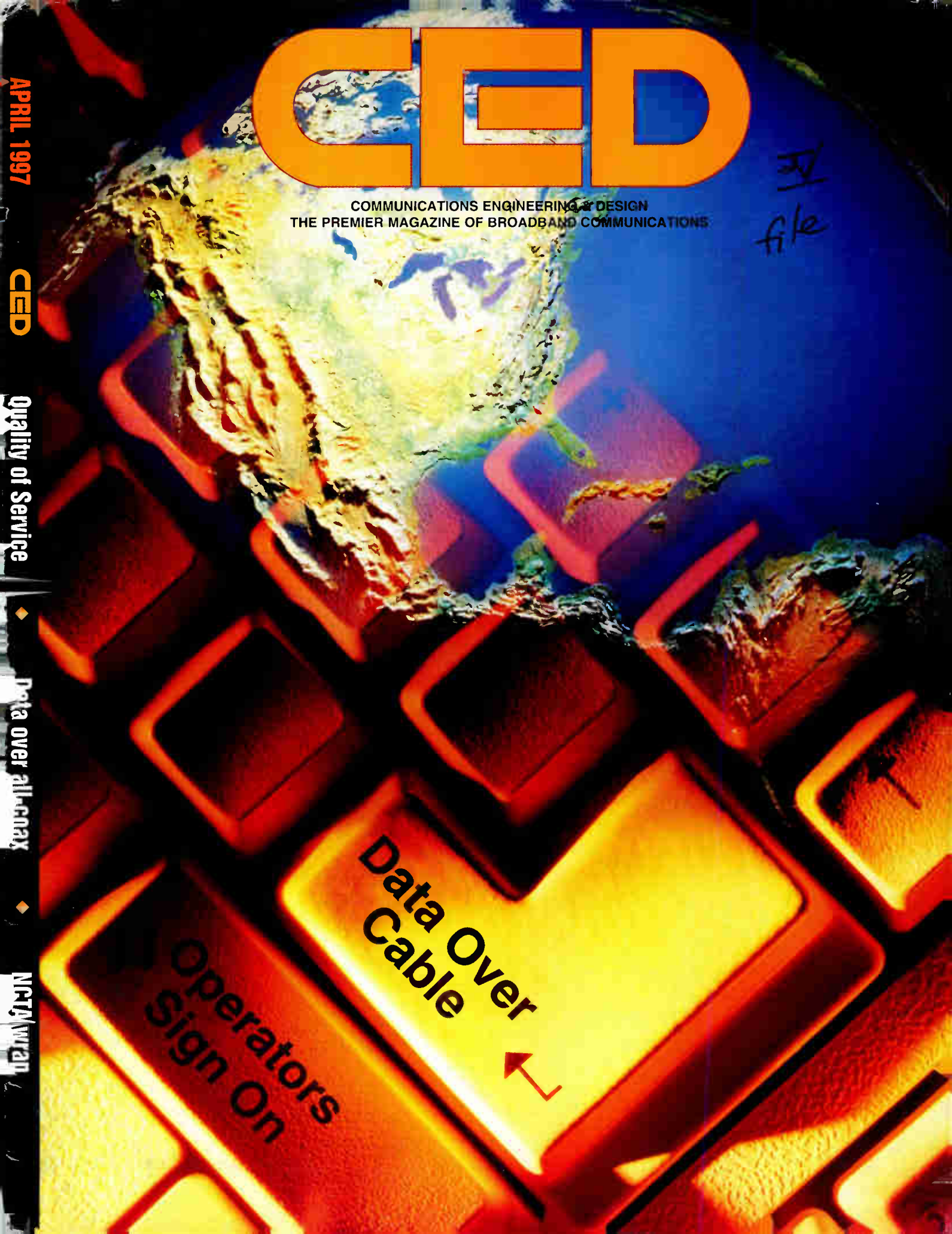
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COMMUNICATIONS ENGINEERING & DESIGN
THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS
APRIL 1997
CED
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Data over all-coax
NCTA wrap
Data Over Cable
Operators Sign On

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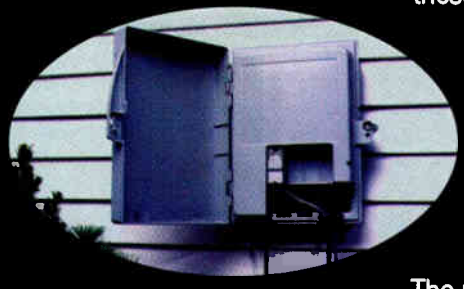

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Reader Service 1

Real-world data story looks promising

During a meeting last month, I was asked if I thought high-speed data over cable was really going to be a viable service offering. Standing in front of an intelligent, data-savvy crowd, I was tempted to take the easy way out and just tell them what they wanted to hear–a resounding "yes."

Instead, I paused. Thoughts of 500 channels, digital compression, full service networks, interactive TV, Teletext and other failures or missteps flooded my brain. I've seen a lot of neat technology that never went anywhere, largely for non-technical reasons (interdiction, anyone?). So, call me skeptical. Call me jaded. I'm both.

But, do I think datacom over cable will take off? Without a doubt, I do–unless the fickle public decides the Internet, chat rooms and new on-line services were just the latest passing fads. But with new content offerings, the promise of on-line gaming, the ability of the medium to renew itself almost constantly and the incredible popularity of America Online and its brethren, will on-line services flame out soon? I doubt it.

The challenge for cable systems isn't really technical; it's operational. Can cable operators train their technical and customer service personnel to understand and deal with data problems? Can software be written so that customers only get one bill? Can help desks actually provide help, without leaving a bitter taste in the consumer's mouth? Those will be the key questions going forward.

To amplify those suppositions, I point to an interesting research survey by Douglas Shapiro, an analyst with New York-based Deutsche Morgan Grenfell. While small in scope, the survey directly contacted 30 paying customers of high-speed data services offered by three different providers (@Home, RoadRunner and Highway 1) and reports on how they feel about speed, reliability, customer service quality, installation procedures and overall satisfaction.

The good news: Consumers are elated with the system's speed and report few or no problems with modems. Shapiro says consumers are almost "exuberant" in their love for the service, with some noting that it's a steal at $40 per month. Even where some problems have been encountered, nearly everyone said they'd recommend the service to a friend.

Now for the bad news: Customer service and technical support have been identified as the Achilles' heel. Of the 30 people contacted, five reported problems. All of those were customers of Time Warner's RoadRunner service (mostly in Akron, Ohio). Complaints ranged from lost e-mail to numerous outages; but complaints over customer service really got people worked up.

That means anyone who plans to launch data services over a cable system must have enough personnel to answer the phone; be prepared to deal with a wide range of questions and problems; and be better than the telcos when it comes to overall service.

Can the MSOs do it? Shapiro thinks so. He says the quick survey shows that operators are indeed equipped to handle the complex technical issues–if they devote the resources. Are you ready?

Roger J. Brown

Roger Brown
Editor

CED MAGAZINE

VP Group Publisher
William McGorry

Publisher
Robert C. Stuehrk, Rstuehrk@aol.com

Editor
Roger Brown, Rbrowner@aol.com

Managing Editor
Dana Cervenka, Dlcervenka@aol.com

Associate Editor
Michael Lafferty, McLaffrt@aol.com

Contributing Editors
Leslie Ellis, Ellis299@aol.com
Fred Dawson

CONSULTING ENGINEERS

Chairman
Wendell H. Bailey, NCTA VP, Science and Technology

MEMBERS
Jim Chiddix, Chief Technology Officer, Time Warner Cable
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Director of Sales & Marketing
Scott C. Snyder, SSnyderCED@aol.com

National Accounts Managers
Linda S. Sommer, Lssommer@aol.com
Michael Tangney, TangneyCED@aol.com

Account Executive
Todd Marquez, Tmarquez@chilton.net

Classified Sales Manager
Tim Reeder; 800/866-0206

Assistant to the Publisher
Michelle Pazar

Production Manager
Johanna McGinnis, Jmcginni@chilton.net

Art Director
Don Ruth, Druth@chilton.net

Assistant Art Director
Anney Grossberg, Agrossbe@chilton.net

Address
600 S. Cherry St., Suite 400
Denver, CO 80222
303/393-7449; Fax 303/393-6654
Web site: http://www.cedmagazine.com

Circulation Director
Maria Gottlieb; 212/887-8565

Associate Circulation Manager
Shawn Green; 212/887-8564

Subscriber services
CED, P.O. Box 10728
Riverton, NJ 08076-0728
Telephone: 609/786-0501; Fax: 212/887-8493

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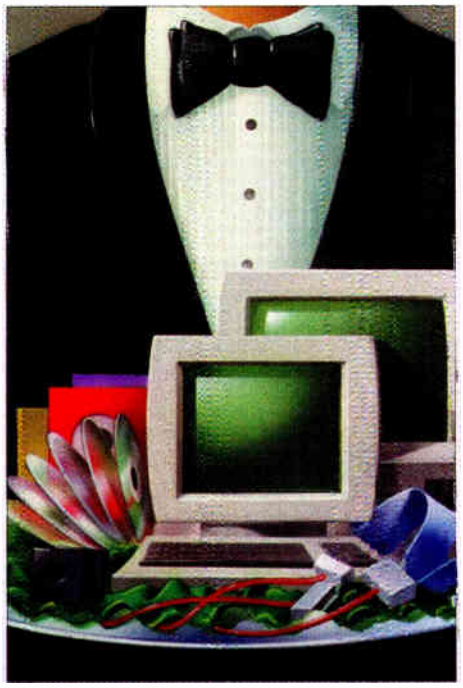

Illustration by Theo Rudnak, SIS

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Modern cryptographic techniques, employing a combination of symmetric and public key cryptographic mechanisms, can address and resolve the security issues associated with data over cable services. However, this must be accomplished in a way that doesn't drive up the costs of the service or equipment, while preserving the effective bandwidth available to users.

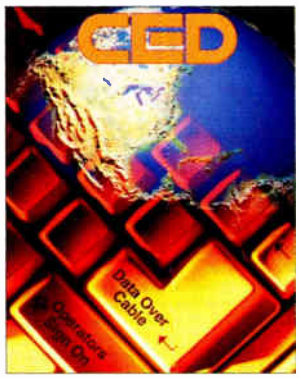

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Photo by George B. Diebold, The Stock Market

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At last month's National Show in New Orleans, vendors were eager to show off new developments in digital fiber optic technology and network management to technology-hungry cable executives. And in keeping with several recent industry gatherings, data, data, and more data news seemed to dominate the show, including the latest developments from the MCNS group.

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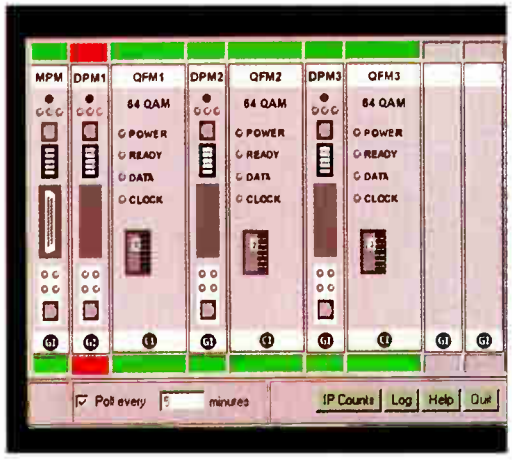

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Is ingress making your return path a road to nowhere?

Ingress is the major roadblock to getting your return path up and running. Fortunately, there's the new HP CaLan Sweep/Ingress Analyzer. It's the only test gear that allows you to quickly and accurately troubleshoot your system, regardless of the presence of ingress.

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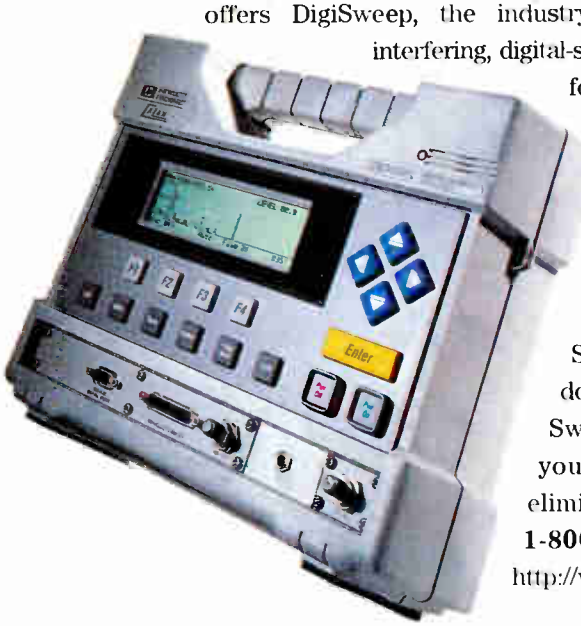

So don't let ingress slow you down. To find out how HP CaLan's Sweep/Ingress Analyzer can help you identify, troubleshoot, and eliminate your ingress problems, call **1-800-452-4844, Ext. 1748**. Or visit us at: http://www.hp.com/go/catv

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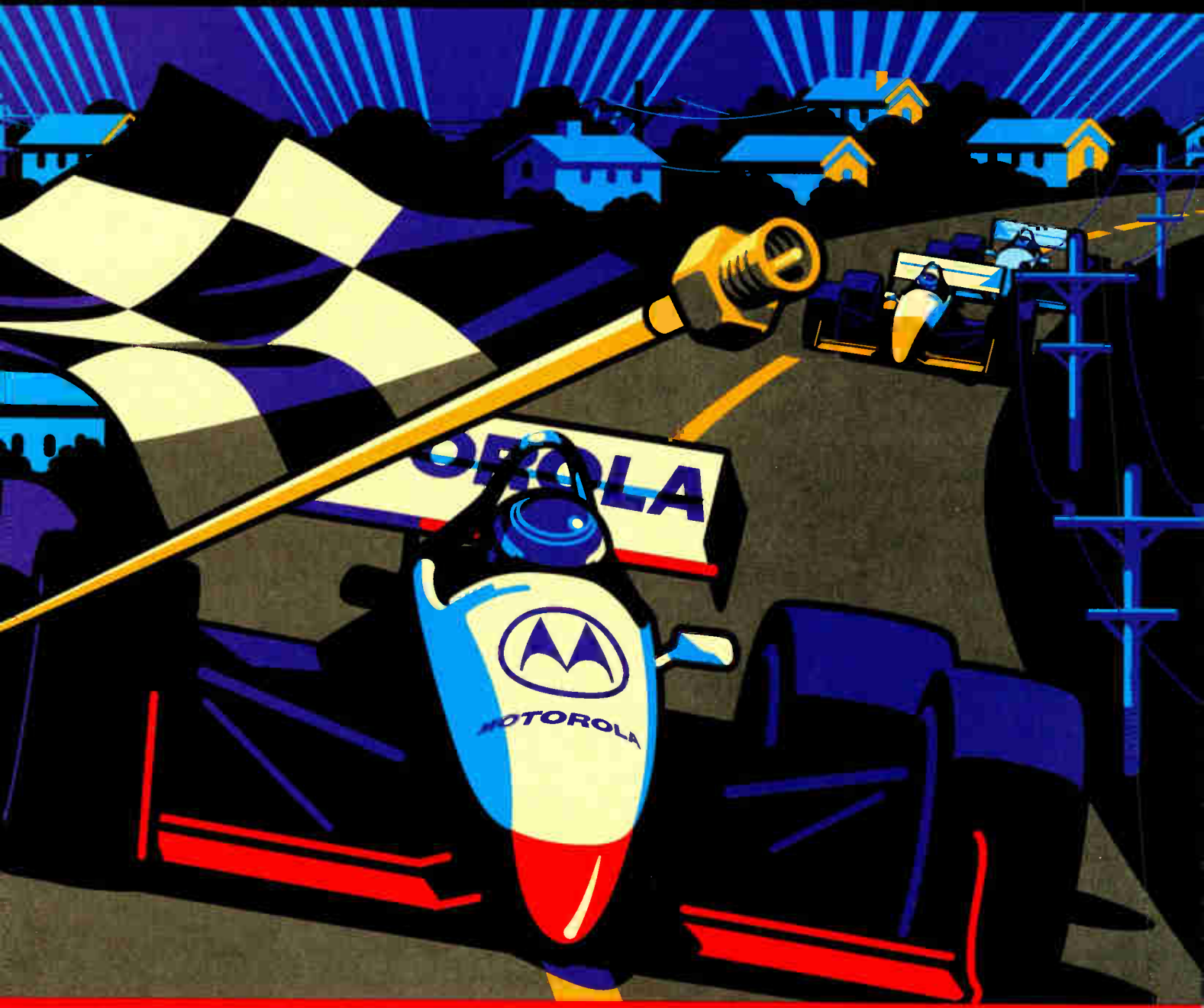

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The high-speed data race is on; cable and MMDS ops do battle

The race to provide high-speed Internet access and data communications over networks is rising to a fever pitch as several cable TV and MMDS operators have committed to purchase modems and are rolling out customized services to consumers.

Within the past 60 days, Continental Cablevision launched its "Highway 1" service in suburban Detroit (its third market), while TCI deployed @Home in suburban Chicago, marking the third market it is serving. Time Warner is also up and running in a handful of markets and plans to deploy asymmetrical modems manufactured by Toshiba Corp. in Portland, Maine.

Adelphia also got into the act, choosing to purchase telco-return SURFboard modems from General Instrument to go along with the LANcity modems from Bay Networks it has already deployed. Adelphia is offering data services to 126,000 homes passed in Riviera Beach, Fla. and plans to expand that number to 600,000 homes in Florida by later this year. By the end of the year, 1 million Adelphia homes will have access via either two- or one-way modems.

MMDS operators are also getting into the act. Spike Technologies Inc. launched its broadband bidirectional wireless local loop, offering Internet access, wide area network connectivity and videoconferencing over MMDS spectrum. The service is being provided by Spike's Third Rail Wireless Services division using Spike's PRIZM Broadband Delivery System.

The system requires only two 6-MHz channels, has an aggregate data rate capacity of 400 Mbps, utilizing a 20-sector antenna system, and individual users get 10 Mbps burst rate upstream and downstream.

Spike designed the PRIZM system around a proprietary narrow-beam compact sectored antenna technology. The base station is a roof-mounted design, and measures less than eight feet tall by three feet wide and deep. Spike's network operation center (NOC) contains ATM switches, high-speed Ethernet switches, a bank of RF modems, and mass storage. It is capable of switching up to 104 Gbps of digital traffic, allowing for future expansion of the PRIZM system.

Not to be outdone, three other "wireless cable" operators have chosen to get into the game, selecting equipment from Hybrid Networks.

Hybrid has developed a 64 QAM-based microwave transmission technology to deliver high-speed Internet access. The Series 2000 Wireless product family incorporates an internal 64 QAM modulator and adaptive equalization for improved robustness and fewer errors in a multipath environment.

It also provides 30 Mbps of speed in 6 MHz of bandwidth. The architecture allows data to be sent at 30 Mbps speeds split into three channels of 10 Mbps each. Subscribers can use conventional modems and telephone links for the return connection while receiving data at Ethernet speed. The 2 MHz channels can be combined to suit the available frequency bands and can be used independently to offer different grades or types of service.

When connected to a LAN, a single Hybrid modem can support up to 20 personal computers or workstations. For most applications, no additional routers are required at the subscriber location. The subscriber requires a rooftop or window antenna, connected by a coax cable to the modem/router. This system works with wireless cable equipment, educational television, and the new, short-range microwave broadcast systems proposed for use within cities. The frequency bands supported are MMDS, LMDS, ITFS and MDS.

Wireless operators Metro.Net, DirectNET and Selectview will be among the first to test or deploy the equipment. Metro.Net intends to use the technology in upgrades in Las Vegas; in Santa Rosa and Berkeley, Calif.; and in Prescott, Ariz. There are also plans in 1997 to roll the systems out in the greater San Francisco Bay area and Los Angeles, and other cities and markets where Metro.Net controls frequencies.

