, complete modularity and several packaging and performance options. Genasys meets 1350 to 8000 watt centralized node power requirements and can be configured as simple or sophisticated as required. For more information, contact Alpha Technologies, 3767 Alpha Way, Bellingham, WA 98225 (800) 421-8089.

Circle Reader Service No. 95

1550 nm AM Transmission Systems: More Power & Options

Synchronous Group, Inc. is the leading supplier of high performance 1550 nm AM transmission systems for Cable, HFC and Advanced Network systems. Discover our new and expanded line of External Modulation Transmitters and Erbium Doped Fiber Amplifiers. Our new product catalog is now available. To obtain your copy, call (800) 659-6750 or Fax (408) 362-4826.



Circle Reader Service No. 96

NEW! Amplifier Catalog

Viewsonics Inc. full color catalog contains photos and specifications of all of their amplifiers, including their newest low noise models with the figure at 3 dB and 3.5 dB, depending on the gain, as well as several new 2-way models. You'll find their amps all over the world including places you've never heard of, so call (800) 645-7600 and/or Fax (407) 998-3712 for your free Viewsonics Amplifier Catalog today.

Circle Reader Service No. 97

Universal Remotes with ENHANCED MEMORY RETENTION

ABC Cable Products has added an enhanced memory retention function to their ProMote II family of universal remote control units for the CATV industry. The feature allows the remote control to retain its memory for months after the batteries have reached the level where the remote no longer functions. And once the batteries are removed, the memory is retained for up to six hours before replacement with new batteries — even if the keys are accidentally pressed. This feature is now standard on all ProMote II remotes. Call now for more information! (800) 777-2259.

Circle Reader Service No. 98

FREE: Wavetek's New 1996 CATV Selection Guide

The new 27-page *Cable Television Selection Guide* presents a full line of sophisticated test equipment designed to meet cable television's specific system testing needs. The guide features **Wavetek's** new leakage meter and combination leakage/signal level meter, the CLI-1450. The new CMS 1000 Central Monitoring System is included, along with info on the complete line of MicroStealth signal level meters. In addition, the popular Stealth System Sweep, Flash Mini OTDR, and other test equipment are featured. **Call (800) 622-5515.**

Circle Reader Service No. 99

Vela Research for Video Servers, Encoders and Decoders

Vela Research Inc. designs and manufactures video servers, encoders and decoders. Their Perspective 2000 video server stores digitized video (movies, video clips, commercials, etc.) in a compressed digital format (MPEG-1, MPEG-1+ and MPEG-2) and can deliver multiple NTSC or PAL video outputs. Vela's MPEG Encoder can compress and multiplex audio and video signals into MPEG compliant data streams. Vela's MPEG decoder boards are designed for a wide range of video applications. Contact Vela Research at (813) 572-1230.

Circle Reader Service No. 100

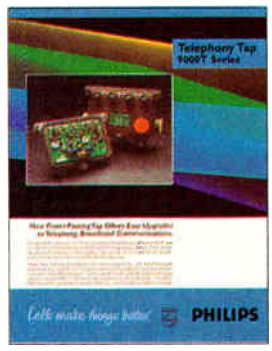
Opening the Lines of Communications

BURNUP & SIMS through a merger in 1994 formed the world's leading telecommunications infrastructure provider. MasTec, publicly traded parent company, with combined assets of 480 million and employees exceeding 5,000. **BURNUP & SIMS TSI** — Cornerstone of MasTec's Cable Television operations continues the 25 year plus history of building Broadband Systems and 65 years of Tele-Communications Contracting. Call (770) 492-9700, Fax (770) 492-9710 for more information.

Circle Reader Service No. 101

Philips Offers Data Sheet on 9000T Series Telephony Tap

Philips Broadband Networks, Inc. has launched a series of product data sheets, including one detailing the company's 9000T Series power-passing telephony tap, featuring the Tel-Spot, Philip's unique reflective indicator for quickly indentifying a telephone-ready tap from ground level, even at night. To request literature or for additional information when calling in the U.S., please phone (800) 448-5171 (in NYS (800) 522-7464). If calling internationally, please call (315) 682-9105.