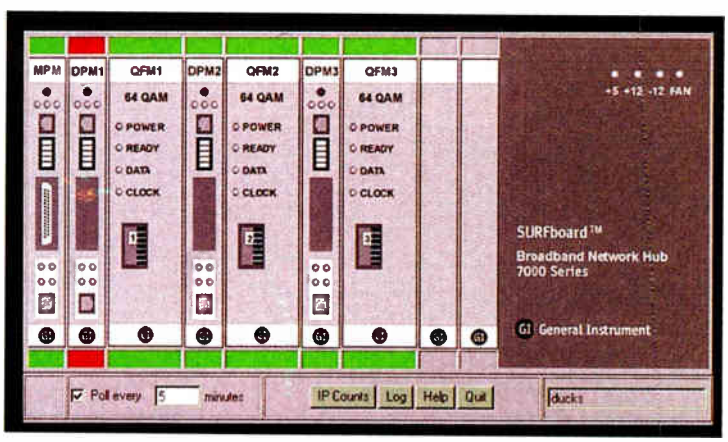
Meanwhile, DirectNET has signed a $3 million purchase order for the system and modems. DirectNET, a Virtual Private Network Provider, will be rolling out a secure Internet access service to businesses and end-user customers in the Ft. Lauderdale and Miami, Fla. areas, with six other markets to follow.

Finally, Canadian operator Selectview, the first company in Canada to receive approval to offer wireless Internet access, has selected Hybrid as its supplier of wireless access modems and headend systems. With a transmitter located atop the CN Tower, Selectview has a broadcast reach to more than two million homes and businesses in Toronto.

GI offers turnkey data solutions

General Instrument Corp.'s NextLevel Satellite Data Networks Group is working to provide turnkey high-speed data solutions to cable TV operators by bundling its SURFboard network with complete Internet service provision through relationships with on-line service companies such as Community Networks Inc. (CNI).

GI is working with CNI to provide Cablevision of Loudoun County, Va. with a complete data network solution. GI marries its 27 Mbps/telephone return modem and associated network with content developed by CNI, which also provides a comprehensive set of products and services which enable MSOs to launch and manage broadband data services. Those services include data network design, network management, systems integration, marketing and promotion, content management, community Intranets and customer support.



A mock-up of GI's new, rack-mounted SURFview data network management system.

Once the data network is installed, CNI also provides subscribers with a content service based on local community information and events. For example, subscribers can access up-to-the-minute traffic reports, school lunch menus and notes on a child's little league team–all without going onto the Internet. CNI

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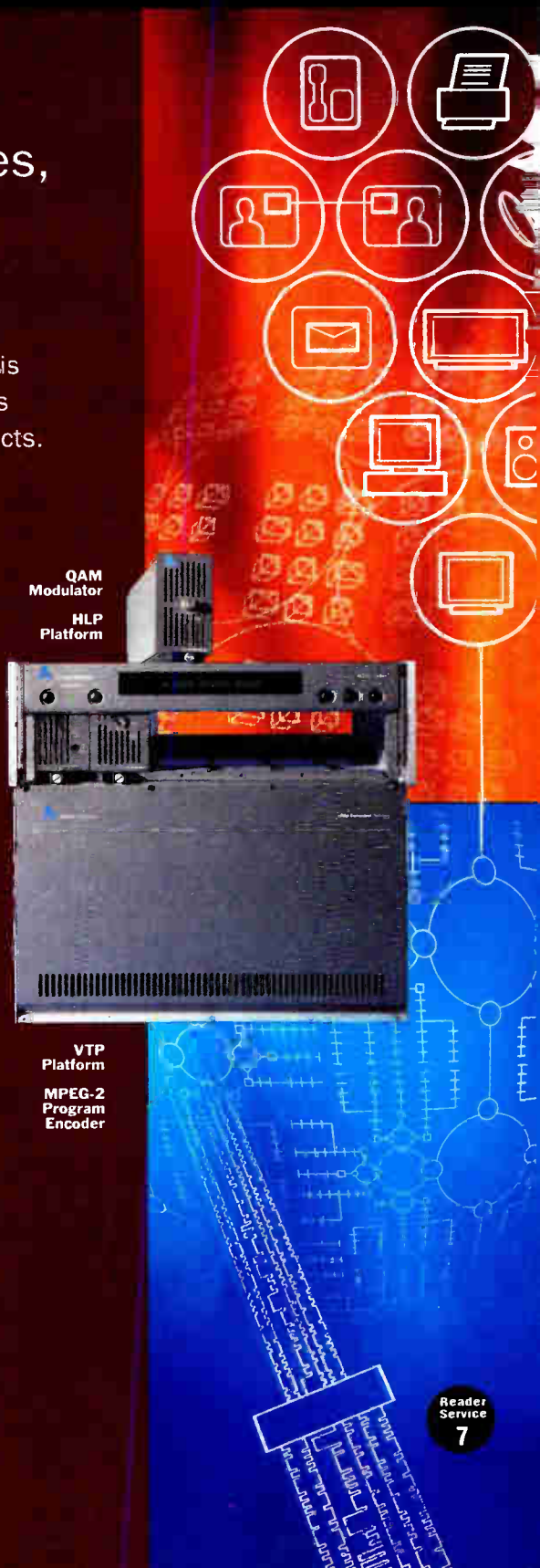

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also enables subscribers to customize a service interface that delivers news and Web sites of special interest on a daily basis, continuously updating and making new content available.

Cablevision of Loudoun County began testing the cable modems and network in February 1997. The commercial launch is slated for April 15, 1997. The test will include 300 subscribers. Several hundred more subscribers are on a waiting list for commercial service.

GI's first generation SURFboard cable modem is an internal ISA card that fits into the subscriber's PC. GI has also announced an external version that will use an Ethernet connection to the user's PC. It will be available in May 1997.

On the software side, GI is planning a suite of products that, together, will make up a Web-based management system that enables network operators to manage SURFboard modem networks. The "SURFview" management system offers a simple graphical user interface to monitor network operations.

Element managers monitor GI's Broadband Network Hub, which packetizes TCP/IP data and sends it out over cable TV networks via a modular chassis that provides an interconnect between high-speed routers and the cable system.

The system will work with any PC or Unix workstation with a Java-enabled Web browser. The element manager interfaces with a Web browser to retrieve a Java applet from the HTTP server, which resides on the Hub. In fact, to avoid distributing and maintaining updated versions of software, components of the management tool reside on the Hub.

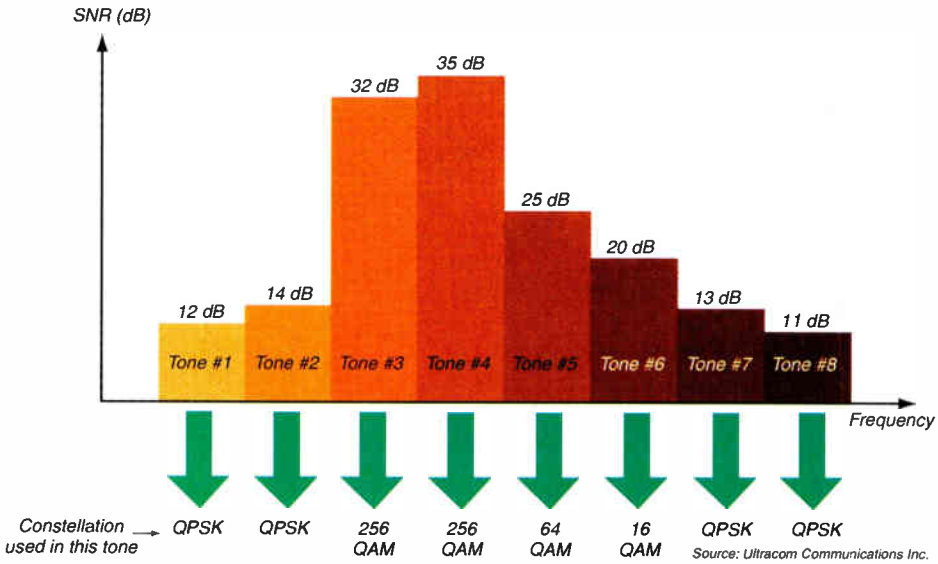
Interdiction enjoys comeback

Long-time cable industry veterans may get a dose of deja vu reading this, but Motorola and Scientific-Atlanta last month both announced significant enhancements and upgrades to video signal transport systems that deliver "clear," or unscrambled, signals to the home, making set-top boxes unnecessary.

Motorola introduced the "HomeClear Broadband Video System," a centralized descrambling system that can descramble more than 50 channels en masse while passing an unlimited number of clear channels.

The system is built around core technology developed by Multichannel Communication Sciences Inc. of San Diego. Known as "Omniband," the system was invented by Ron Katznelson, president of MCSI. Motorola invested in MCSI last year through its CyberSeed Venture program.

How Variable Constellation works



Motorola officials were quick to point out the advantage cable operators will have over competing technologies, including direct broadcast satellite, after deploying the HomeClear system. Katznelson also said work is underway on next-generation technology that incorporates program guides and centralized digital video decoders that would supply multiple TV sets.

The system is presently being trialed by Time Warner Cable in San Diego, which plans to test the viability of the technology and experiment with multiple program tiering options.

About a week later, Scientific-Atlanta announced a new line of four- and eight-port 750 MHz addressable interdiction units.

The new devices also have an expanded return spectrum (5 to 40 MHz); are compatible with enhanced-definition TV and digitally compressed signals; accommodate 90-volt, 15-amp network powering; have addressable return path disconnects to ensure a "cleaner" return path; and capability to supply power to side-of-home telephony devices.

Unicom develops return modulation

Planning on deploying high-speed data over your network, but plagued by nasty ingress and noise in the return band? A Silicon Valley start-up is presently developing a new, higher-order modulation method that promises to overcome excessive noise and keep the upstream portion of the two-way communication path open.

Ultracom Communications, led by Hybrid Networks founder Howard Strachman, is developing "Variable Constellation/Multi-Tone Modulation" expressly for the cable industry, which has found the upstream path of its network to be problematic in many cases. The technology is described as a variant of orthogonal frequency division multiplexing and discrete multitone, which is used in digital subscriber line (DSL) systems designed for telephone systems.

The modulation scheme divides several QAM-based carriers into separate bitstreams and packs them into small, densely-populated RF channels using standard FDM methods. The size of the constellation, however, varies depending on the signal-to-noise ratio in that channel. Where little noise is encountered, signals can be sent via 256-QAM. When the noise level goes up, the system dynamically shifts to lower-order schemes, all the way down to QPSK, according to Strachman.

In fact, said Strachman, lab models suggest that the system can deliver 7 bits per Hertz in environments where other transport methods no longer work.

Of course, the proof will come in real-world tests, which Ultracom intends to undertake later this year, said Strachman.

He noted that cable operators, by deploying this technology, can significantly reduce plant maintenance costs and avoid having to constantly "clean" and "tighten" a network's return band. "Why send trucks and people, when signal processing can do the job for you?," argues Strachman.

Statmux boosts digital channels

General Instrument Corp. has announced an upgrade to its digital compression system so that it now has the capability to transmit 16 video channels on a single, 24-MHz satellite transponder. According to GI executives, the

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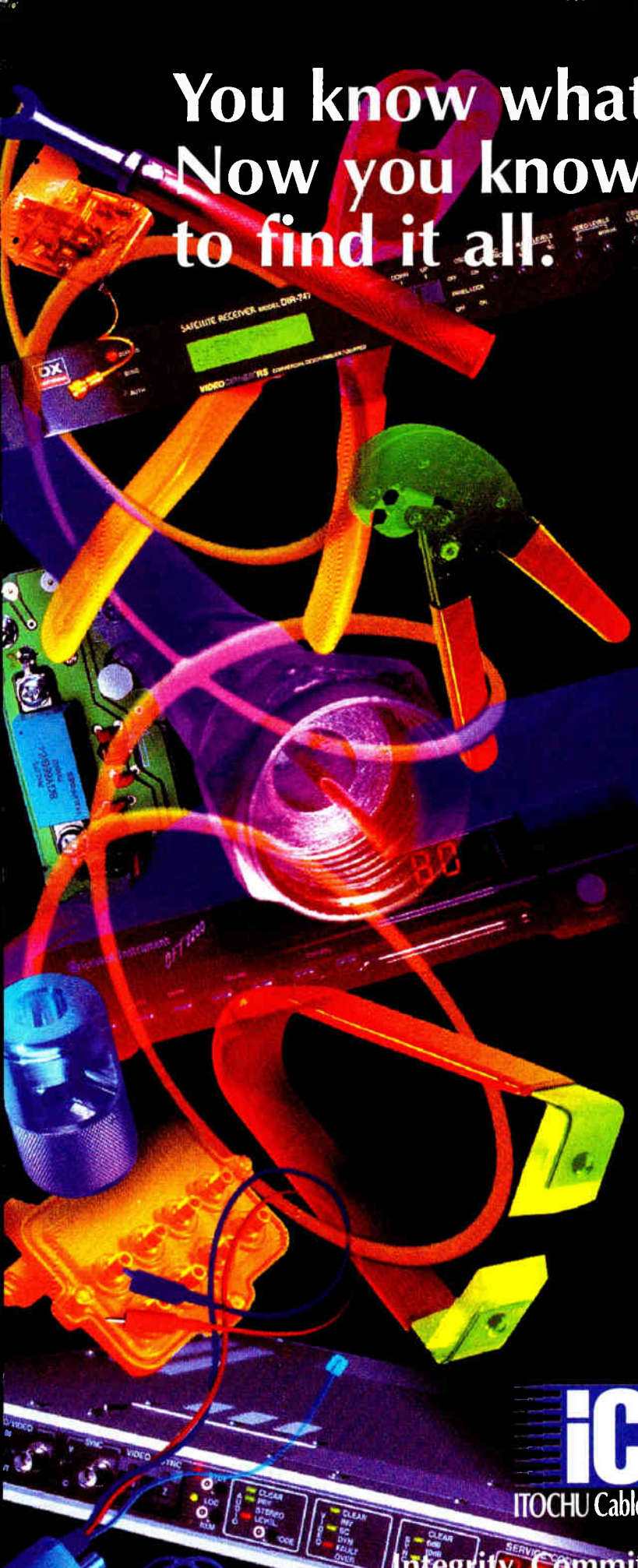

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system will be available for commercial deployment this spring.

In the past, only eight to 10 channels were available at acceptable quality levels. This increased digital video capacity is made possible through application of statistical multiplexing ("stat mux") capability. Through this technology, 14 of the 16 channels provide programming, and two channels are reserved for redundancy.

Stat mux examines all the incoming video feeds as a group, and dynamically assigns compression bit rates based upon the complexity and motion in each feed. The basic premise is that, at any given time, there will be some feeds that have a lot of motion, some with very little, and some that are "average."

Stat mux works by having all of the channels that are included in a stat mux group report their compression demands to one decision-maker–in this case, the Packet Multiplexer. The PM considers all of the demands, decides on the bit rate to assign to each channel, then communicates that decision back to each channel. This "negotiation" for bit rate takes place about 35 times per video frame–about 1,000 times per second–to ensure that even the slightest change in scene complexity becomes part of the decision-making process.

Monet group shows off WDM

The Multiwavelength Optical Networking (Monet) consortium has unveiled an eight-wavelength, configurable network linking high-capacity testbeds in three New Jersey locations.

The all-optical cross-connect testbed from Lucent Technologies interconnects the local-exchange network testbed at Bellcore and the long-distance network testbed at AT&T and Lucent Technologies. The three high-capacity testbeds are now linked, using optical fiber, to form the Monet New Jersey Area Network.

The testbeds all use wavelength division multiplexing (WDM), enabling transmission of digital and analog signals over multiple wavelengths of light through optical fibers.

The Monet consortium's booth at February's Optical Fiber Conference featured remote network management of the New Jersey Area Network and a demonstration of a prototype wavelength-selective cross-connect network element. Exhibit workstations also offered simulations of optical network performance.

The Monet consortium includes AT&T, Bell Atlantic, Bellcore, BellSouth, Lucent Technologies, Pacific Telesis and Southwestern Bell Technology Resources Inc., in cooperation with the National Security Agency and the Naval Research Lab. Monet was established in December 1994 and is funded in part by the Defense Advanced Research Projects Agency.

The cross-connect testbed, at Bell Labs in Holmdel, N.J., configures the interconnections between the long-distance and local-exchange testbeds by switching wavelengths. The testbed verifies features and performance aspects of wavelength selective cross-connection.

The local-exchange (LEC) testbed at Bellcore in Red Bank, N.J. features ring-and-ring interconnection topologies, using optical-fiber and link distances that are typical of LEC networks. The LEC testbed contains wavelength add/drop multiplexers and cross-connects.

The 2,000-kilometer long-distance networking testbed in Holmdel, N.J., transmits 20 gigabits of digitized information, carrying 2.5 gigabits per second on each of eight channels of light through a chain of optical amplifiers.

Monet consortium members are currently building an experimental multiwavelength network in the Washington, D.C. area that will link facilities at Bell Atlantic, the National Security Agency, and the Naval Research Lab in 1998. They will interconnect the New Jersey area and Washington area networks in 1999.

The Monet Consortium's objective is to define and demonstrate the best way to achieve national-scale, high-capacity, high-performance, cost-effective, reliable, transparent multiwavelength optical networking–integrating network architecture, advanced technology, network management and business drivers.

Monet envisions a transparent, reconfigurable optical networking layer capable of supporting all currently employed or proposed telecommunications standards. Those standards include synchronous optical network (Sonet) services ranging from OC-1, which carries 51.8 million bits of information per second, to OC-192, at 9.953 billion bits per second, and asynchronous transfer mode (ATM) broadband, multimedia and high-speed networking services.

The optical networking layer would simultaneously support other new formats, allowing a range of format-independent, bit-rate-independent and protocol-independent service. This has the potential of offering increased flexibility and economic advantages in commercial networks, and also is of particular interest to the U.S. defense establishment.

S-A acquires Danish manufacturer

Scientific-Atlanta Inc. has completed the purchase of Arcodan A/S, a Danish manufacturer of headend systems, opto-electronics and RF distribution equipment.

Financial terms of the transaction, which was originally announced in February, were not disclosed. Arcodan revenues for the last 12 months ending January 31 exceeded 200 million Danish Kroner (more than $32 million USD).

Arcodan serves cable operators, installers and systems integrators throughout Scandinavia and the rest of Europe and employs 270 people. Development and manufacturing takes place at its facility in Sonderborg, Denmark. Its products are distributed through its subsidiaries in Germany and Poland; a partly-owned subsidiary in France; and through a direct sales and distribution network in Europe.

Arcodan joins three other Scientific-Atlanta subsidiaries with operations in Europe: sales and service facilities in the United Kingdom and Italy, and an opto-electronics research and development laboratory in the United Kingdom. In addition to Arcodan, Scientific-Atlanta has manufacturing facilities near Atlanta and others in Mexico, Canada, and China, plus relationships with manufacturers in Japan and Korea in supplying broadband equipment to customers in more than 100 countries.

Jottings

Count two new additions to the list of companies wishing to do business with cable TV operators. **US Robotics,** the massive modem manufacturer (which will soon be taken over by 3Com Corp.), recently introduced an end-to-end system that will help cable operators offer high-speed data services over their networks. The system is designed for today's one-way networks by providing a telco return path. US Robotics intends to build modems that will be offered at retail outlets . . . New entrant #2 is **SilCom Manufacturing Technology** of Ontario, Canada, which is developing upstream amplifiers to support data services over cable systems. SilCom hopes to reduce distortion and power consumption of such amps while solving packaging and heat dissipation issues . . . In just three short years, **Corning Inc.** has sold 1 million kilometers of a special singlemode fiber designed for the long-haul, wavelength division multiplexing market. Designed for the 1550 nm window, the fiber can send signals twice as far as standard singlemode fiber. The brisk sales pace shows that the long-haul market is once again a hot one, according to Corning officials. To amplify that position, Corning said it was expanding its components factory, which makes erbium-doped fiber amps, among other things . . . CED

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Medin: No more dumb pipes for cable

Milo Medin

It's hard to make the transition from technologist to manager. Just ask @Home Network's Milo Medin, who illustrates his dilemma with an excerpt from the comic strip "Dilbert."

"There's a guy in a devil suit talking to Dilbert. He says, 'C'mon, Dilbert! Stop being an engineer and become a manager.' Dilbert tells him to go away. He says, 'Your technical skills are getting stale. You're becoming a generalist. Take the *easy* route.' The last frame is this devil holding a box. He says, 'I brought you a suite of applications that all work together.' And Dilbert replies, 'That's unnatural. Be gone!' That's sort of where I am right now," says Medin, though he keeps a Sparc workstation on his desk to keep him honest.

In truth, Medin's responsibilities are too mammoth in scope to allow him to have hands-on oversight of all the technical aspects of @Home's high-speed data rollout, as he's in charge of the system architecture, the IP transport system, the backbone and the feeder system, as well as all of the servers and all of the software that runs inside the network.

As VP of Networks, Medin is focusing his energies on rolling out the commercial service in multiple markets, working with the cable operators who are partners in @Home to make sure that everything runs well, from the network management systems to the in-home wiring.

In addition, Medin and his engineering organization are concentrating on new product development to support telephone return as an option for those operators who'd like to establish a footprint first, and then activate their return paths later. He's also working on the technology to support a variety of content-related services.

"We believe that our architecture of an intelligent network, where there's caching, replication, multicasting, etc., and not just a plain pipe for pushing data," explains Medin, "is the right architecture for being able to feed any kind of a broadband data service."

Cookie-cutter architecture

In fact, Medin has plenty of lessons to share from his personal experience of a high-speed data rollout. "The key things, in terms of deployment, are maintaining a consistent architecture and set of equipment, because if you have a bunch of things which are all different, being able to manage them effectively becomes darn near impossible," he notes. "Having an architecture which you can replicate in a cookie-cutter mode is virtually the only way that you can field this (service)."

And in a refreshing change, the bottleneck now becomes the PC, as the broadband network can deliver information far faster than many computers' brains can handle. "You have to have performance from an end-to-end perspective. It's not just the network; it's not even the servers in the system," he adds. "You have to look at how the PCs are plugged in, and all of that, to make a really compelling service."

Medin, a relative newcomer to the world of cable television, hails from the world of serious computing power. Prior to joining @Home, he spent more than 10 years with NASA's Ames Research Center, where he led a team of contractors to construct the agency's first real internal IP network. Eventually, that network would evolve into the NASA Science Internet, connecting more than 200 sites in 16 countries. With the help of two satellite connections and a transcontinental fiber link, the network served both the highest and the lowest latitudes on the Internet: stretching from Greenland to a base in the Antarctic. "I loved the time I spent at NASA," notes Medin, "because technology there exists to support a real mission: you're not just doing research on networking for networking's sake."

Before NASA, while being schooled in computer science at Lawrence Livermore Labs, the young Medin worked as a contractor, helping program in Fortran and Cray assembly code on supercomputers at the Labs and at Los Alamos. Primarily, he worked on two defense-related projects: one being modeling for solid-state laser design for the Strategic Defense Initiative (the predecessor to the "Star Wars" program); the other was using computers to model the effects of nuclear weapons detonation.

Would you like fries with that?

The child of Yugoslavian immigrants, Medin grew up on a 20-acre grape farm nestled in a central California valley. After his father died, when Milo was only five years old, his mother took over the farm operation, simultaneously learned how to drive and how to speak English, and raised her son and his younger sister to become valedictorians of their high school graduating classes. "I have an enormous amount of respect for my mother," he says. "There were a lot of easy ways out, and she didn't take any of them."

Neither does her son. A self-described political conservative, Medin believes that the government should avoid playing the role of "Big Brother" when it comes to taking care of its citizens; however, he also takes his personal responsibility to fill the social welfare gap seriously. It's not unusual to find him handing out gift certificates for fast-food restaurants to people on the streets who need a hand.

Currently single, Medin spends much of his time "eating his own dogfood." No, it's not a result of his bachelor lifestyle–that's the phrase he's borrowed from Bill Gates to describe the consumption of one's own product or service. From his data-surfing travels, Medin has learned first-hand what his customers want: "That the service feels fast, that they can do things on it they can't do anywhere else."

–Dana Cervenka

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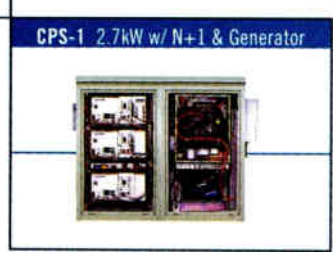

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Supplying too much of the wrong thing?

By Wendell Bailey, VP of Science and Technology, NCTA

A few weeks ago, I attended a conference in Washington, D.C. on the future needs of public technology. Public technology is a code phrase for accessibility of the masses to technical offerings that other people pay for. Perhaps that is a little too cruel. Let me try this: the primary goal of groups that seek to promote public technology is to make sure that no one is left out of the benefits that these technologies offer. There, that sounds better. No matter how you say it, it still comes down to this: how do we make sure that the riches of the Internet and cable TV and telephone connectivity reach those who are not in a position to normally acquire them?

We should all be thankful that there are groups that work on behalf of the "have-nots" to make sure that as technology progresses, no one is left behind. I know that I'm glad.

A collective gasp

The conference got my attention when I realized that the single, overriding theme was the provision of a *broadband, switched, two-way network for every single person and place in the United States of America.* Now, don't get me wrong. I'm a sensitive guy. I care about the potential of a world where only some of the lucky ones have access to everything that technology can offer. I mean, if the Internet is the be-all and end-all of human interaction, then can we afford to take lightly the people who can't get connected? I don't think so.

In fact, you will be pleased to know that the entire panel (of which I was only one participant) all said that they (or, more precisely, their companies) would also do everything they could to help this future world come into being. They (and I) only got into trouble when we said that, as public companies which need to show results to our owners, we would all need some incentives to make the massive investments that seem to be at issue here.

The trouble was nothing so ignoble as cat-calls or raspberries. It was more of a collective intake of breath. At first, I thought that someone had uttered an expletive that I missed–but no, it was the reaction of the audience to the idea that this goal must be weighed against the idea of corporate profit.

What about the "don't-wants" ?

I am constantly reminded that not everyone can appreciate the good deeds of corporate America if they detect the tiniest hint of self-service in a project. It seems not to matter that a company could have chosen a less edifying project for its limited funds. No, there are those who believe that all ends should match up nicely with pure means.

I'm afraid that I caused another of those sharp intakes of breath when my turn came. I was doing OK until I mentioned, almost in passing, that not everyone might actually need a two-way, broadband, switched network connection. I mean, what about a person who just does not want to surf the Web? I'm almost sure that these types exist. Are we to wire up every nook-and-cranny on the off-chance that the non-surfer dude will rise up from the couch and have an urge to check out a homepage that he heard about?

I'm afraid that this last idea made me an enemy. When the part of the conference that I was speaking in was over, and the crowd broke up to go to lunch, I was accosted by a man who wished to take issue with my words. It seems that he has concerns about the people who will be left out of a world where some have wide bandwidth, and others (shudder) only have twisted pairs. "All," he stated with conviction, "must have the same access and capability."

"What about those who don't even have a computer?," I responded. "They might get one, if they had access to such a network," he replied. "What about those who have a perfectly acceptable 28.8 modem–do they also need a broadband connection?," I inquired. Once again, he said "yes."

The crime, it seems, is not that someone has such a marvelous network and doesn't use it, but instead, what if someone wants it, and doesn't have it? Good question. I could feel the gray matter sweating as this was digested. Should every home and place of business have a broadband, two-way switched network, even if 15 percent of the population is functionally illiterate and cannot use the keyboard on a computer? Some people drive four-wheel-drive cars and live in moderate climates. Does this mean that there should be a subsidy by auto manufacturers so that everyone can have four-wheel-drive for the two times it snows in the mid-Atlantic region? I must either be missing something, or have a defective empathy module.

The basics first

I have a hard time understanding the motivation of groups that latch onto the idea of the biggest, most capable, most expensive network for everyone, when so many need more basic things. Telephone companies, cable systems, broadcasters and every entity in the telecommunications world do good things for their communities all of the time. Is it enough? No, it never is. Is the broadband, two-way switched network enough? Maybe it's too much of the wrong thing.

The world will change in our lifetime. More people than ever before will have computer skills. More people than ever before will have a desire to surf the Web and learn new things, but not everyone. Not by a long-shot. Many need other things first. Where are the groups dedicated to seeing that they get the *other* things? CED

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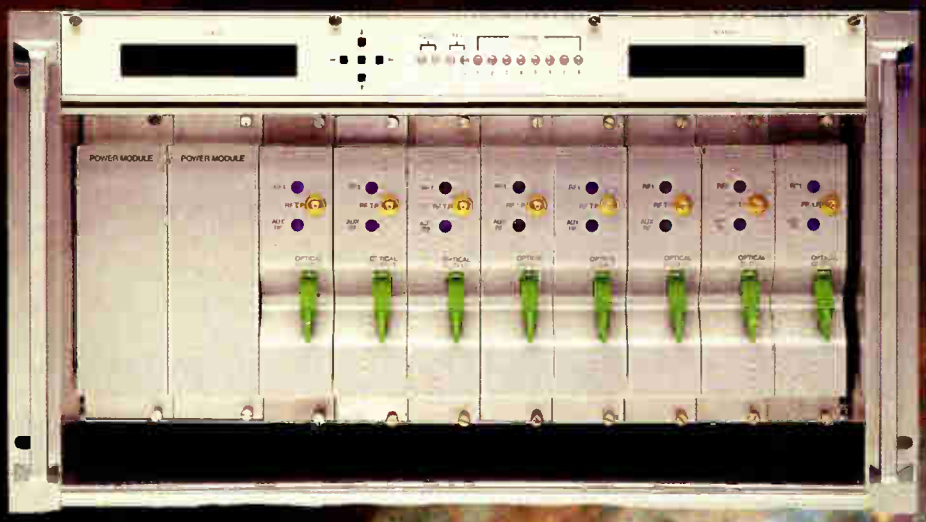

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HOH: A new money saving idea

By Jim Farmer, Chief Technical Officer, Antec

Here's a great idea for making cable plant more efficient. We are presently fighting several problems which can be solved in a single paradigm shift. The breakthrough came when I discovered the amazing properties of a chemical compound known as hydrogen hydroxide (HOH). HOH is non-toxic, non-compressive, exhibits a relatively high specific heat and is not expensive.

We are having a lot of problems powering the plant now, and we also are having trouble cooling distribution equipment. From optical nodes to line extenders, as we force more circuitry into a smaller space, the cooling problems get worse. We can solve these problems with HOH, and get some other benefits as well.

HOH is a fluid, and we all know that fluids cool more efficiently than do convective air flow and radiation, the main methods used for cooling distribution equipment today. We need a way to get HOH to each amplifier station–then, we can use it for cooling.

HOH as a dielectric

One way also allows us to get rid of some of the inefficiency in the coaxial hard-line. The coax contains a dielectric material between the center conductor and the shield. It does nothing but sit there, adding cost and weight to the cable. Replace it with a series of small spacers which hold the center conductor in place. Insulate the center conductor, and send the HOH fluid through the space now occupied by the dielectric. If the HOH is pure enough, it makes a decent dielectric.

By replacing the dielectric in the coax with HOH, which is pumped in after the cable is lashed, we save in several ways. First, we no longer have to pay for the dielectric, as it doesn't exist, except for some small spacers. That should make hard-line cheaper. Second, we save weight by not having the dielectric. This saves freight costs, and makes the cable easier to put up.

We now have a way to get the HOH fluid to the equipment that needs to be cooled: we pump the fluid through the coax and through the amplifier stations. Now, because the fluid will be moving, we can generate electricity at each amplifier. Simply put a small, fluid-operated generator in each amplifier. It will be turned by the HOH fluid we are pumping through the system anyway, and will generate the power to operate that station. No IR loss in the cable, no standby batteries–just a mini-generator at each amplifier. (You will recall that when current is passed through a resistance, and every conductor has resistance, then we lose power. The power lost is equal to the square of the current, I, times the resistance, R; hence the term "IR (more properly, I squared R) loss" to signify that we lose power because of resistance in the coaxial cable. If we have no current, then we have no IR loss.)

The cable industry likes to be efficient, so what do we do with the HOH fluid when it reaches the end of a branch? What we would have at this point, after it has been pumped through several amplifiers, is hot HOH. So sell the heat! You should be able to sell it to a subscriber who is located close to the last amplifier, for domestic heating. A number of industrial processes utilize HOH at elevated temperatures, so you may find a local factory which will buy it. If you can't sell it, then put in a sauna, and charge for using it. The HOH will be very efficient for heating the water. Hey, saunas are big business these days. If you build it, they will come.

Finally, if all else fails, you can simply forget about the HOH fluid if you pass it under a bridge following the last amplifier.

A bonus: energy to power the headend

In most developed countries, you can get a sufficient quantity of HOH fluid at reasonable costs, though you may have to purify it somewhat in order to make it useful as the dielectric in the coax. Local suppliers may have the facilities for delivering HOH very close to your present power insertion points. NASA and others have done some interesting work with a means of power generation in which the elements which make up HOH are combined such that electrical energy is produced. In this process, HOH is produced as a byproduct. It may be possible to produce your own HOH, using the energy released in the production process to power your headend. On the other hand, if electricity is not expensive in your area, you may not realize a net savings as a result of producing your own HOH.

There are no FCC Rules regarding the use of HOH for this purpose, so far as I know. You may have to contend with the EPA, but if you purchase your HOH from a local certified vendor, you shouldn't have any problems. Some municipalities may insist that a trade member be involved in connecting to an HOH supply, though.

Safe for cable jocks

HOH is a safe fluid, even for human consumption (it is a major ingredient in beer, among other products familiar to cable jocks). If you develop a leak, you should not be accused of polluting, at least, not in most places. It's safe for lawns and will not damage asphalt. If present in large quantities, it is sometimes used to levitate objects, including humanoids. There is some danger in this process, but you will not be using HOH in quantities that will present a problem.

Truly, HOH is a miracle fluid with a thousand uses, and the potential to save us money. Wonder why no one has thought of this before. CED

Have a comment?
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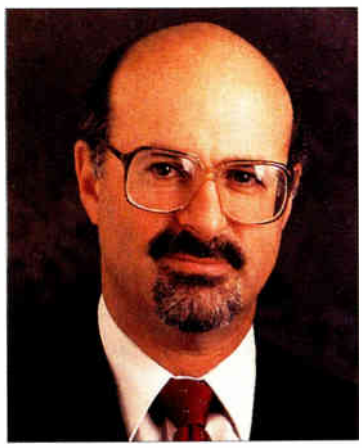

By Jeffrey Krauss, digital channel surfer and President of Telecommunications and Technology Policy

Let's see. When I hit the "channel up" button on my new digital TV set, does it go from channel 34.1 up to channel 33.8, or up to channel 33.1? Or maybe they'll be called 34-A and 33-H. Or maybe they'll be called "NBC-1" and HBO-W." Or maybe my new remote control won't have a "channel up" button at all.

People are only now starting to think about the implications of digital TV channels that carry multiple standard definition programs, how to name or number them, and how to navigate. This is a particularly difficult issue for broadcasters, who want to maintain their "brand" identity during the transition from analog to digital, because often their brand identity is tied to their current channel number. But most broadcasters will be moving to a different channel for digital broadcasting.

Analog vs. digital channels

Analog TV channels occupy 6 MHz of bandwidth, and over-the-air channels are numbered sequentially from 2 to 69. Television viewers today, whether they are receiving an over-the-air signal or a cable TV signal, don't need to know what actual frequency corresponds to the TV channel they tune, only the channel number. Viewers can get from any channel to any other channel by punching the "channel up" or "channel down" button a few times, or by punching in the channel number.

With digital television, things get more complicated. Each 6 MHz channel can carry one or two HDTV programs, or many standard definition TV (SDTV) programs, or some combination of HDTV and SDTV programs. How will a viewer select a channel? What will the local newspaper's printed "TV Week" booklet look like? The MPEG-2 digital TV standard includes packets that carry nothing but program IDs and maps, in order to keep all the information under control, but there is no standard way to translate the MPEG IDs into channel numbers or subchannel numbers.

Cable operators will most likely provide spreadsheet-like channel navigation guides that are displayed on the screen, and remote controls that can point and click to select a program. The System Information (SI) tables specified in the ATSC A/56 standard for digital television tell where to look for channel navigation information. (Go to <www.atsc.org> to get this document.) Using this information, the cable operator can create virtual channel tables and can, for example, map the 12 programs carried within channel 27 into channels numbered 200 through 211, or 200-A through 200-L.

The cable operator will have the "editorial control" that will be needed to create consistent, user-friendly navigation schemes. Digital cable-ready TV sets will have to be able to read the A/56 System Information tables and do the channel mapping, so that if you select channel 151, it will know what frequency to tune to, and what program within that SDTV multiplex to select.

Broadcast problems

For broadcasters, things are more difficult. Compliance with the ATSC A/56 standard is optional. There is no mandatory broadcast industry standard that tells how to transmit channel guide information to TV sets. (But there probably will be, once the broadcast industry understands the significance of this issue.) Even with a mandatory standard, one TV broadcaster is not likely to carry the channel guide information for other broadcasters in town.

And what about channel numbering? MPEG supports virtual channel numbering, but what if two broadcasters in town (one broadcasting on TV channel 47 and the other on channel 53) both want to use virtual channels starting with 100? Unlike their broadcast channel numbers, nobody owns the virtual channel numbers; any broadcaster can claim them.

Well, assuming the local broadcasters can get together and work out who gets which blocks of virtual channel numbers, what about adjacent cities? If I live between Baltimore and Washington, for example, and a broadcaster in each city chooses a block of virtual channels starting with 200, how will my TV set know which channel to tune when I punch in 205 into my remote control?

Here's another issue: using channel numbers for "branding." I can never recall the station's call letters, but I know the Washington, D.C. CBS affiliate is on channel 9. The station has a public service activity called "Nine on Your Side." They use a big 9 on their logo. They aren't just channel 9, they are "Channel 9." They won't want to give up that identity when they start broadcasting a digital signal on (say) channel 38. But if they want, they can create virtual channel numbers 90 through 99 for their digital programming, as a way to retain the "Channel 9" brand.

Channel up?

Virtual channel numbering will take quite a bit of agreement among broadcasters. Or perhaps they will think of an even more user-friendly navigational approach. But broadcasters will have to deal with this issue if they hope to retain any over-the-air viewers, because cable operators will certainly adopt user-friendly channel navigation guides. It looks like the cable industry has at least part of this challenge under control, because the industry has agreed to use the ATSC A/56 standard, and a cable operator can control how his channel lineup is numbered and displayed. The broadcasters still have a lot of work to do.

But what about the "channel up" button? If you're tuned to virtual channel 200, which is actually carried as one of 12 programs on cable channel 67, will "channel up" take you to virtual channel 199, or to a program carried on cable channel 66, or somewhere else? I don't know. What do you think "channel up" should do? CED

Have a comment?
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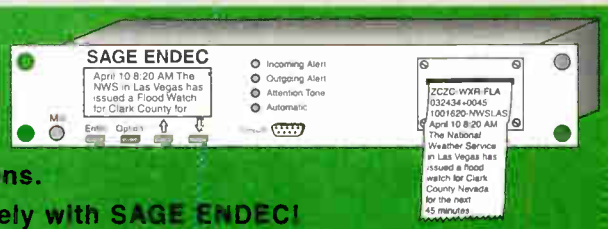

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Reader Service 13

Security in hybrid fiber/coax based networks

Using cryptographic technology

By Gerry White, Consulting Engineer, Data Over Cable Division, Bay Networks Inc., gerry@lancity.com; and Chet Birger, Ph.D., Internetworking and Security Consultant, cbirger@tiac.net

Part 1 of 2

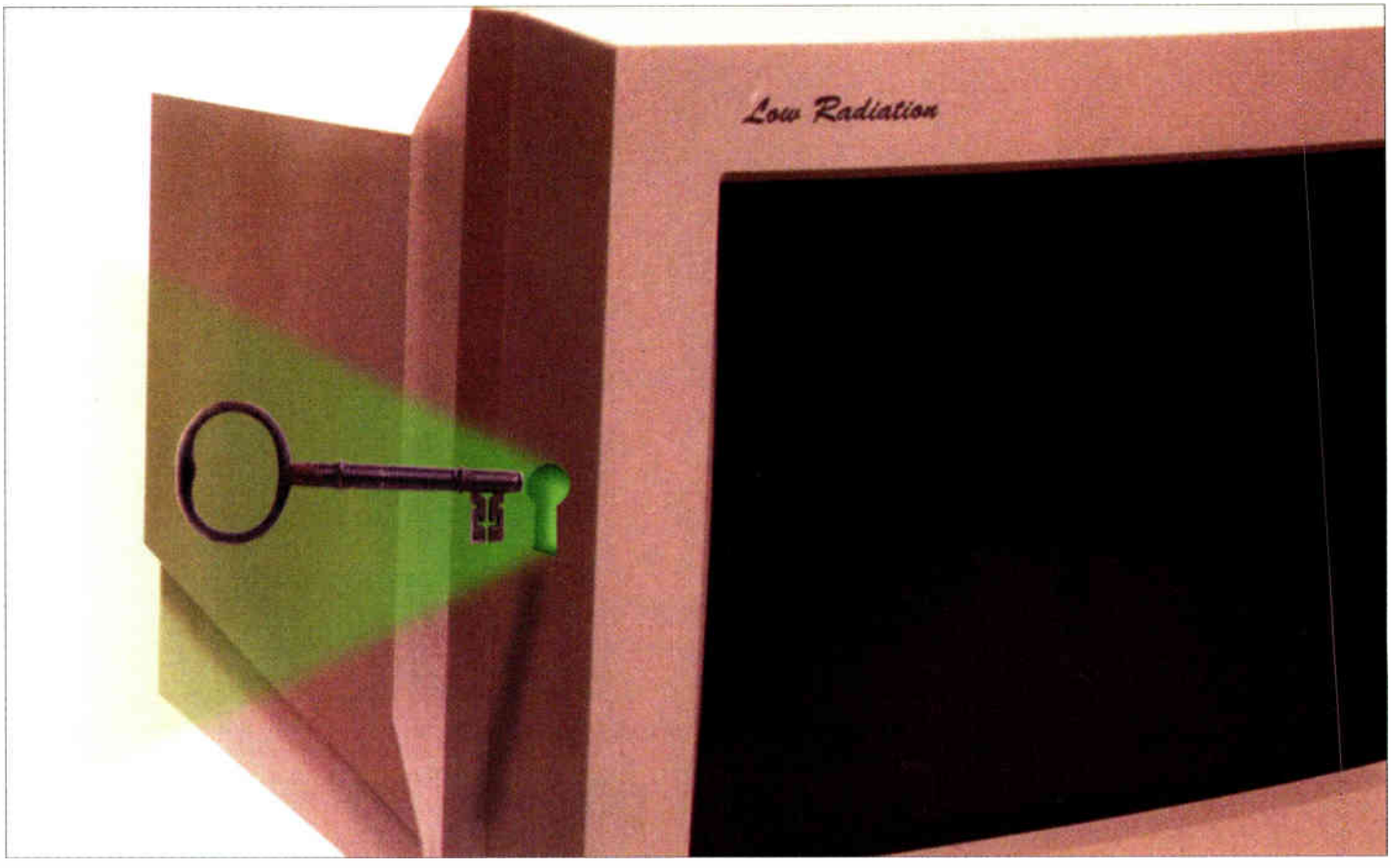
Digital transmission over hybrid fiber/coaxial (HFC) networks provides high-bandwidth network access for computers in the home and small office. It has been argued that HFC network technology provides these services far more efficiently than can be provided by telephony-based broadband access networks [1,2]. An HFC network's efficiency is attributed to the high degree of aggregation of users' traffic, made possible by the network's shared-medium technology and its tree-and-branch topology.