Circle Reader Service No. 102

Philips Broadband Introduces Four-Port Optical Node Amp

The high-performance Diamond Net™ optical node amplifier (6-DNA) features four active Power Doubling™ outputs that improves system performance and reliability. The new four-port DNA can be configured and adapted to add greater reach and flexibility in design. The unit has a patented design with many features to increase control of the powering system. For literature or additional information when calling in the U.S., phone (800) 448-5171 (in NYS (800)-522-7464). Internationally, (315) 682-9105.

Circle Reader Service No. 103

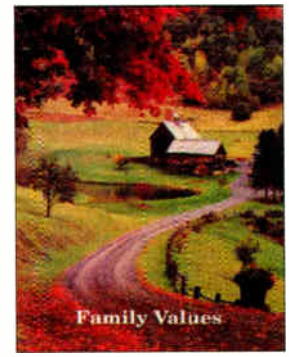
EAS Messaging Systems From ALBRIT

CABLE ENVOY© — Affordable and flexible solutions to EAS-message channel distribution requirements and FCC compliance without dropping program signals. Multi-mode capabilities include videotext crawls, page mode displays and audio messaging as well as remote telephone message and voice-over capabilities for local emergency officials. RF processor and IF generator configurations. Commercial applications defray EAS compliance costs. Suitable for all CATV systems great and small. Call Ken Lawson at (801) 942-2207 or Fax (801) 942-5798.

Circle Reader Service No. 104

Technical Software from FamilyWare

Our software family is used by thousands of cable operators worldwide to meet technical dept. needs. MOM (Monthly Outage Management) helps reduce outages. POP (Proof of Performance) documents proof tests. LES (Leakage Evaluation System) is the industry standard for controlling leakage. For details on our complete family, call (702) 827-2522 or Fax (702) 827-1866.



Circle Reader Service No. 105

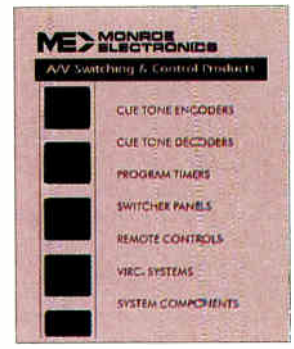
Innovations in Testing and Distribution

MULTIDYNE provides excellence in Fiber Optics for video, audio and data; Test Signal Generators to test performance to FCC specifications; video and audio Source ID Generators; Video Cable Equalizers; Distribution Amplifiers for up to 150 MHz video, audio, data and DS3; Routing Switchers as well as television accessories. Applications include Broadcast and Cable Television, Telephone and Distance Learning. **MULTIDYNE** Inc. 191 Forest Avenue, Locust Valley, NY 11560-2132 USA. (800)-4TV-TEST, Fax: (516)-671-3362.

Circle Reader Service No. 106

Monroe Audio/Video Switching

Monroe Electronics designs, manufactures and markets - to worldwide customers — a full line of electronic manual programmable audio/video switching, timing and remote control equipment. These products are used by the cable, wireless, braodcast and telephony industries. Monroe's products have a time proven record of reliability and we are eager to assist customers with their standard or custom switching product needs. For support you require on our products or services, call (716) 765-2254 or (800) 821-6001, Fax (716) 765-9330.



Circle Reader Service No. 107

Fiber Optic and CATV ID Labels

VIP™ Products 1996 Catalog offers fiber optic, CATV, telephony, and Outside Plant identification labels, tags, markers, and signs. FREE catalog features stock products, includes pricing, and a sample packet of most popular items. Stock available for immediate shipment, credit cards accepted. Custom products mfg. to your specs. Call today for FREE info. (800) 950-4921 or Fax to (800) 967-3986.