While HFC's shared-medium characteristics provide economies of scale that make broadband access over HFC extremely attractive, they also introduce security issues that, if not addressed, could undermine the service's marketability. In particular, because HFC is a shared medium, each connected user can potentially see all traffic on the network, threatening the privacy of a subscriber's communications. The shared medium also presents malicious users with opportunities to masquerade as others, introducing security risks ranging from data and service piracy to forgery.

This article discusses these security issues and demonstrates how modern cryptographic technology can be employed to address them.

Modern cryptographic techniques, employing a combination of symmetric and public key cryptographic mechanisms, can address and resolve the security issues associated with data over cable services. This must be done in a way that (1) does not drive up operational costs of the service or data terminal equipment (i.e., the cable modems), and (2) does not reduce the effective bandwidth available to users.

Cryptographic technology has long been applied to securing data communications. Recent growth and popularization of the Internet has accelerated activities in this area, including standardization efforts associated with network layer security (IPsec[3]), transport layer security (e.g., SSL[4]), application layer security and key management. In developing its own security solutions, the cable industry can benefit from the Internet community's efforts to secure communications (e.g., prevent eavesdropping, tampering and message forgery) over the Internet.



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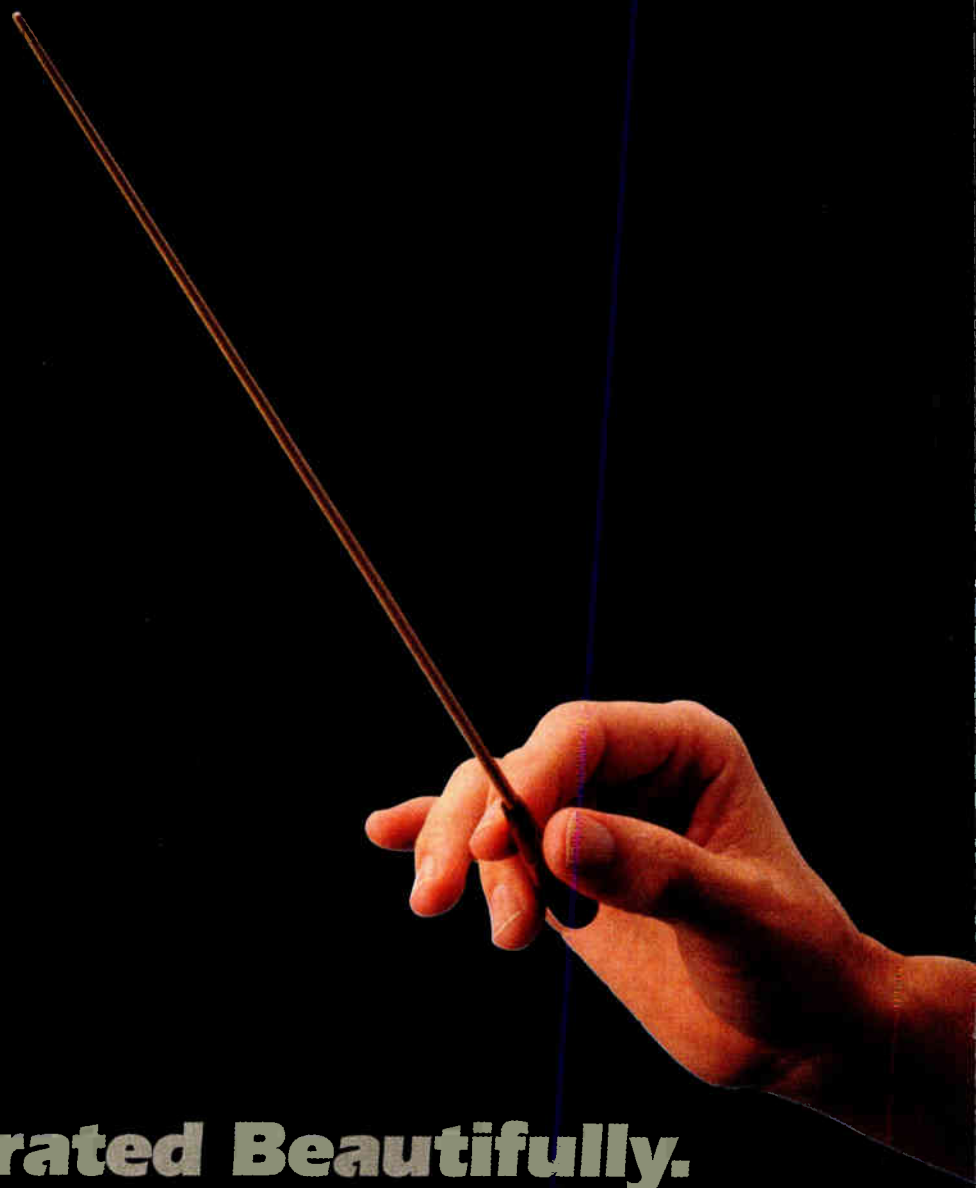

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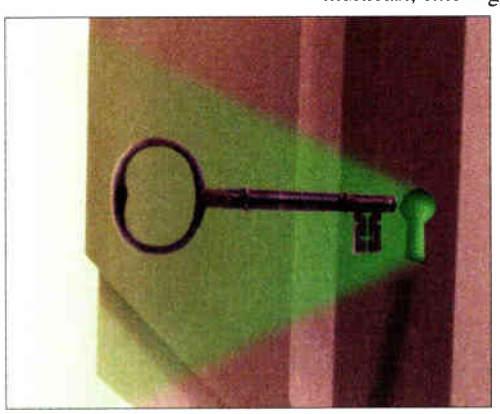
Reader Service 14

Data over cable architecture and security goals

Consistent with the dominant view within the cable industry of cable modem devices as data link layer forwarding devices, i.e, Media Access Control (MAC) bridges, user traffic is transparently bridged across the HFC network. At the customer premises, a cable modem (CM) transparently bridges data link layer frames to and from the HFC network. At the headend, a cable modem termination system (CMTS) transparently bridges data link layer frames (associated with users' aggregate traffic) between the HFC network and a backbone network or switch. The backbone network provides connectivity to the Internet and/or other network service facilities. This high-level network architecture is depicted in the figure on page 30.

As MAC bridges, cable modem devices make forwarding decisions based on the MAC addressing of frames they receive across their network interfaces. For example, although a cable modem can potentially receive all downstream traffic appearing on an HFC network (HFC is a shared medium communications channel) it will filter all but those frames addressed to customer premises equipment the cable modem is serving. Data link layer traffic flows across the HFC network are either unicast, between CMTS and a particular CM, or multicast, entering the HFC from a particular CMTS or CM, but targeted at multiple end systems behind multiple CMs.

Privacy on the HFC network requires that HFC traffic be encrypted



Cable service providers envision employing multicast transport to distribute "premium" data services (e.g., stock prices, newswire feeds). Because multiple users on an HFC network can be authorized to receive a particular multicast traffic distribution, the security issues surrounding multicast traffic differ somewhat from those of unicast traffic. For this reason, we distinguish between unicast and multicast services in the subsequent discussion of security goals.

In the context of the HFC network's function of providing data link layer transport of unicast and multicast frames, the fundamental security goals for an HFC-based network access service can be stated as follows:

✔Ensuring privacy, authenticity and integrity of user traffic across the shared-medium HFC network.

✔Restricting access to basic unicast service to authorized users.

✔Restricting access to "premium" multicast services to authorized users.

In addition to satisfying the above goals, an HFC network security solution must adhere to the following constraints:

✔It must not significantly add to the cost and complexity of cable modems.

✔It must not significantly add to the cost of operating the network.

✔It must not significantly reduce CMTS and cable modem throughput.

✔It must not complicate "out of the box" cable modem operation.

Finally, we must make the following operational assumptions when discussing the security of data communications over HFC:

✔The cable operator (MSO) has complete control over the CMTS modem device.

✔The cable operator has little control over what gets attached to the HFC plant downstream from the CMTS.

Functional requirements

Because the HFC is a shared medium, and cable operators have little control over what devices are attached to their HFC plant downstream from a CMTS, *ensuring a user's privacy requires encryption of that user's traffic on the HFC.* This, of course, implies that CM and CMTS have keying material necessary to encrypt the traffic flows between them. Key distribution is fundamental to any cryptographic security system; in particular, *authenticated key distribution is requisite for providing privacy across the HFC.*

Restricting key distribution to authenticated, authorized users ensures a message's authenticity: only authenticated users can retrieve the keying data needed to encrypt a received HFC frame. Ensuring the integrity of a message (i.e., protection against message tampering) requires additional security mechanisms: a message authentication code accompanying each HFC frame, for example.

Restricting access to Basic Unicast Service

Privacy on the HFC network requires that HFC traffic be encrypted. Encryption also serves to restrict access to authorized users. An unauthorized user will not be provided with the keying data required to encrypt upstream and decrypt downstream traffic. Because the CMTS will be conducting the inverse operations (decrypting upstream and encrypting downstream traffic), a cable modem operating without these keys will be unable to exchange traffic with the CMTS. The end result is conditional access to the HFC network's basic unicast transport service.

Restricting access to multicast services

As was the case for restricting access to basic services, restricting access to multicast services requires that downstream and upstream data flows be encrypted and distribution of decryption keys to cable modems be restricted to authenticated and authorized users. The key distribution is administratively more complex, as a single user must receive keying data for all multicast groups to which the user has subscribed. Another complicating factor is that the multicast service key for any given service must be shared amongst a CMTS and all cable modems authorized to receive that service on the CMTS's HFC link. Thus, a single multicast service key is of value to multiple users, and there is the threat of a single authorized user extracting this key and distributing it to unauthorized users.

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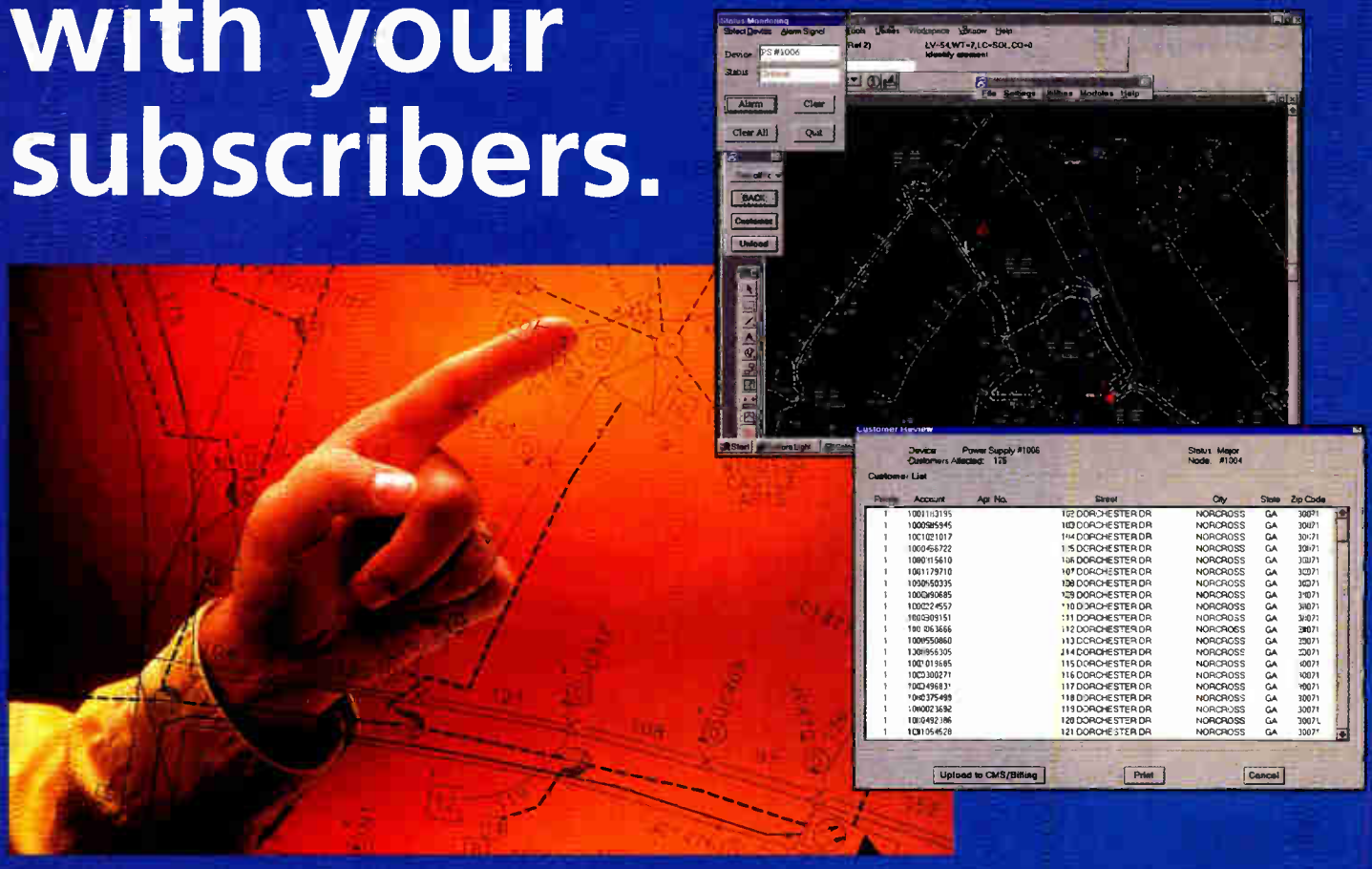

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ciphertext available. In addition, the more predictable that ciphertext is (e.g., protocol packets with known data within certain header fields) the more effective the attack. Thus, reducing a key's "exposure" is an objective of many data communications security systems.

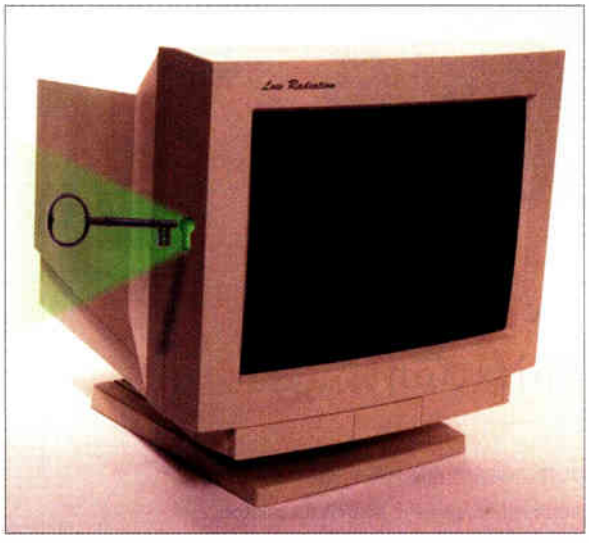
This section discusses key management within cable modems, and design issues relating to reducing a key's susceptibility to direct and indirect attacks.

Protecting data encryption keys in the modem

The security of an encryption-based system rests on the premise that the keys are not disclosed. Because HFC network encryption supports access control as well as privacy, it is desirable to hide keying material from the user of the keys to prevent pirating and unauthorized redistribution. In an HFC network, keys stored in cable modems located at the customer premises are susceptible to direct attack.

Reducing a key's exposure defends against cryptanalytic attack

One option to protect the keys would be to require that all keys be held in a tamper-proof security module, and that keys be encrypted any time they are outside the security module. This, however, has a severe impact on the ability of a system to maintain high throughput at a reasonable cost. In particular, it requires a high-speed interface between the security module and the forwarding system, as all cryptographic operations (except possibly certificate or signature verification with a public key) must be done within the security module.



In order to keep costs down and maintain high throughput, it is preferable to relax these requirements and perform all per-frame security processing (e.g., frame data encryption/decryption, frame data authentication) in high-speed unprotected memory in the baseline cable modem. This, however, makes the keys susceptible to direct attack. A weakening of key protection from a direct attack is permissible if the long-term "value" of keys can be reduced to the point where the incentive to pirate and redistribute the keys is eliminated.

How valuable are the keys used for encrypting HFC traffic? If a key is obtained by extraction from modem memory, the perpetrator already has access to the decrypted data and hence the key's value must be associated with the value of the service and not the data. The key, however, can only be used to gain access to services on the particular HFC network from which it was pirated; i.e., it is tied to the CMTS serving the CM from which the key was extracted. Because only a limited number of users can attach to a single HFC network (at most 1,000), its "resale" value is limited.

A common method of reducing the value of keys is to give them a limited lifetime, e.g., replacing a particular service key once a day, or once an hour, or once a minute, depending upon the value of the data being protected. There are costs associated with extracting a key from CM memory and redistributing it. Decreasing key lifetime multiplies these costs.

Thus, while storing keying data in unprotected cable modem memory does make the keys susceptible to a direct attack, incentives for doing this are low and can be lowered further by periodically changing keys.

A further advantage in not storing encryption keys in a tamper-resistant security module is that it would allow a low-cost, hardware-based symmetric key encryption/decryption engine to be incorporated as part of the base cable modem; possibly incorporated into an ASIC implementing the RF MAC protocol.

Reducing key exposure

Reducing a key's exposure defends against cryptanalytic attack. Two-tier encryption schemes are frequently employed to protect long-term service keys from such attacks. Rather than use the long-term service keys to encrypt data, thus exposing them to cryptanalytic attacks, the service keys are used to encrypt frame keys. Because frame keys are short compared to the frame data, and are pseudo-random numbers, the long-term key is getting little exposure, and it would not be subject to known–or chosen–attack.

For the encryption of HFC data frames, a conservative approach would be to generate a new frame key for each frame, and include the ciphertext of each encrypted frame in the security header. This approach requires that each data frame undergo the following cryptographic procedure prior to transmission across the HFC network:

✔generate security header
✔generate frame key from cryptographically strong pseudo-random number generator
✔encrypt frame payload using frame key
✔encrypt frame key using the appropriate service key.

Decrypting frames received across the HFC interface would involve the following steps:

✔extract from the security header a security association identifier (combination of the cable modem address and a service key ID)
✔decrypt the frame key using SA's service key
✔decrypt the payload using the decrypted frame key

A lower-cost solution (described in next month's installment), avoids generating, and encrypting, a new frame key for each frame, but still changes the frame data encryption key frequently enough to reduce key exposure and discourage cryptanalysis.