Circle Reader Service No. 108

Interactive Product Catalog Available

Reserve your copy of Cable Prep's Interactive Product Catalog. This new Windows®-based software lets you easily use our cross references to find tools to match the major cables and connectors. Easily print instruction sheets and view application pictures. A graphical map puts you in instant contact with your closest or preferred distributor. Call **Cable Prep** at (800) 394-4046, (860) 526-2291 to reserve your free copy today.

Circle Reader Service No. 109

AEL's AELINK Brochure Now Available

This brochure describes the AELINK product line that includes high power externally modulated fiber optic transmitters, (1300nm and 1550nm) optical fiber amplifiers and optical receivers. It also includes specific data sheets on each model. These products combine external modulation technology with superior signal conditioning and temperature compensation to provide the ultimate in network flexibility. AEL, A Tracor Company, Optical Communications Division, 305 Richardson Road, Lansdale, PA 19446-1485. Phone (215) 822-2929, extension 2941 or Fax (215) 822-2608.

Circle Reader Service No. 110

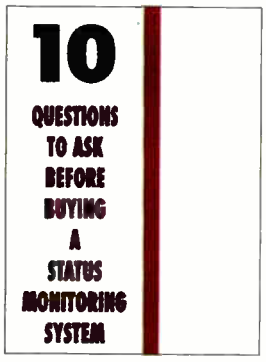
An SOS For Your System!

Hybrid fiber/coax (HFC) infrastructures should be extremely reliable, fault-tolerant, and cost effective, permitting smooth transitions to the new services of tomorrow. Switchable Optical Splitters (SOS), new fiber components manufactured by **OptiVideo Corporation**, permit adding self-healing rings and route redundancy to your system with no additional transmitters. For information on how SOS can plug-and-play in your rebuild, call (303) 444-2160.

Circle Reader Service No. 111

Cheetah's Answer to Monitoring

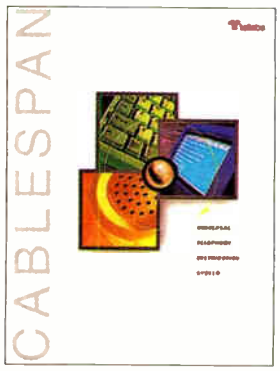
Cheetah™ provides an integrated network monitoring solution that is designed to evolve with your network requirements. This solution offers flexibility, reliability and the ability to integrate equipment from multiple vendors. Cheetah provides status monitoring of headends, fiber nodes, power supplies, amplifiers and end-of-lines. For the "10 Questions You Need To Ask Before Ordering A Status Monitoring System", call **Superior Electronics Group** at (941) 756-6000.



Circle Reader Service No. 112

New CABLESPAN™ Brochure from Tellabs

A new, full-color brochure from **Tellabs** describes the benefits of the company's CABLESPAN 2300 Universal Telephony Distribution System, which allows cable television operators to provide telephone and data services using the existing CATV infrastructure. Alternate-access providers will also find the CABLESPAN system to be a unique, innovative approach to providing business and residential telecommunications services around the world. To receive a copy of the brochure, call (800) 445-6501.



Circle Reader Service No. 113

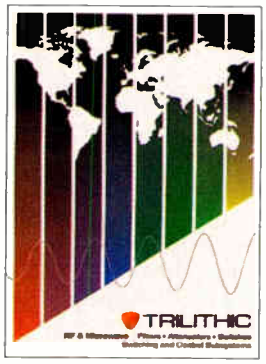
FIBER End-to-End Systems

Ortronics delivers leading edge fiber technology with our wall or rack mount cabinets, adapters, jumpers, pigtails, patch and splice accessories and fiber management. Other system solutions include multimedia workstation and closet products, raceway, patch panels, 110 cross-connects, wire management, interface cords, and more. Ortronics also offers custom products, technical support, training and our 25-Year Warranty Programs! Ortronics, Inc. 595 Greenhaven Road, Pawcatuck, CT 06379, USA. Sales: (860) 599-1760, Fax: (860) 599-1774.

Circle Reader Service No. 114

New Catalog from TRILITHIC

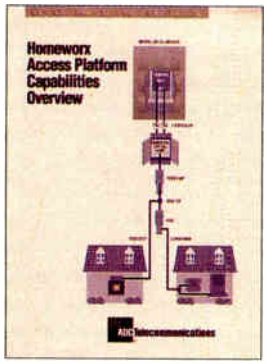
From signal level meters to leakage detectors, from frequency counters to calibration equipment, the new Instruments Catalog from **TRILITHIC** has all of the products you need to test and maintain your CATV/Broadband distribution system. Updated in September, the catalog now includes such popular new instruments as the TRICORDER II and III and the SUPER PLUS leak/ingress locator, and the current price list. Trilithic Inc., 9202 E. 33rd St., Indianapolis, IN 46236. Phone (800) 344-2412.



Circle Reader Service No. 115

ADC Homeworx Access Platform Overview

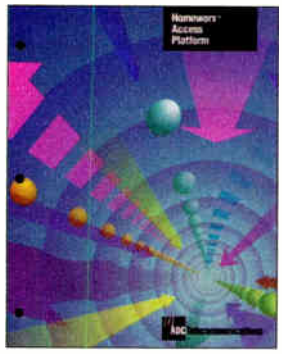
This overview discusses ADC's Homeworx platform, a fully integrated loop access and transport system with telephony and video subsystems. With the Homeworx platform, the subsystems can be installed separately or simultaneously, depending on the service provider's needs. The platform accomodates basic and premium cable TV services, and allows service providers to gradually add more sophisticated services, such as video-on-demand and interactive television. **ADC Telecommunications**, (800) 366-3891.



Circle Reader Service No. 116

ADC Frameworx Fiber Frame Architecture

This complete package contains information on ADC's integrated approach to total fiber distribution frame cable management. Frameworx is a platform on which service providers can build a total fiber distribution frame management system that provides automated record keeping, remote test capabilities, patch cord traceability, optical amplification and advanced circuit schematics such as signal monitoring, switching, attenuation and wavelength division multiplexing. **ADC Telecommunications**, (800) 366-3891



Circle Reader Service No. 117

Zenith's Broadband Solutions

With more than 15 years of experience in the Network Systems areas, **Zenith Electronics Corporation** has extensive development and deployment expertise in advanced analog set-top decoder technology, including video and audio scrambling, real-time two-way cable systems, digital transmission technologies and computer networks, and is the industry-leading supplier of high-speed cable modems to more than 300 cable systems worldwide. For more information, call (800) 239-0900.

Circle Reader Service No. 118

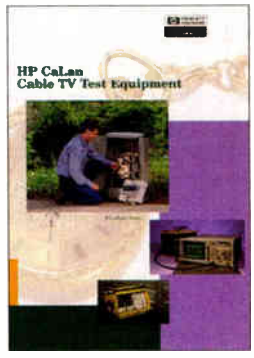
Zenith's MetroAccess™ System

MetroAccess is a complete, cost-effective family of RF data communication products from **Zenith Electronics Corporation**. It uses proven, high-speed technology for hybrid fiber/coax systems linking businesses, communities, schools and residences for a wide range of applications, including work-at-home, distance learning, real-time video conferencing, Internet access and on-line services. For more information, call (800) 788-7244.

Circle Reader Service No. 119

New Brochure From Hewlett Packard

Hewlett-Packard's new cable TV test equipment brochure is now available. This new piece highlights HP CaLan's complete line of test equipment for every task, at the headend and in the field. Featured in this brochure is HP CaLan's new SWEEP/INGRESS ANALYZER - the industry's most essential tool for two-way system activation and maintenance. Also featured is the HP CaLan 8591C cable TV analyzer - the industry's only one-box tester for all non-interfering RF and video measurements. For your copy of this new, comprehensive brochure please call HP CaLan at (800) 452-4844, x. 2009.