A long-term, "master" service key must be shared between encryption endpoints. Basic unicast services each have two encryption/decryption endpoints: a

cable modem and the CMTS that serves it. Multicast services have one encryption endpoint (the CMTS) and multiple decryption endpoints (cable modems authorized to receive the multicast service). Rather than use these master keys to encrypt data directly, thus exposing them to known or chosen plain-text attacks, one can use the master service key to generate a pseudo-random sequence of frame keys (in contrast to using them to encrypt, on a per-frame basis, keys generated from an independent pseudo random number generator).

A "Zero-Message Master Update Algorithm," similar to that employed in the SKIP protocol [5] can be used to allow encryption endpoints to independently generate synchronized sequences of data encryption keys based on a single shared master key and a synchronized counter (e.g., low-resolution clock).

This algorithm would generate a random sequence of keys by concatenating a master key with a counter and then applying a pseudo-random one-way hash function (such as MD5). The current key in the sequence, rather than the original master key, would be used as a basis for the symmetric frame data encryption key. Encryption endpoints would need to share a single, long-term master service key and a synchronized counter, whose resolution can vary depending on the perceived value of the data. The counter's value would be included in each frame's security header. CED

Editor's note: Next month, the authors discuss a low-cost security method for data over cable.

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Parts of this paper were printed in the NCTA Technical Papers.

Serving up Quality of Service

Are cable operators missing a few items from their data service menus?

By Mark Laubach, Chief Technology Officer, Com21 Inc.

As discussions of high-speed data provision over cable TV networks have progressed, the concept of "Quality of Service" has cropped up, mainly brought on by equipment vendors. But just what is Quality of Service, and why is it important? The cable industry's economics in the not-too-distant future will depend on understanding the important differences and synergies between what is currently delivered as "transport and bandwidth services" and that of "Quality of Service." How Quality of Service applies to future integrated services is starting to be discussed in the cable industry at this time. There are technical and economic considerations relating to understanding Quality of Service that are fundamental to running a business which commits to deliver integrated, high-speed digital services to the customer.

Let's examine briefly the telephone industry's competitive threat to the cable industry: When the regional phone companies get their asymmetrical digital subscriber line (ADSL) or fiber-to-the-curb (FTTC) services widely installed, their initial Internet service deployments will potentially install for them a scalable, shared, ATM-based switching fabric that is redundant to the existing circuit-switched network. Their chief financial officers and shareholders will look beyond the smallish revenue gained by delivering only residential Internet access to the home, and they will start to offer preferred services in addition to Internet access over the same single ADSL pipe to the home. New services will be added with much reduced incremental cost as they are sharing the switching fabric of the previously-installed service.

The capability of offering these services will compete directly with the cable industry's four basic revenue-generating services: i.e., video, voice, data and interactive gaming. The telcos should be able to offer these services easily because they have an abundance of prior experience with supplying predictable services and thinking through the ramifications of what Quality of Service means for integrated services. A shared switching fabric based on ATM network technology carries integrated services–it was designed to do just that–and provides a predictable, high degree of Quality of Service support. In contrast, if the telco industry just deploys a non-shared switching network as it deploys its Internet service, the future addition of each new service will be burdened with the cost of deploying completely separate switching for each new service.

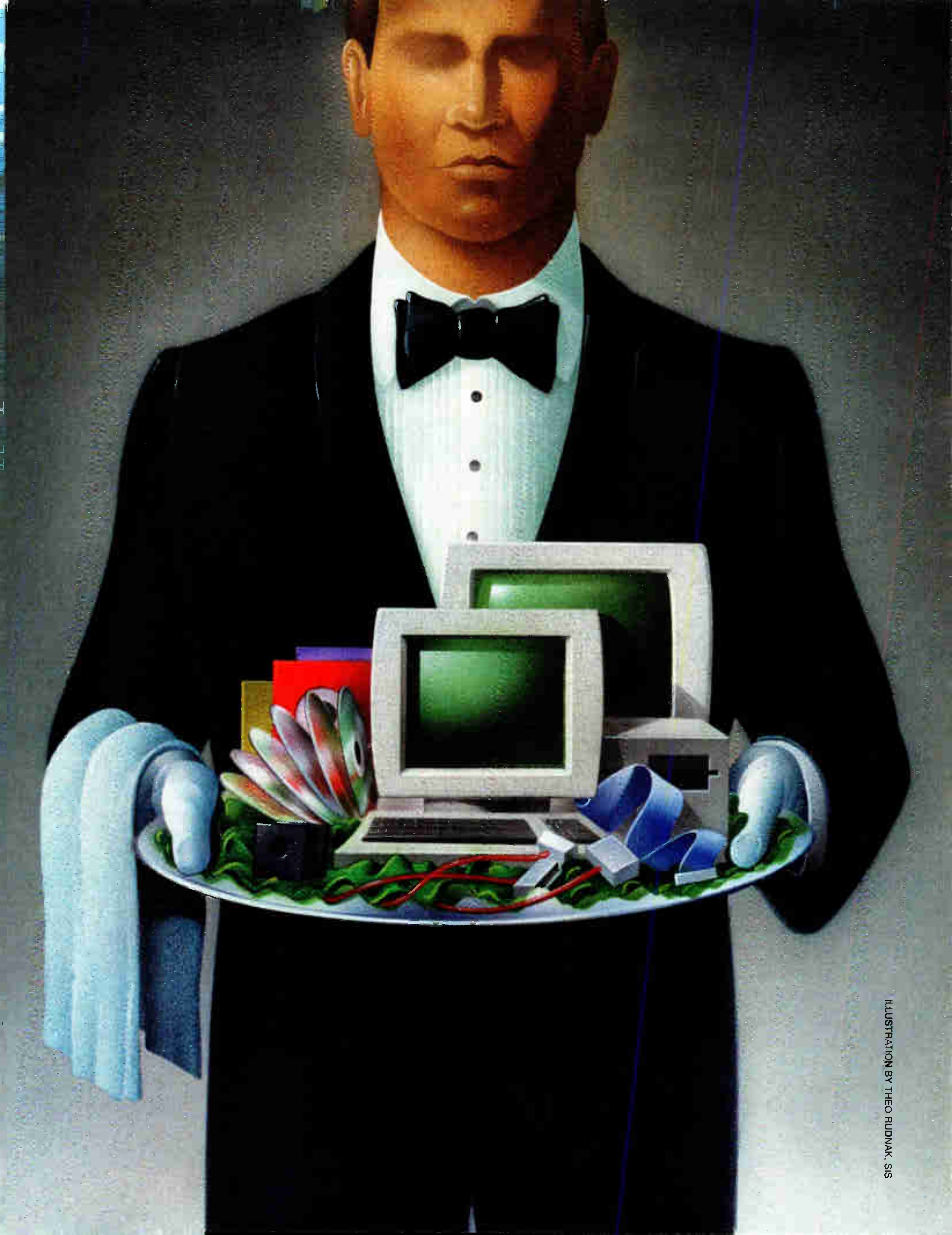
Quality of Service done well in the shared switching fabric and cable TV distribution network is also important for delivering multiple pricing class tiers for the same service, for delivering varying amounts of delay as requested by the subscriber, and for delivering predictable service under load. This is identical to the airplane industry model where first- and coach-class service have different rates. Passengers will pay more to be treated better. Passengers will also agree to suffer a little bit to pay less. Performance of the airline is achieved by delivering the passenger to the seat he pays for and getting the airline to the destination with minimum delays.

There is also a parallel with the freight industry being able to charge differently based on either weight or speed of delivery. Customers will pay according to the amount of delay for the goods they want delivered. A freight company's performance is measured by getting the package there on time and not losing or damaging the cargo. We all have direct experience with just how well a service provider performs in delivering its service when placed under load. The trick is to be able to measure the performance of the service network to provide predictable behavior and establish service guarantees for the customer, almost regardless of how many other customers may be using the service.

FedEx is a prime example of delivering packages on time because it knows how to measure its network and adjust it to suit load with the tracking system. Because its service network is engineered to be predictable, it can commit to a high level of quality, which attracts and maintains customers.

To bring this in line with the cable industry, integrated services and Quality of Service are to high-speed digital data what tiering and addressability are to cable industry video services; plain Internet service is like "just" having HBO.

The cable industry now has in front of it the ability to think through the ramifications of integrated services, Quality of Service and predictable service. Unfortunately, there are many options now being offered for high-speed



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digital services, each with its own Quality of Service story to tell. Some solutions are more aimed at the short-term, and some are not. Cable operators concerned about their middle- to long-term financial picture might want to take a step back and think about the incremental cost of delivering future additional digital services.

The many faces of QoS

Quality of Service is also known as the acronym "QoS," which is pronounced like saying the individual letters "Q" "o" "S." The jargon simply means that QoS is the quality of delivering the service the customer is paying for. "Doing it well" means that the network supports the quality of delivery requirements for whatever service the customer is paying for. If the network supports a variety of services, the quality of a delivered individual service must meet customer expectations, especially when the customer may be taking delivery of multiple services at the same time.

There are many cable modem companies and other vendors defining a general Quality of Service into their products. Many vendors, including the author's company, raise their hands and shout: "Hey, we do QoS!" Apparently, though, only a very few have thought through the long-term issues. For some, QoS means "we work with good performance." For others, it means that for Internet access, they are able to differentiate bandwidth for cable modems on an individual or group basis.

For still others, it means they are able to deliver the quality of service for the type of service that has been provisioned for and/or signaled for by the customer, and that in the future, the product may be asked to support another type of service or another tier. For them, QoS support is inherent in the fundamental shared switching service and not specifically tied to the particular type of service being provided. It is true that the current cable industry service "du jour" is high-speed Internet access to the home. However, it is possible to design a system that initially supports "Home Box Internet" but can readily be extended to support future additional or enhanced services.

Here's another way of looking at that Quality of Service issue: On October 3, 1996, the North American cable industry announced it was most interested in delivering video, voice, data and interactive gaming via the newly-enhanced SCTE Digital Video Standard (DVS) downstream digital video modulation specification. This is great news, because it means the vendor industry can focus on a single physical (PHY) modulation scheme for the North American cable industry, with the goal of having a commodity of downstream PHY chipsets available. But why stop with just the PHY? Why not move one layer up in the networking stack and drive a shared switching fabric layer to an open standards status? It's a viable viewpoint that if the PHY is going to support the four basic revenue service groups, then the shared switching fabric should also switch video, voice, data and interactive gaming over the same PHY.

In a humorous metaphor, some people may describe lack of Quality of Service to be similar to TCI's dropping the Comedy Channel for economic reasons. Of course, those of us who are addicted to the cartoon "The Tick" are in an uproar. In a QoS-based, integrated services world, a user would not be bothered; he'd make a request to the cable system for a particular "Tick" episode, and the network would set up a virtual channel and deliver the program as requested (i.e., pay-per-Tick), even if the user is utilizing his personal computer to access the Internet via a cable modem at the same time. The content provider who supplied the "Tick" episode, and the cable operator who provided the shared switching fabric and residential access network would both make some money off the request, and everyone would be happy.

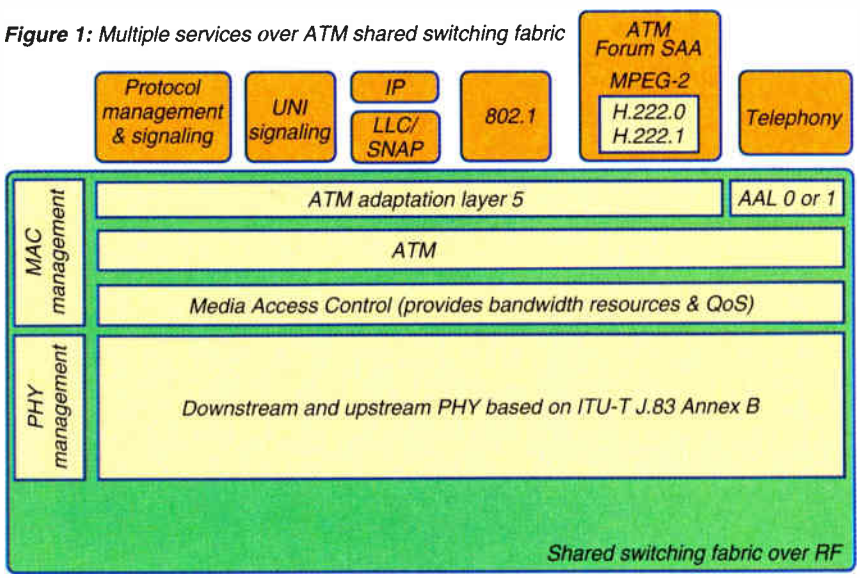
Background on ATM and state of standards

Some people are apprehensive about ATM (asynchronous transfer mode) networking technology for a variety of reasons. From a technology standpoint, when the term "ATM networking" is used, it generally encompasses not only the fixed-sized, cell-based shared switching capability of ATM, but also the signaling, management software and functions required to run an ATM network. The more recent specs also include the performance specifications, metrics and the means to measure the ATM network for certifying guaranteed performance and predictability.

A cell-based shared switching fabric, its management, QoS and predictability go a long way toward supporting integrated services. In addition, many believe that having this fundamental predictable cell-switching network deployed will also lead to a better cost of ownership story through enhanced management, measurement and ability to incrementally add services with minimized up-front costs. (Watch for more about the economics of shared switching fabrics in a future article.)

The ATM Forum Traffic Management Revision 4.0 specification defines an architecture which supports five ATM service categories: Constant bit rate (CBR), real-

Figure 1: *Multiple services over ATM shared switching fabric*



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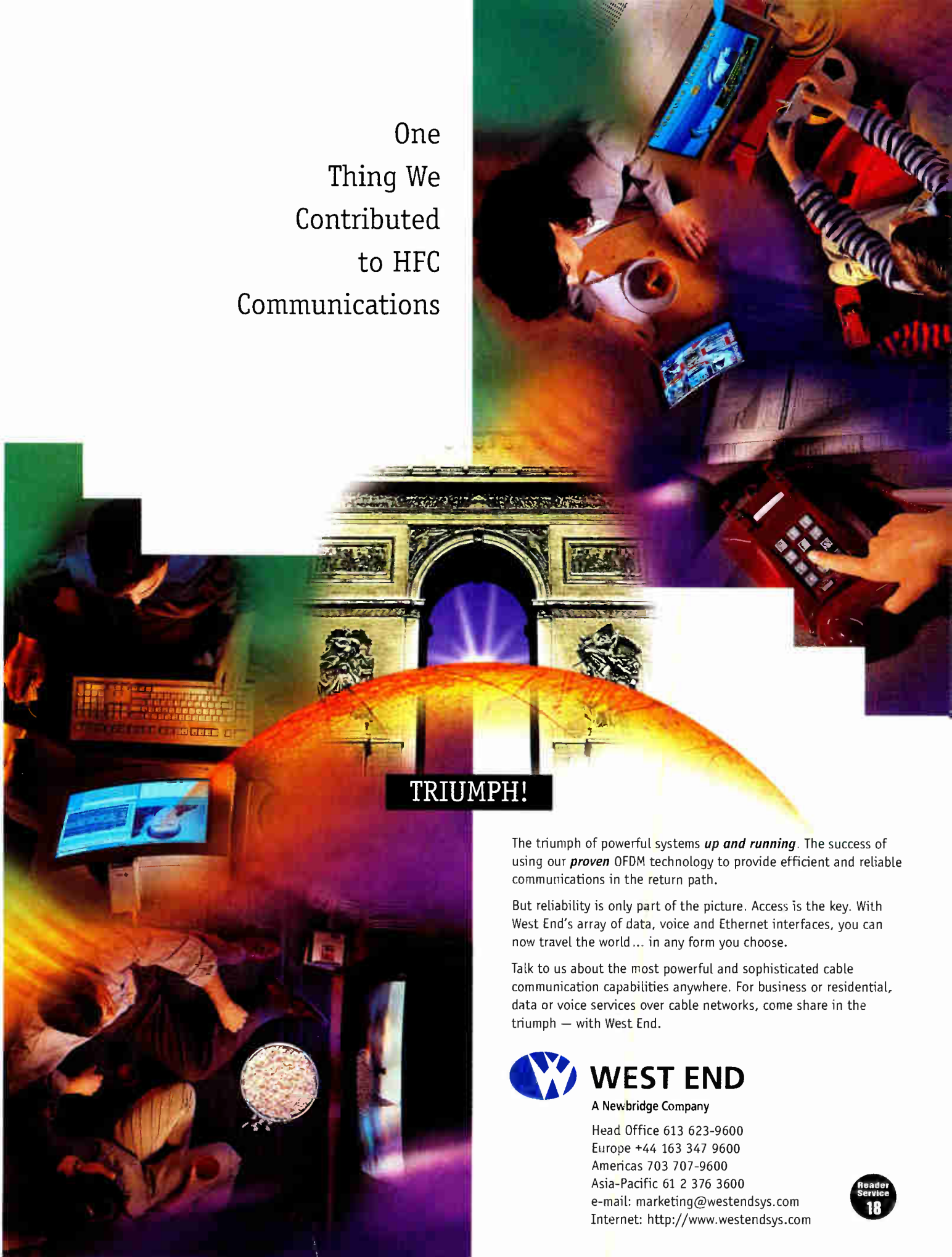

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time variable bit rate (rt-VBR), non-real-time variable bit rate (nrt-VBR), available bit rate (ABR), and unspecified bit rate (UBR). In addition, various minimum and maximum data bit rates may be specified for each of the service categories. When a user requests services from an ATM network, he selects the service category and the desired data rates.

The details of these five service categories and data rate specifications are beyond the scope of this article. However, as a quick overview, CBR directly supports voice telephony and some forms of video-teleconferencing; ABR and UBR directly support Internet data services; and VBR directly supports downstream digital video services. For example, a user can request a 64 Kbps CBR, or ABR with a minimum bandwidth of 128 Kbps, or VBR with a peak data rate of 1.5 Mbps, etc. The combination of the service category and the bandwidth parameters, however, is *not* what is meant by QoS.

QoS is specified using three separate parameters: peak-to-peak cell delay variation (known commonly as jitter); maximum cell transfer delay, which specifies the maximum end-to-end delay tolerance allowed for the connection; and cell lost ratio, a maximum tolerable discard rate for ATM cells.

Table 1: *Existing standards for multiple services over ATM.*

Service	Standard
Video (MPEG-2) and audio	ITU-T H.222.0, ISO/IEC 13818-1, Generic coding of moving pictures and associated audio information, 1996.
Internet over ATM	Internet Engineering Task Force standards: RFC1483, RFC1577, RFC1626, RFC1755.
ATM signaling	ATM Forum af-sig-0061.000 ATM User-Network Interface (UNI) Signaling Specification Version 4.0, July 1996.
ATM traffic management	ATM Forum af-tm-0056.000 Traffic Management Specification Version 4.0, April 1996.

The user specifies the service category, bandwidth parameters for the service category and the QoS requirements for each connection. For example, users can specify an ABR or UBR connection with a large maximum end-to-end delay tolerance (very much like the Internet is today), or they may specify an ABR with a very short maximum end-to-end delay tolerance, which is needed for interactive gaming over the Internet, for example. Further, a downstream connection may specify a VBR connection with desirable bandwidth, but with low cell loss, tight jitter bounds, and not much care for end-to-end delay, which is well-suited for downstream digital video.

Standards are already in place that support multiple services over ATM; i.e., the four revenue-generating services over ATM (See Table 1). The essential building blocks for delivering the four basic revenue services groups over ATM are already in place.

The open and public standardization efforts of the IEEE 802.14 Working Group will provide support for integrated services via ATM over all-coax and hybrid fiber/coax (HFC) cable TV networks. The IEEE 802.14 working group plans on having its first draft specification out in July 1997. Much of 802.14's emphasis on support ATM is a direct result of communications from the North American cable industry.

Another important, but less talked about, aspect of ATM networking is that there are specifications in place that define ATM performance and predictability for a public network. That is, the building blocks, measurements, means to measure and guaranteed behavior specifications for a public network provider, or a cable operator, are already established. What this means is that if the network follows the specifications and standards, the delivered performance and QoS is predictable and guaranteed on a user-by-user basis. This goes a long way toward certifying that the network is delivering the expected service to the customer. Note: these specifications are only valid if the ATM network is the lowest layer which multiplexes streams of data. Said more specifically for cable operators, MPEG multiplexed via ATM produces a predictable ATM network and delivers MPEG via the standards noted above. ATM via MPEG PID multiplexing does not produce a predictable network. A predictable (and measurable) network is required for providing the Quality of Service necessary for the transport of the four revenue-bearing services of the cable industry.

Service options and predictable delivery

Users will pay for lower delay for high-speed Internet access. In general, they are mostly interested in the time it takes to access the information they desire and just how responsive the residential access network is for interactive services. Some users will pay more than others to obtain better delay performance. Multi-tier offerings provide better revenue streams than single tier offerings.

Corporations will pay for differential service for their group of users. Some corporations will pay more than others to obtain different service for their employees. Cable-based access systems which support corporate work-at-home solutions will need to take advantage of multi-tier services for supporting different users within different corporate groups. Corporations will likely pay for integrated services. Employees working at home require, at a minimum, a data connection to the corporate Intranet, a voice connection to the PBX, and perhaps even support for collaborative video conferencing for meetings. The bandwidth management required for supporting corporate work-at-home neatly falls out of an integrated services network.

An upcoming problem in the deployment of high-speed Internet cable modems is isolating the abusive customer. An abusive customer is pushing too much bandwidth, either intentionally or unintentionally, and is interfering with the ability to deliver service to another user at the QoS they expect. The classic office Ethernet LAN does not have resource allocation controls for allocating por-

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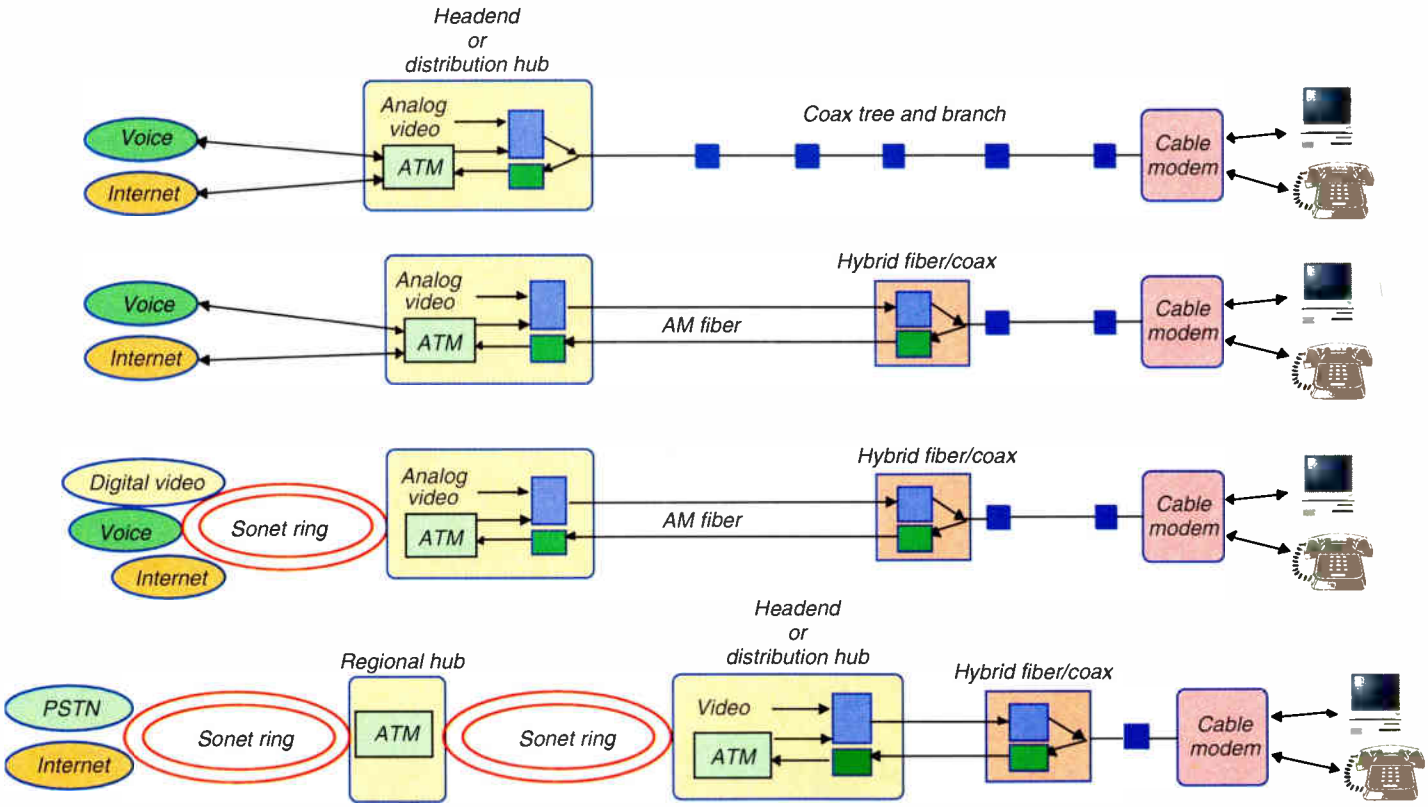
Figure 2: Shared switching fabric incremental deployment.



Model based on discussions with cable industry executives.

tions of the shared resources on a host-by-host basis. Most readers have probably noted that one machine or a pair of machines can slow down the office LAN. LANs were designed to share bandwidth resources in an environment where everyone is a "friend" or a co-worker. An abusive workstation can usually be dealt with by going over to that employee's office and applying peer pressure.

This kind of feedback, while suited for the office, is out of place when dealing with residential customers. One can't just walk up to the door of a subscriber, and say, "Stop that." In order to avoid this upcoming pitfall, it is important that the network be able to supply high-speed data service at the expected quality to each customer, regardless of how other users may be using the same network. A system that has taken care to do QoS and integrated services well automatically ensures that it can discriminate between customers and allocate its network resources appropriately; i.e., the system is well-policed.

Quality of Service, as presented here, is not RF signal quality or a quality management process. The term used here specifically relates to the quality of delivering high-speed digital services. This article has addressed a variety of topics, each time concluding that Quality of Service is the foundation for future integrated services, multi-tier offerings and predictable service delivery required by a public residential access network.

An ATM network is scalable, flexible, manageable and predictable. ATM was designed to support integrated services. (It's just taking longer than expected to get the details flushed out in the industry.) Further, there are existing standards for providing multiple services over ATM that are already in place that support the four revenue-bearing service groups of the cable industry: video, data, voice and interactive gaming.

The short-term focus on supplying high-speed residential Internet services is important for the cable industry. Recent activities indicate that QoS has been discarded as an objective in deference to time-to-market pressures. The author believes that more care is needed in planning for the future deployment of shared switching fabrics with predictable service. The observance of how telcos are approaching their deployment of ADSL and ATM switching systems to support residential Internet service suggests that there is a potential for them to take advantage of incremental service deployment in the future.

Upcoming open standards will provide for ATM over all-coax and hybrid fiber/coax systems. The overlooked benefit is that integrated services can be evaluated over two-way coax plants, allowing the operator to get another "turn" on the last capital investment, and for incremental growth to the next generation of integrated services. The ability to incrementally test new services will point to the direction for the next capital investment. The ability to support integrated services over the same shared switching fabric should result in a lower cost of ownership proposition when running a multiplicity of services. The ability of a network to be predictable is necessary for Quality of Service. These abilities maintain the flexibility and entrepreneurial approach favored by the cable industry for the deployment of future high-speed digital services. CED

The ability of a network to be predictable is necessary for Quality of Service

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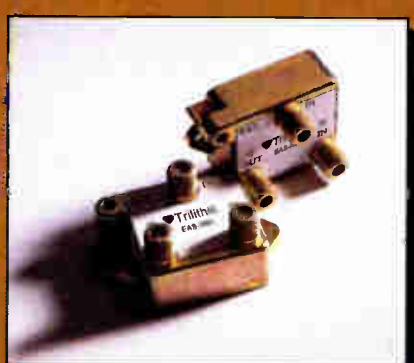

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So you want to cash in on high-speed data?

Systems integrators may provide the services some ops need to succeed

By Michael Lafferty

"The skills required for implementing a high-speed data service include planning, network design and traffic engineering, marketing, customer service, hardware and software, and technical support in the form of help desks. These are emphatically not the core competencies of the cable industry, so these skills require either an infusion of new people and extensive training of existing employees, or outsourcing of some of the tasks. Either way, the skills required to make this happen cost money. We believe that the MSOs initially underestimated these costs but are beginning to recognize that trying to cut corners here will be fatal."

—The Yankee Group Datacom White Paper

Believe it or not, all things being equal, that's the good news, according to the Yankee Group White Paper published just last summer. The no-holds-barred report pulled few punches in its overview of cable's chances for success in high-speed data communications.

The report was the first to admit, that on the surface, the cable industry looks like it has a slam-dunk on high-speed data. In this rosy, fairy-tale scenario, everybody wins as they skip merrily down the digital highway to datacom nirvana where money flows like water.

In this digital Emerald City, the modem vendors make money selling their products. Content developers have wide-open vistas of high-bandwidth capacity to introduce as-yet-unheard-of, almost magical applications on the Internet. Operators finally get some real money-making magic to use against the telecommunications goblins in telephony, DBS and wireless cable. And, last but not least, consumers are absolutely agog over the lightning-like performance improvements they're experiencing navigating the Internet.

Even Dorothy, with Toto firmly in hand, would be knocked on her gingham keister with a modem-in-the-sky story such as this.

But the Yankee Group report gives this fairy tale short shrift as it quickly gets into some stark realities. The report has a few caveats, such as there probably won't be standards-compliant cable modems before 1998. Also, the industry is taken to task (again) for overstatement, with its oft-stated utopian vision of 10 Mbps to every user at "1,000 times the speed of current methods." The report cuts cable's hyperbole to the quick on this point by stating, "You can take your Porsche out on the autobahn, but if there's bumper-to-bumper traffic, you may as well be on a Schwinn bicycle."

Most importantly, the report notes that this running-off-at-the-mouth habit the industry continues to display has the very real potential to squander what the industry needs most, but has very little of—credibility. Citing the industry's woefully underwhelming track record of introducing new services based on emerging technologies, the report zeroes in on operators' historic attitude that, while it may have gotten them where they are today, will almost certainly doom them to failure in the future.

Says the report, "In its haste to generate cable TV revenue (in the past), the industry adopted a mentality that all too often focused on quantity instead of quality of both the coaxial cable and the installation itself. The poor training of employees, low-quality control of installations, and severe management deficiencies reflected a notorious short-term mentality that is coming back to haunt the industry. If the MSOs go into this recklessly with the same short-term mentality as they did with the cable television market, they will

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squander a potentially promising opportunity while taking down the cable modem vendors and their associated research and development (R&D) investments with them."

Obviously, the industry is going to need some help to pull this one off. That help, states the report, is there for the asking.

Take this and integrate it

As many operators are quickly learning, data communications is a whole lot different and a lot more complex than video entertainment, whether that programming be analog or digital. While cable operators wrestle their return paths into some semblance of operability, they're finding a whole different set of issues that are equally vexing, and which also need to be dealt with before any datacom service can be launched.

That's where systems integrators like Digital Equipment Corporation's (DEC) Cable Industry Network Competency Center are filling the core competency void. And the operator's urgency to plug the holes in their datacom strategies and get to market is not lost on DEC.

Lois Levick, director of DEC's Competency Center, reports the rising sense of urgency in the industry shows no sign of abating. "The whole decision-making and implementation time-frame is collapsing," says Levick. "The time-to-market urgency has become more significant. The decision-making (process) was so long before, that people/companies were bleeding to death in trying to support it. They took a three-phased approach in making their decisions before. If you talk to people now, they will actually say, 'We go to market immediately. We do a deployment immediately.'

"Why? Because frankly they know they can make money from it. They feel the need to make money from it. And they also feel that if they don't get to market quickly enough, someone else might."

Because each cable network is different, Levick points out that data communications is certainly no "cookie-cutter kind of rollout." The first thing the Center insists on when working with an MSO, is an accurate characterization of a system before it takes the first step. For some operators, that can be a rude awakening.

Help desk support systems may be crucial in establishing customer service credibility for operators providing high-speed data communication services.

"The systems integrator's (SI) role," says Levick, "should be to make sure the plant is qualified. The SI can do it with its staff and equipment or conduct a detailed review and verify the operator's records and readings. And, we're learning that a lot of the operators have this belief that their plant is in a particular state. Most often, they think they're better off than they are. In part, because they want to believe that. But usually, that belief is based on old records or old equipment."

Levick

Paff

Levick says this baseline study doesn't take long to perform. "It's doesn't take very long to do it if it's done right. If you have the right equipment, it shouldn't take more than two weeks at the most. But making this assessment is absolutely crucial.

"We check signal levels. We want to know what's on the network, what else we have to deal with. We also want to know what may be impinging on the delivery of services that operators never had to worry about before."

While some system problems are readily identifiable, others aren't that easy. Levick sites, as an example, the high-speed data trial DEC is doing for Singapore CableVision. Sometimes, she says, the problem turns out to be a basic fundamental flaw. "What we found in Singapore, where the plant is brand new and one would think would be close to perfect, was that we had an awful lot of signal egress. And we couldn't figure it out at first. It took one of my folks actually going through the system and checking it at every single point to determine that some of the loss was in the apartment complexes. It turned out to be as simple as the wires were never crimped properly."

One of the key concerns in the fast evolving datacom boom is making sure that equipment from a variety of vendors not only works together, but can be monitored and managed seamlessly. In order to facilitate such work, DEC launched in-lab cable network product and design testing in December of last year.

"The labs that we've set up," says Levick, "are intended to test three things: performance, interoperability and scalability. The labs are designed to pretty much duplicate a system. One of the reasons why we decided to initiate these new lab services was because we were finding that people were making assumptions based on very small-scale experiences.

"For example, they would put a few pieces of new equipment in their lab or in an isolated environment and say, 'Hmm, isn't it nice these two things talk well together?' But later, 5,000 or 50,000 customers are going to be on this equipment and you may think everything will be fine. That's not necessarily the case."

Levick thinks this assumption could be based on an over-reliance on data supplied by manufacturers. The better thing, she says, is to do some rigorous testing beforehand, "so that before they deploy, before they're in front of the customer, ops can find out what's actually going to happen when this equipment is serving large numbers of customers. It could delay the process. But it will also stop them from having problems as they deploy and scale up."

A modem by any other name

Of course, a key element in this burgeoning service area is the cable modem. The 20 or so

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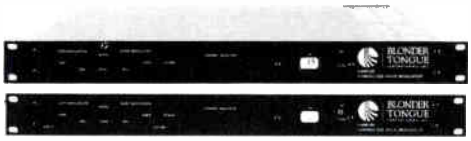

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Reader Service 92

Blonder Tongue's IRD-6185-RS integrated receiver/descrambler provides high quality, CATV grade performance at a price that won't send your budget into orbit. This receiver is C and Ku band ready with an integrated VideoCipher® II RS descrambler module. The IRD-6185-RS is designed for analog satellite programming, allowing the operator to choose from the hundreds of channels available from today's many satellites.

The IRD-6185-RS is C and Ku band compatible, accepting signals in the 950 to 1450 MHz frequency range. Frequency selection is accomplished via front panel thumbwheel switches, supporting both C band transponder and direct C and Ku band frequency settings. The receiver offers two modes of synthesized frequency control. A high-stability quartz crystal reference mode, with a 1 MHz tuning increment, allows for optimizing the receiver's TI immunity. An AFC mode is also included, which provides tracking of the LNB frequency drift of the input signal. An ultra-stable phase locked loop demodulator features superior C/N threshold extension. This design delivers excellent picture quality, even under weak signal conditions.
The IRD-6185-RS can be set to one of two aural subcarrier modes, including: fixed (6.8 MHz) and variable (5.4 to 8.2 MHz). An external 70 MHz IF loop is provided, which allows TI filters to be inserted as needed. The IF loop comes with a standard 32 MHz IF bandwidth filter installed.

The IRD-6185-RS is housed in a single height, 1.75" high, rack mountable, steel chassis with a rugged aluminum cover. Front panel design allows front of rack access to the descrambler module, replaceable battery, authorization number, and renewable security (RS) card, without removing the IRD-6185-RS from its rack mounting. A wide variety of features are also provided: including a ganged audio (stereo L/R and mono) level control, audio mode switch for calibrated factory or variable audio level, and an automatic resetting thermal breaker for the LNB power source.

products in the marketplace are battling it out for market share. As a result, says Levick, the initial strategy DEC planned to utilize changed. "In the perfect world," she says, "we would have gone in with product recommendations based on our knowledge and experience. And in the initial stages, some people thought that that was the right approach.

"What we're finding though, and this is a change, is that the cable modem vendors are much more aggressive now in trying to build their base. So they're selling directly. It's happening everywhere. There isn't a place that we go that the cable modem vendors haven't already been there."

Levick reports, in some cases, operators are committing themselves to a particular modem product before they've analyzed their systems. "I can't say why or how they're making these decisions," says Levick. "It could be there's a confidence level based on the information that's conveyed by the modem vendor. That's a very nice thing. It could be the price, which is not necessarily the answer. It could be anything. But, we're finding in many cases, it's an after-the-fact kind of situation."

Like DEC, when it comes to comparing modems, Integration Technologies doesn't push one product over another. "I like to say we're religiously agnostic," says Andy Paff, IT president. "And that is an important element to our success. Particularly since we come from hardware parents (Nortel and Antec). We don't sell any product, other than the software products we developed (model it and field it).

"Our approach is not to come in and do equipment bake-offs.' What we would do, either for a manufacturer or a customer, is look at compatibility. I think our role is to help, not only the MSOs, but the equipment manufacturers understand the real world and what they're dealing with out there and adjust their products accordingly.

"The operators will make the decisions. They will make them based on their particular situation. their available bandwidth, the type of systems they want to deploy."

Levick notes that the modem vendors' aggressive sales efforts have changed the Competency Center's approach as well. "What's happening now," says Levick, "is that we're being called in at various levels of integration. Whereas before, we always saw ourselves as the prime integrator that's brought in at the very beginning. We're getting calls from some of the cable modem vendors, who are trying to expand their market share, to do their installs after they've already closed the deal with the operator. We're not complaining, but it's a very different model."

The customer service conundrum

While any SI worth its coax will help operators tackle such issues as headend provisioning, residential/business deployment, network traffic analysis and management, Internet service provisioning, security, training and project management, customer service may be the area where they're needed most. Industry observers continually stress that this competency, as a key differentiator against competitors, could very well make or break datacom as a viable revenue source for cable operators.

First off, says Levick, operators have to come to the understanding that once they deploy high-speed data communications, their customer base will essentially go schizophrenic. "Physically," states Levick, "they may be the same subscribers that they've been doing business with in the past. But logically, with these new services, they're different subscribers, and they have different requirements and demands.

Operators will have to acquire new core competencies like help desk and network traffic management and analysis.

"It's very, very important that the operators spend quite a bit of time making a decision on how they are going to support the home (data) user. They've really got to nail it. They have to have their customer service plan absolutely clear, well-defined and efficiently in place so that once that service is turned on, there are no surprises. What happens otherwise, is that people at home, if they go on-line and have a problem, think because they have this new service, that the service broke their computer.

"Some of the operators have toyed with a drop station or a deal with a local retailer. This is where the customers can take their PC to a designated retailer to have his or her high-speed service needs met. I haven't seen a lot of that, but that was a lot of the discussion we had with operators initially.

"We're more apt to offer a help desk solution for them. Normally, operators want to take the first call. They want to have that engagement so that the subscriber feels connected to them. That's fine. Then we'll take the second or third. We'll escalate it for them. We'll even take the first if they prefer it."

Another important facet of datacom customer service involves getting customers physically hooked up to the service. Levick says DEC learned a great deal about the complexities of this function during a telecommuting trial with MCI and Century Communications in Colorado Springs, Colo. "What we found with that small group, I think it was 20 or 25 telecommuters, was that there wasn't one PC that was like the other. They were all at different levels of software.

"There were just so many different things that had to be dealt with. How do you bring everyone up to grade so they all have the same experience? And that's important so that you can maintain that customer base as well.

"What some of the ops are starting to do is that they're creating a set of pre-conditions (i.e., minimal computer power/system thresholds) that customers must meet before they can come on-line. And that's smart. They're setting the conditions, and not just saying they want as many people on-line as possible."

Is there an SI in your future?

Is there a systems integrator in every operator's future? Not necessarily. Do systems integrators possess expertise that operators could well use, in one way or another, during a datacom service rollout? Undoubtedly. Trying to figure out if, when, or where a systems integrator can help you, says Levick, involves taking a good look both inward and outward.