Circle Reader Service No. 120

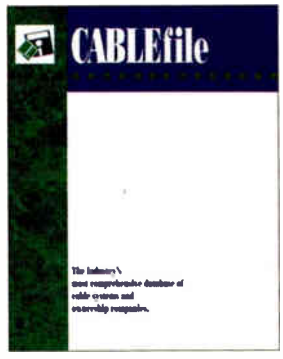
Digital Video Media Server Technology

Digital Video (DV), a division of Arris Interactive, provides server-based advertisement insertion, Near-Video-On-Demand (NVOD), and media store and forward applications for the cable, television, and telco industries. DV's product line provides solutions from a single platform over today's HFC networks to multi-node systems. Most importantly, DV's system is open standards-based, supporting MPEG-2 with transport streams, SNMP, SQL and other industry standards. DV, a division of Arris Interactive, is a joint venture between NORTEL and ANTEC. Tel: (800) 469-6569. Fax (770) 734-9823.

Circle Reader Service No. 121

Make Your First Sales Call To CABLEfile

To make your marketing and sales plan complete, call (303) 393-7449. CABLEfile is the most comprehensive and current database of cable systems and MSOs available. Keep up with changes in personnel, ownership and construction plans by subscribing to our update program. CABLEfile has been compiling statistics on the cable industry since 1982. If you need specific marketing research, please call for our custom research rates.



Circle Reader Service No. 122

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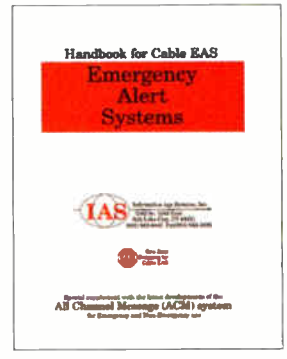

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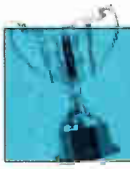

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A fair warning label to alert consumers

By Walter S. Ciciora, Ph.D.

In my last column, I discussed the FCC's responses to the Petitions for Reconsideration to its 1994 Report and Order (Docket No. 93-7) on compatibility. My major concern remains that the FCC reversed its earlier rule requiring products which do not fully comply with its yet-to-be-defined definition of "cable ready" to carry an advisory label. While the FCC called it an "advisory label," the consumer electronics manufacturers called it a "negative label" or a "skull and crossbones." I prefer to call it a "fair warning label" because it would alert consumers to stop and think about this purchase.

The fundamental problem

The term "cable-ready" was *unilaterally* created by the consumer electronics industry without any authorization or approval from the cable industry. There were not even inter-industry discussions about what should constitute cable-ready technical specifications. The term has become meaningless. It has been used arbitrarily by manufacturers to entice consumers to buy products that frequently yield only disappointment when a cable operator provided set-top terminal is required to compensate for the product's deficiencies.

The "fair warning label" was originally required to be used on non-complying products starting June 1997. In our comments to the FCC, we made it clear that we would be willing to tie that date until a reasonable period after the FCC's cable-ready rules were established.

It's important to note that the only absolute requirement previously put on consumer electronics manufacturers was to provide a "fair warning label" on products which did not comply with the FCC's rules for cable-ready products. With the elimination of that rule, *the entire burden for compatibility has been shifted to the cable industry.* Consumer electronics manufacturers who choose not to make equipment which complies with FCC cable-ready rules have no obligations whatsoever–and salespersons can imply that the products available are cable-ready by use of FCC-allowed "factual" statements.

A fundamental of marketing is that the consumer compares the features, quality and price of a superior product to competitive products and decides if the advantages are worth any additional price. If a retailer cannot convincingly make such a "value proposition" to the consumer, the superior product will not sell.

Cable-ready products will have higher quality components and additional features which will add cost. Additionally, there will be non-recurring engineering costs and tooling costs to modify product designs. In the highly competitive consumer electronics business, cost is a major issue.

The strong opposition to the fair warning label causes a doubt as to whether there will ever be cable-ready products. If consumer electronics manufacturers had a desire to make and sell cable-ready products, it would seem advantageous to have a fair warning label on non-cable-ready TVs and VCRs, clearly distinguishing them from the higher quality, but higher-priced versions. It will be difficult to sell more expensive cable-ready units against low-priced products on the salesroom floor, where a laser disc player is the usual signal source and all of the TVs have excellent pictures. Price then becomes the most noticeable difference between them.

Because the FCC has allowed advertising which strongly implies cable-ready, the easy route for consumer electronics manufacturers is to avoid the cost of making products which are truly cable-ready and just allow consumers to be given the impression that normal products will give full satisfaction. The FCC specifically allowed the EIA's examples of: ... "tunes cable channels with unsurpassed accuracy" or is "capable of receiving 125 cable channels." To make matters worse, products which do not meet FCC requirements for cable-ready can still carry a statement that they are cable-ready according to the Canadian rules!

Given all of this, it is hard to imagine why a consumer electronics manufacturer would ever go through the expense of designing and building equipment which complies. I'm afraid the likelihood of seeing truly cable-ready products has been reduced to near zero, and the probability that inadequate products will be represented as cable-ready has been all but assured!

Cable's fair warning

The responsibility for advising consumers about the hazards of products which tune cable channels but do not fully comply with the FCC's technical rules for cable-ready falls squarely on the cable industry. It is critical that the cable industry use the means at its disposal to ensure that consumers' expectations for non-complying products are properly managed. This includes an understanding of what the products cannot do, and who to contact when there is a disappointing result. If consumer frustration and anger are not directed to their proper source, they will again go to the city council, the PUC, the FCC and Congress.

Cable operators should advise consumers that the FCC has determined that there is no such thing as a cable-ready TV or VCR. The FCC specifically forbids the use of the terms cable-ready or "cable compatible" or any terms which might imply this capability unless the products fully comply with FCC rules. Because the rules are not complete, no products can comply. Consumers should be warned that any statements implying that a product is cable-ready are incorrect and in violation of FCC rules. Consumers should be informed that under common signal circumstances, and for certain very desirable cable services, a set-top terminal will be required with TVs and VCRs sold with the unfortunate implication that they are cable-ready. CED

Have a comment?
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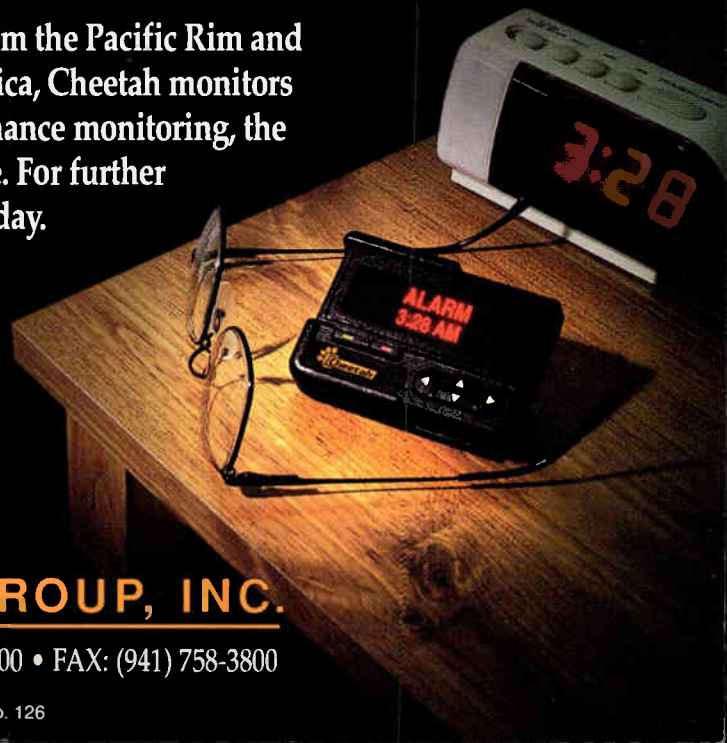