"Operators should actually do a self-assessment," explains Levick. "They should say, 'What are our skills? What is our knowledge level? What is our risk?' Where somebody is already knowledgeable and they already have some defined levels of expertise, then they should leverage that.

"But, where there is new learning to take place, they should spend what they need to assure themselves that they're doing the best quality rollout possible. Because if they don't start out on the right foot, they're always going to be playing catch-up.

"One of the things we find, is the cost-consciousness of the operators, shall we call it, sometimes, in the past, created a condition where they cut corners. And this is not an area where they should do that. It is critical, I think, for their reputation and their future business that operators do this deployment properly. Because otherwise, their competitors will eat their lunch. And coming from the telephone side of things, which is my background, that's exactly what they will do." CED

Advertisment

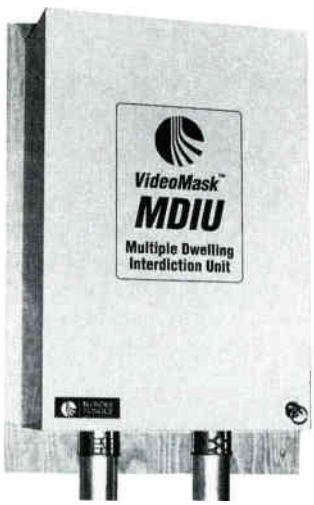
VideoMask™ Interdiction System Multiple Dwelling Interdiction Unit (MDIU)

Blonder Tongue's VideoMask™ Interdiction System is the complete program security solution for today's cable market. The Multiple Dwelling Interdiction Unit (MDIU) is a new member of the VideoMask™ family and is ideal for MDU installations. The MDIU is available in 8, 12, and 16 port configurations and is housed in a rugged, outdoor, steel enclosure. Each MDIU consists of one or more 4-port subscriber groups mounted in an RFI-tight steel inner enclosure. An outer steel enclosure provides excellent protection for outdoor installations, while an integrated lock prevents tampering with the interdiction components.

The MDIU is suitable for wall mounting and includes a backing plate with locating studs for quick installation. A removable bottom panel provides easy access to the entry/exit connections and subscriber drops. Ample room is provided for installing a directional coupler for those system designs requiring cascaded MDIU's. This work space can also accommodate the installation of L-band components for those systems providing both analog (50-750 MHz) and digital (950-2150 MHz) programming. Blonder Tongue also manufactures these L-band components - please contact our Sales/Marketing Departments for more information.

Available in 8, 12, and 16 port configurations

Blonder Tongue's VideoMask™ Interdiction Unit (VMIU), which serves 4 subscribers from a die cast housing, is also suitable for pedestal based MDU installations. Blonder Tongue has recently begun offering several pedestal mounting kits, including Channell (SPH1320, SPH1212, SPH1010) and Reltec (TV1024) models. These bracket kits allow up to 4 VMIU's (a total of 16 ports) to be mounted in one pedestal, with plenty of room for entry/exit connections and subscriber drop cables. Both the MDIU and VMIU provide identical electrical performance and can be intermixed on properties to increase the efficiency of the system design.



Reader Service 83

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New!

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Operators look at back-door telephony service

Another way to dial for dollars?

ILLUSTRATION BY WILLIAM WHITEHURST, THE STOCK MARKET

Just when cable engineers thought that they were beginning to get the technical issues surrounding the provision of broadband data services under control, up jumps an unexpected opportunity—or distraction? Now that operators are putting their plans to offer fullscale cablephone service on hold, they are starting to take a hard look at what it would take to provide various incarnations of Internet telephony, or voice over IP services via the cable network, and which applications would make money.

"I don't know that it makes sense to try to do Internet telephony to replace your 911-grade basic POTS dialtone," says @Home Network's VP of Networks Milo Medin, "but certainly, you can do some interesting things like (eliminate) the need to have a second phone line for faxes."

Toll quality voice?

The technology could also open some doors for smaller systems. Bill Bauer, president of the small but innovative WindBreak Cable, believes that the technology has some significant opportunities for long distance bypass services. "I'm actually looking at it a bit differently, where we would use the IP network that we've built as the transport back to our headend, and then hop onto an IXC—not the complete connection where we go all the way over the Internet, say, to Europe," explains Bauer. "I'm looking at true, toll quality (voice), not much lower. But I don't have all the answers. All I know is, I can do it—now, what do I do with it?"

"We are looking at Internet telephony very seriously," echoes Steve Craddock, vice president of new media development with Comcast Corp., another partner in @Home, who adds that while the MSO has been aware of the potential of IP voice for quite some time, both the necessary hardware and software "are not ready for prime-time yet."

"We have seen some promising stuff, but there are so many things that still have to come together," adds Craddock.

Technology not mature

The technical challenges of Internet telephony exist on both the software and the hardware side, ranging from voice codecs to gateway servers to modems, and even the PCs (or Macs) themselves. While cable modems could, theoretically, offer a clearer, higher-quality conversation with less delay than current 14.4 or 28.8 kbps telephony modems (see sidebar), the cable modems available today were not designed to carry

Motorola RF CATV Distribution Amplifiers

Since the very inception of the cable TV distribution industry, Motorola has excelled as a leading supplier of innovative technical products to the CATV market. Three examples of such solutions are the first 860 MHz conventional and power doubling hybrids, patented Darlington circuitry, and the only ultra–linear feedforward amplifiers in the industry.

Highlighted in the Selector Guide is the first series of low current reverse amplifiers, featuring new packaging as well as the newly introduced fiber optic receiver. Also premiered herein are exciting soon–to–be released state–of–the–art products utilizing transistors with sub–micron geometries.

Fiber Optic Receivers for HFC

40–860 MHz Hybrids

Device	Hybrid Responsivity Min dB	Flatness dB	Maximum Distortion Specifications IMD 2(52) dB	Maximum Distortion Specifications IMD 3(52) dB	Equivalent Input Noise pA/√Hz Max	Package/ Style
MHLW8000 (53) ★	23.0	1.0	–70	–80	7.5	714U/1

Note: Please call your local Motorola Sales Office for information on optical connector options for this part.

Forward Amplifiers

40–1000 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 152 CH	Cross Modulation dB 152 CH	Noise Figure @ 860 MHz dB Max	Package/ Style
MHW9142 (54)	14	152	+38	–59(40)	–59	–63	8.5	714/1
MHW9182 (54)	18	152	+38	–59(40)	–59	–59	8.0	714/1
MHW9242 (55) ★	24	152	+38	–59(40)	–58	–59	8	714/1

(40)Composite 2nd Order; V_{out} = +38 dBmV/ch

(52)Two laser test with 0.5 mW optical power at 40% modulation index per laser; f1 = 373.25 MHz f2 = 415.25 MHz

(53)Refer to Figure 3 for circuit configuration information.

(54)Refer to Figure 2 for circuit configuration information.

(55)Refer to Figure 4 for circuit configuration information.

★New Product

CATV Distribution: Forward Amplifiers (continued)

40–860 MHz Hybrids

Device	Gain dB Typ	Frequency MHz	V_{CC} Volts	2nd Order IMD @ V_{out} = 50 dBmV/ch Max	DIN45004B @ f=860 MHz dBμV Min	Noise Figure @ 860 MHz dB Max	Package/ Style
CA901 (56)	17	40 – 860	24	–60	120	8	714P/2
CA901A (56)	17	40 – 860	24	–64	120	8	714P/2
Power Doubling Hybrids							
CA922 (56)	17	40 – 860	24	–63	123	9.5	714P/2
CA922A (56)	17	40 – 860	24	–67	123	9.5	714P/2
Hybrid Jumper							
CATHRU	0	1 – 1000	75 Ohm Broadband Hybrid Jumper				714V

40–860 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 128 CH	Cross Modulation FM = 55.25 MHz dB 128 CH	Noise Figure @ 860 MHz dB Max	Package/ Style
MHW8142 (54)	14	128	+38	–60(40)	– 61	– 66	8.0	714/1
MHW8182 (54)	18	128	+38	–60(40)	– 60	– 60	7	714/1
MHW8222 (54)	22	128	+38	–60(40)	– 60	– 60	7.5	714/1
MHW8242 (55)★	24	128	+38	–60(40)	– 60	– 60	7.5	714/1
MHW8272 (55)★	27	128	+38	–60(40)	– 60	– 60	7.0	714/1
MHW8292 (55)★	29	128	+38	–56(40)	– 60	– 60	7.0	714/1
Power Doubling Hybrids								
MHW8185 (46,54)	18.5	128	+40	–62(39)	– 64	– 64	8.0	714Y/1
MHW8205 (46,54)	20	128	+40	–60(39)	– 63	– 64	8.0	714Y/1
Feedforward Hybrids								
MFF524B★	24	128	+44	–68(36)	– 66	—	13.0	825A/2

40–750 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 110 CH	Cross Modulation FM = 55.25 MHz dB 110 CH	Noise Figure @ 750 MHz dB Max	Package/ Style
MHW7142 (54)	14	110	+40	–60(39)	– 62	– 66	8.0	714/1
MHW7182 (54)	18	110	+40	–62(39)	– 62	– 64	6.5	714/1
MHW7222 (54)	22	110	+40	–55(39)	– 60	– 60	7	714/1
MHW7242 (55)★	24	110	+40	–60(39)	– 60	– 60	7	714/1
MHW7272 (55)★	27	110	+40	–60(39)	– 60	– 60	6.5	714/1
MHW7292 (55)★	29	110	+40	–60(39)	– 60	– 60	6.5	714/1

(36)Composite 2nd order; V_{out} = +44 dBmV/ch

(39)Composite 2nd order; V_{out} = +40 dBmV/ch

(40)Composite 2nd Order; V_{out} = +38 dBmV/ch

(46)To be introduced 1Q97.

(54)Refer to Figure 2 for circuit configuration information.

(55)Refer to Figure 4 for circuit configuration information.

(56)Refer to Figure 5 for circuit configuration information.

★New Product

40–750 MHz Hybrids, V_{CC} = 24 Vdc, Class A (continued)

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 110 CH	Cross Modulation FM = 55.25 MHz dB 110 CH	Noise Figure @ 750 MHz dB Max	Package/ Style
Power Doubling Hybrids								
MHW7185A (54)	18.5	110	+44	–58(36)	–58	–65	8.5	714/1
MHW7185C (46,54)	18.8	110	+44	–64	–62	–63	7.0	714Y/1
MHW7205A (54)	20	110	+44	–56(36)	–57	–64	8.0	714/1
MHW7205C (46,54)	20	110	+44	–63	–61	–62	7.0	714Y/1
Feedforward Hybrids								
MFF424B	24	110	+44	–70(36)	–68	—	13	825A/2

40–600 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 87 CH	Cross Modulation dB 87 CH	Noise Figure @ 600 MHz dB Max	Package/ Style
MHW6182–6 (54)	18	87	+44	–56(36)	–57	–55	6	714/1
MHW6222–6 (54)	22	87	+44	–56(36)	–56	–56	6	714/1
MHW6272–6 (46,55)	27	87	+44	–63(36)	–57	–55	6.5	714/1
MHW6292–6 (46,55)	29	87	+44	–63(36)	–57	–55	6.5	714/1
Power Doubling Hybrids								
MHW6185–6A (54)	18	87	+44	–64(36)	–64	–66	7	714/1
MHW6205–6A (54)	20	87	+44	–63(36)	–63	–65	6.5	714/1
Feedforward Hybrids								
MFF324B	24	85	+44	–86(38)	–73	–68	12.5	825A/2

40–550 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 77 CH	Cross Modulation dB 77 CH	Noise Figure @ 550 MHz dB Max	Package/ Style
MHW6142 (57)	14	77	+44	–72(35)	–59	–62	7.5	714/1
MHW6172 (57)	17	77	+44	–72(35)	–59	–62	7	714/1
MHW6182 (57)	18	77	+44	–72(35)	–58	–62	7	714/1
MHW6222 (57)	22	77	+44	–66(35)	–57	–57	6	714/1
MHW6272 (57)	27	77	+44	–64(35)	–57	–57	6.5	714/1
MHW6342 (57)	34	77	+44	–64(35)	–57	–57	6.5	714/1
Power Doubling Hybrids								
MHW6185B (57)	18	77	+44	–65(36)	–65	–68	7.5	714/1
MHW6205 (57)	20	77	+44	–60(36)	–64	–67	7.5	714/1
MHW6225 (57)	22	77	+44	–55(36)	–62	–60	7.0	714/1

(35)Channels 2 and M30 @ M39

(36)Composite 2nd order; V_{out} = +44 dBmV/ch

(38)Channels 2 and M39 @ M48

(46)To be introduced 1Q97.

(54)Refer to Figure 2 for circuit configuration information.

(55)Refer to Figure 4 for circuit configuration information.

(57)Refer to Figure 1 for circuit configuration information.

CATV Distribution: Forward Amplifiers (continued)

40–550 MHz Hybrids, V_{CC} = 24 Vdc, Class A (continued)

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 77 CH	Cross Modulation dB 77 CH	Noise Figure @ 550 MHz dB Max	Package/ Style
Feedforward Hybrids								
MFF224B	24	77	+44	–86(35)	–75	–70	11	825A/2

40–450 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test dB	Composite Triple Beat dB 60 CH	Cross Modulation dB 60 CH	Noise Figure @ 450 MHz dB Max	Package/ Style
MHW5142A (57)	14	60	+46	–74(31)	–61	–62	7	714/1
MHW5172A (57)	17	60	+46	–74(31)	–60	–62	7	714/1
MHW5182A (57)	18	60	+46	–72(31)	–61	–59	6.5	714/1
MHW5222A (57)	22	60	+46	–72(31)	–60	–59	5.5	714/1
MHW5272A (57)	27	60	+46	–68(31)	–59	–60	6.0	714/1
MHW5342A (57)	34	60	+46	–68(31)	–59	–59	6.0	714/1
MHW5382A (57)	38	60	+46	–64(31)	–59	–59	5.0	714/1
Power Doubling Hybrids								
MHW5185B (57)	18	60	+46	–67(32)	–67	–67	7.0	714/1
MHW5225 (57)	22	60	+46	–69(31)	–62	–62	6.0	714/1
Feedforward Hybrids								
MFF124B	24	60	+46	–84(31)	–79	–75	10	825A/2

Reverse Amplifiers

5–200 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	Maximum Distortion Specifications: Output Level dBmV	2nd Order Test(30) dB	Composite Triple Beat dB 22 CH	Composite Triple Beat dB 26 CH	Cross Modulation dB 22 CH	Cross Modulation dB 26 CH	Noise Figure @ 175 MHz dB Max	Package/ Style
MHW1134 (57)	13	22	+50	–72	–73	–71(19)	–65	–65(19)	7	714/1
MHW1184 (57)	18	22	+50	–72	–70	–70(19)	–64	–64(19)	5.5	714/1
MHW1224 (57)	22	22	+50	–72	–69	–68.5(19)	–62	–62(19)	5.5	714/1
MHW1244 (57)	24	22	+50	–72	–68	–67.5(19)	–61	–61(19)	5	714/1

(19)Typical

(30)Channels 2 and A @ 7

(31)Channels 2 and M13 @ M22

(32)Composite 2nd order; V_{out} = +46 dBmV/ch

(35)Channels 2 and M30 @ M39

(57)Refer to Figure 1 for circuit configuration information.

Low Current Amplifiers — 5–50 MHz Hybrids, V_{CC} = 24 Vdc, Class A

Device	Hybrid Gain (Nom.) dB	Channel Loading Capacity	I_{DC} mA Max	Maximum Distortion Specifications				Noise Figure @ 50 MHz dB Max	Package/ Style
				Output Level dBmV	2nd Order Test(30) dB	Composite Triple Beat dB 4 CH	Cross Modulation dB 4 CH		
MHW1184L (57)	18	4	135	+50	–70	–73	–64	5	714/1
MHW1224L (57)	22	4	135	+50	–70	–72	–63	5	714/1
MHW1254L (57)	25	4	135	+50	–70	–70	–62	4.5	714/1
MHW1304L (57)	30	4	135	+50	–70	–66	–57	4.5	714/1

(19)Typical

(30)Channels 2 and A @ 7

(57)Refer to Figure 1 for circuit configuration information.

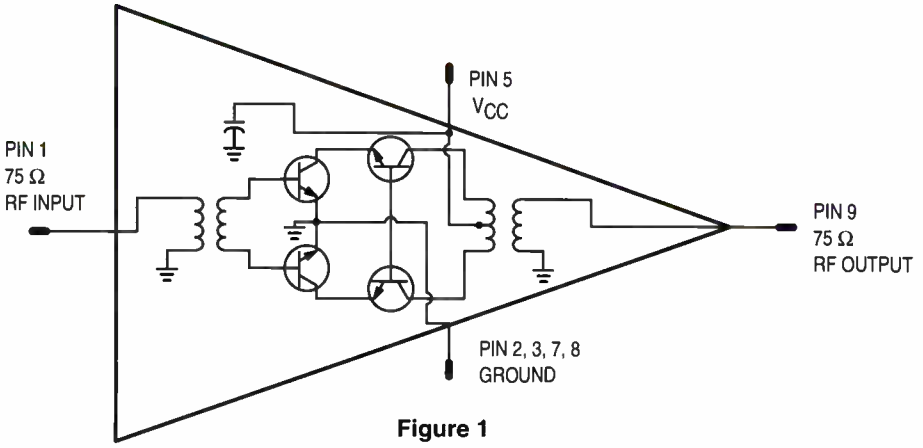
★New Product

Philips to Motorola Cross Reference

Philips	Motorola
—	MHW1184L
—	MHW1224L
—	MHW1254L
—	MHW1304L
BGY61	MHW1134
BGY65	MHW1184
BGY67	MHW1224
BGY67A	MHW1244
BGY83	MHW5142A
BGY85	MHW5172A
BGY85A	MHW5182A
BGY87	MHW5222A
BGY87B	MHW5272A
BGY88	MHW5342A
BGY89	MHW5382A
BGD102	MHW5185B
BGD104	MHW5205
BGD106	MHW5225
None	MFF124B
BGY583	MHW6142
BGY585	MHW6172

Philips	Motorola
BGY585A	MHW6182
BGY587	MHW6222
BGY587B	MHW6272
BGY588	MHW6342
BGD502	MHW6185B
BGD504	MHW6205
BGD506	MHW6225
None	MFF224B
BGY685A	MHW6182–6A
BGY687	MHW6222–6A
BGY687B	MHW6272–6
—	MHW6292–6
BGD602	MHW6185–6A
—	MHW6205–6A
None	MFF324B
—	MHW7142
BGY785A	MHW7182
BGY787	MHW7222
—	MHW7242
—	MHW7242
BGY787B	MHW7272
—	MHW7292

Philips	Motorola
BGD702	MHW7185A
BGD704	MHW7205A
None	MFF424B
—	MHW8142
BGY885A	MHW8182
—	MHW8222
—	MHW8242
—	MHW8272
BGY887B	MHW8292
BGD802	MHW8185
—	MHW8205
None	MFF524B
BGX885N	CA901
BGX885N	CA901A
BGD885	CA922
BGD885	CA922A
—	MHW9142
BGY1085A	MHW9182
MHW9242	MHW9242



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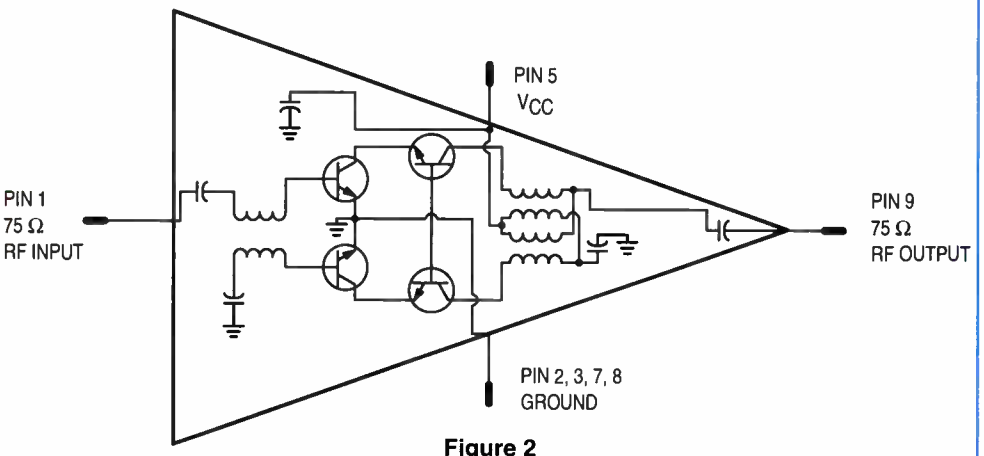