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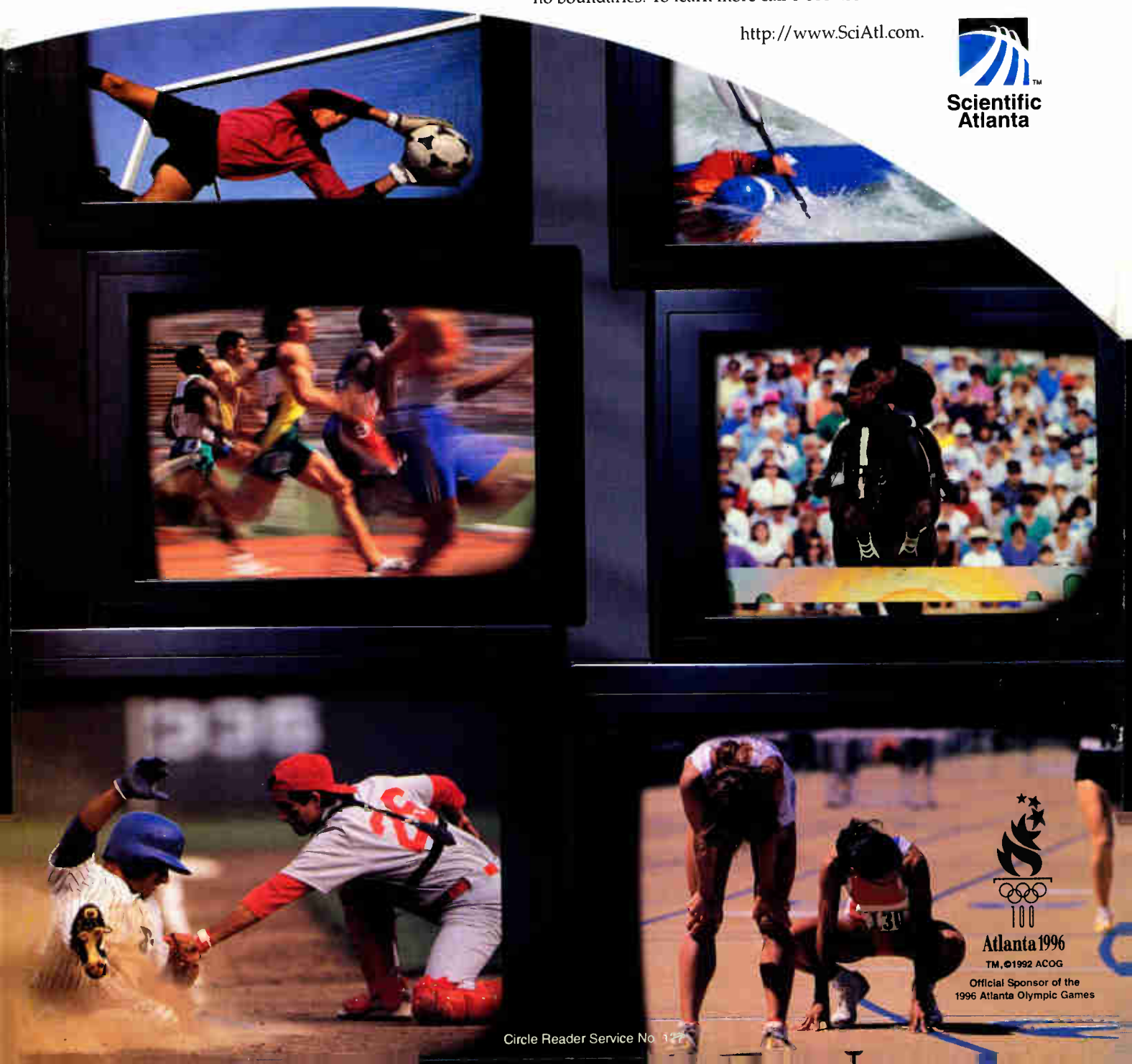

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