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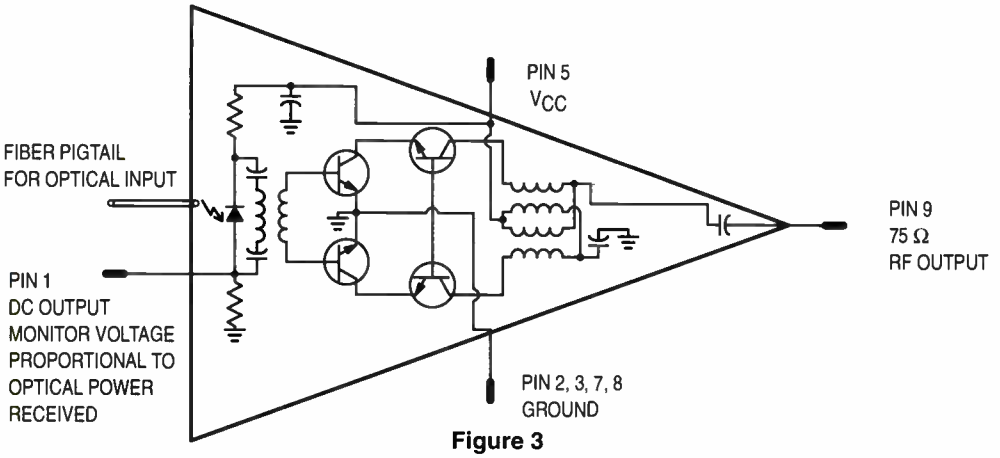

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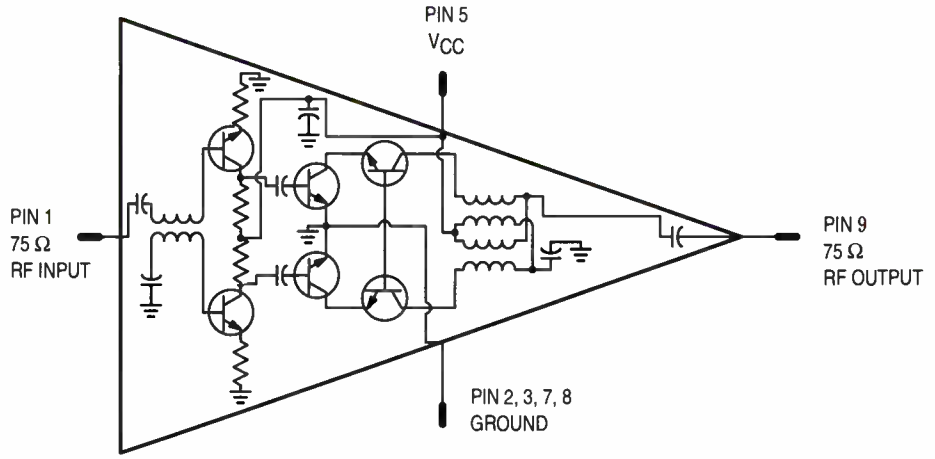

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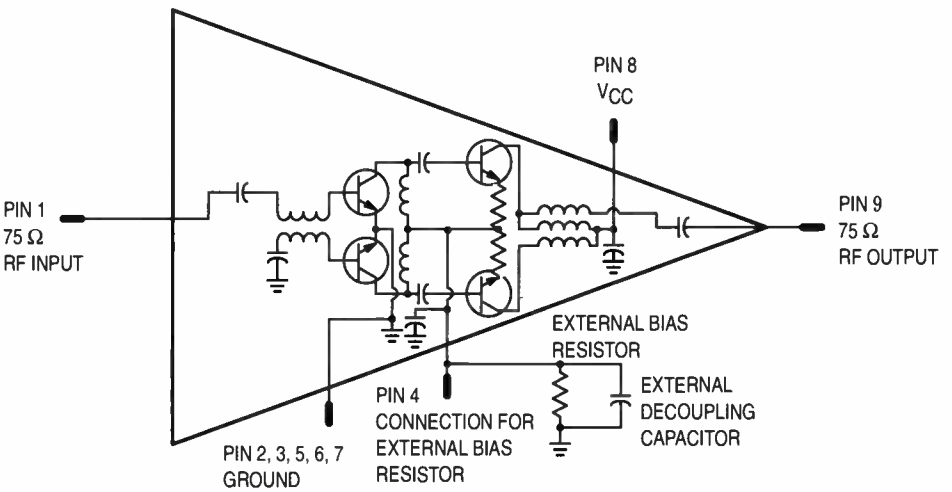

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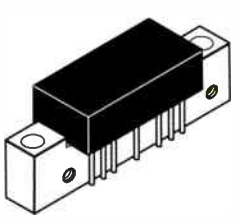

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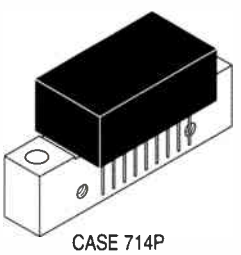

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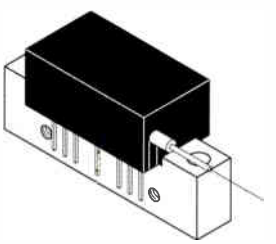

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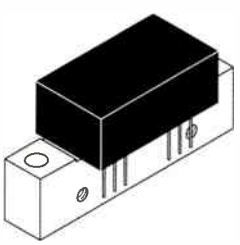

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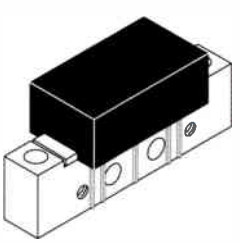

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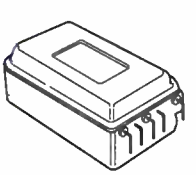

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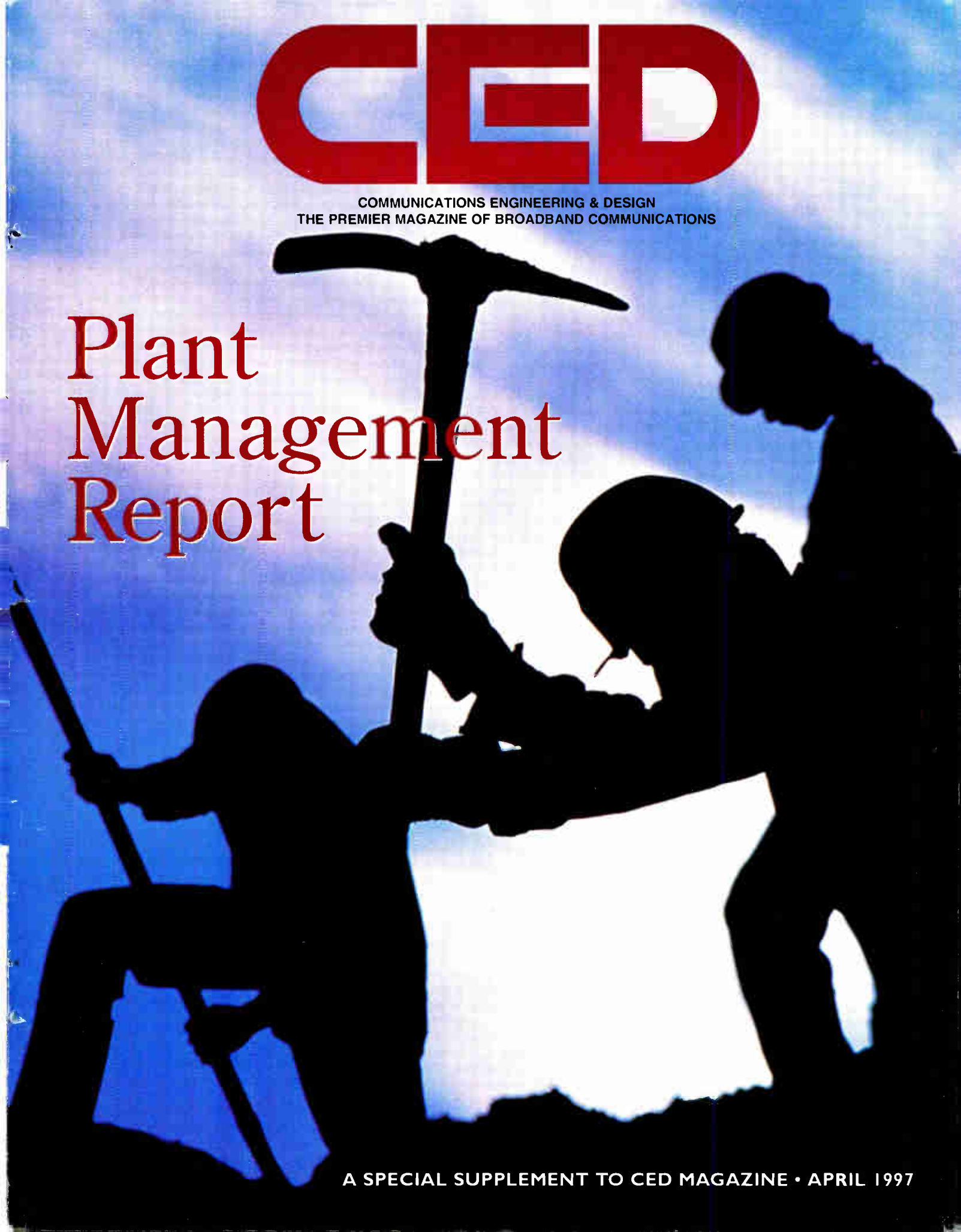

A SPECIAL SUPPLEMENT TO CED MAGAZINE • APRIL 1997

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More ammunition for the front lines

ROGER BROWN
EDITOR

Like any good company, we here at CED like to stay in touch with the people who consume our products. We constantly attend conferences, seminars, meetings and trade shows so that we know what's on our readers' mind. We perform focus groups, commission editorial surveys and hold countless hallway conversations with people who are actively involved in the cable TV industry to make sure our editorial product is timely, accurate and interesting.

From a journalistic point-of-view, covering this industry is, well, fun. There's no shortage of things to write about. There are new products and new services on the way. There's competition and new ways of doing things. The future is unknown; hence, it's exciting.

Sometimes, though, hyperbole takes over, and people are falsely led to believe there are climactic changes that will take place over the course of a few short months. Of course, those changes rarely take place–and when they do, they're evolutionary, not revolutionary.

Through it all, it's important that service providers stay in touch with consumers, so that they can offer the services and support consumers want. Because no matter what new services might be planned, protecting the core customer and giving him what he wants are the keys to success in this new competitive era.

So, while cable operators have to prepare for a two-way, interactive era where a full complement of voice, video and data services are whizzing over their hybrid fiber/coax networks to millions of homes, the fact is that there's a lot of work to be done first. Shoring up the plant, keeping it up and running, keeping employees happy, managing upgrade projects, answering the telephone on time–these are all battles that have to be fought every day, especially now that competition has arrived.

The focus is squarely on useful information

Hence this *Plant Management Report*, a new quarterly supplement we'll be offering to the readers of *CED*. We plan to load these reports with good, useful information for engineering and technical managers to help them perform their jobs better, faster or more efficiently. We won't be publishing theory; the focus is squarely on useful information and tips on how to keep day-to-day operations humming along. In coming issues, we'll bring you helpful articles on construction, test and measurements, human resources, new products and plant maintenance from industry experts and your peers. The hope is that the information can be filtered down to front-line technical personnel, who can in turn use it to help you win in the marketplace.

We obviously hope you find the information on the pages that follow both interesting and useful. Feel free to give us your feedback and story ideas. Call us, write us or e-mail us with your comments. This industry, and the people in it, have thousands of success stories to tell–we intend to uncover them and pass them along. With your participation in the process, I'm sure it will work.

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VP Group Publisher
William McGorry

Publisher
Robert C. Stuehrk, Rstuehrk@aol.com

Editor
Roger Brown, Rbrowner@aol.com

Managing Editor
Dana Cervenka, Dlcervenka@aol.com

Associate Editor
Michael Lafferty, McLaffrt@aol.com

Contributing Editors
Leslie Ellis, Ellis299@aol.com
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Account Executive
Todd Marquez, Tmarquez@chilton.net

Classified Sales Manager
Tim Reeder; 800/866-0206

Assistant to the Publisher
Michelle Pazar

Production Manager
Johanna McGinnis, Jmcginni@chilton.net

Art Director
Don Ruth, Druth@chilton.net

Assistant Art Director
Anney Grossberg, Agrossbe@chilton.net

Address
600 S. Cherry St., Suite 400
Denver, CO 80222
303/393-7449; Fax 303/393-6654
Web site: http://www.cedmagazine.com

Circulation Director
Maria Gottlieb; 212/887-8565

Associate Circulation Manager
Shawn Green; 212/887-8564

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CED, P.O. Box 10728
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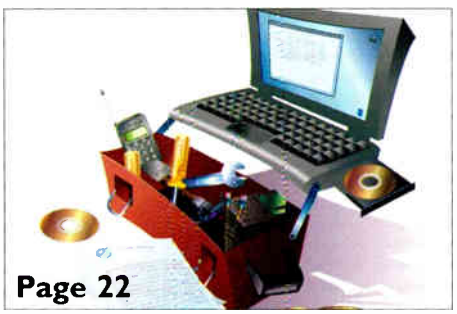
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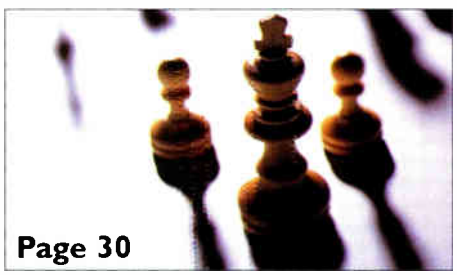
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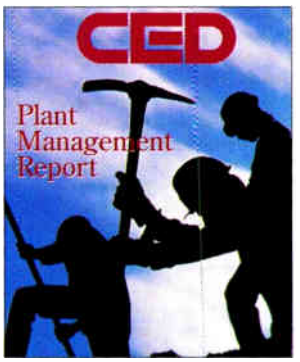

It's construction season. We explain how to manage your upgrade and work with your contractor. Cover by Chris Shinn/Tony Stone Images.

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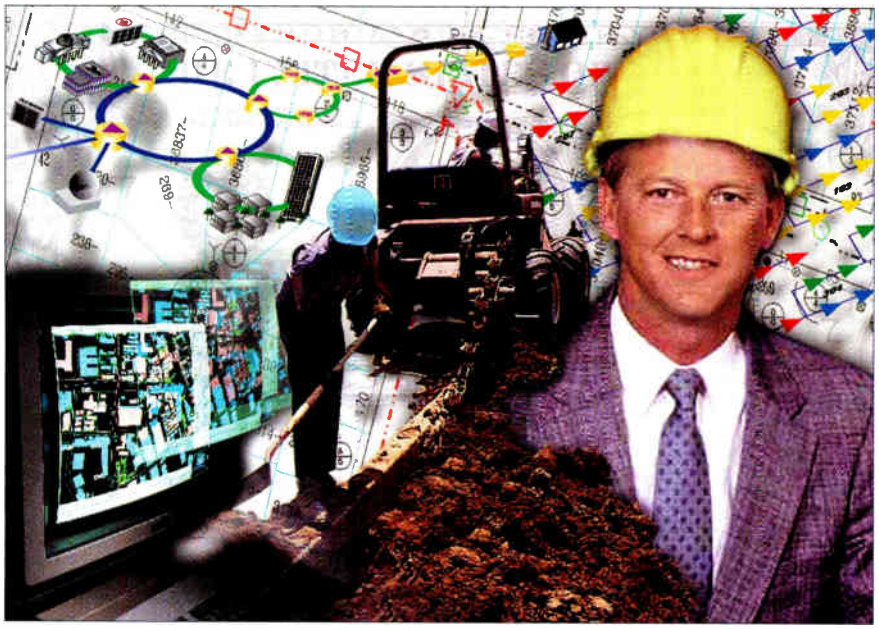

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Changing hats: Managing an HFC upgrade

Tools to make an upgrade project easier

By Walter T. Colquitt, Director-Video Network Development, OpTel

Many cable systems, at least those in most metropolitan areas of the country, have either been upgraded, or soon will be, to some form of a hybrid fiber/coax (HFC) architecture capable of delivering high-speed data, telephony and other two-way services. As the ranking technical manager of one of these systems, you will probably be expected to manage the HFC upgrade project, and to bring it in on time and on budget (often without a reduction of your existing responsibilities). Failure to do so could even cost you your job!

Your prior experience in newbuilds and rebuilds, and in managing the everyday functions of installations, service calls, repairs and maintenance and preventive maintenance, do not necessarily ensure that you have the knowledge and skills needed to undertake this upgrade project. The purpose of this article is to provide some tools to make the job easier and more manageable. Added to the fact that you already know more about your existing cable plant than anyone else, this will help make you the right person for the job.

Understanding the project's scope

Before you can plan your upgrade, it is vitally important to summarize everything you know about the existing plant that is going to be upgraded. This includes the total miles of plant, the number of passings and subscribers, the number of trunk-bridger and terminating-bridger amplifiers plus any geographical obstacles that could have a possible effect on the progress of the upgrade.

Your list of geographical obstacles should include railroad crossings, highway crossings and bridge crossings, as well as any other man-made or natural barriers that might require permits or could otherwise delay your progress; be sure to include any ecological obstructions on this list, such as tree-trimming, etc. Waterways should also be listed, along with known or suspected means of crossing or circumventing them.

Parameters of the HFC system

The next step is to be certain that you fully understand the parameters of the HFC system that is going to be built. These include maximum amplifier cascades, the approximate plant miles per node, the number of passings and/or subscribers per node, and the number of nodes and/or passings per hub.

You also need to know what the expected operating specs of the upgraded system are, including signal-to-noise ratios, cross-modulation and composite second- and third-order distortion. This information is critical to determine what type of optical and RF equipment you will use for the headend-to-hub interconnects, the hub-to-node interconnects, and the coaxial plant, and to determine the channel capacity, operating levels and tilt of each.

Next, you will need to ascertain exactly how many dollars have been budgeted for the upgrade, and what is included in that budget. How much must be allocated for the headend upgrade, and for hubs and hub interconnects, including both fiber and electronics? Does the budget include any amounts that might be needed to acquire (purchase or long-term rental) and prepare new sites and/or buildings for the headend or hubs? Which sites will require standby generators and/or UPS systems, and what will they cost? Has a decision been made as to whose convertors or other set-top devices you will be using, and are these costs, and the costs for the associated headend and billing system and EPG interface equipment, included in the budget? How much is left to upgrade the actual distribution plant, and is it enough? If not, when is the best time to ask for more?

Finally, make sure that you fully understand the timetable you are up against. When is the expected completion date? How much time must be allocated to send out the Request for Proposals, select vendors and execute performance contracts with them? When can the process of selecting contractors and executing performance contracts with them begin? When can the actual

About the author
Colquitt has more than 30 years of experience in engineering/operations management for the cable TV industry.

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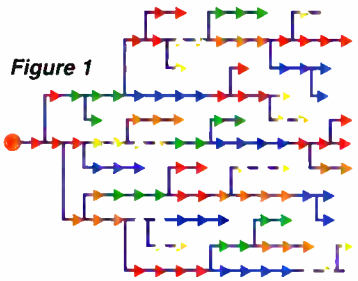


Figure 1

design for the upgrade begin, and how many miles can be designed each month? How long will it take to prepare bills of material and to submit purchase orders for approval? What are the anticipated lead times for materials and labor? How much time is left to do the actual construction?

Do the math

Typically, the upgrade design will place the new network amplifiers at the same locations as your existing trunk-bridger and terminating-bridger amplifiers in order to take maximum advantage of the existing feeder cable routing. Trunk and fiber cables will be mostly designed along existing trunk routes to utilize the existing cables and strand. Therefore, use the information you compiled earlier to make some assumptions about the upgraded plant. For example, the approximate number of nodes can be calculated as follows:

$$\text{Number of nodes} = \frac{\text{Miles of plant}}{\text{Miles per node}} = \frac{\text{Number of passings}}{\text{Passings per node}}$$

Likewise, the approximate number of hubs that will be needed can also be calculated:

$$\text{Number of hubs} = \frac{\text{Number of nodes}}{\text{Nodes per hub}} = \frac{\text{Number of passings}}{\text{Passings per hub}}$$

The approximate number of amplifiers per node and per hub can also be determined:

$$\text{Number of amps per node} = \frac{\text{Number of amplifiers}}{\text{Number of nodes}}$$

$$\text{Number of amps per hub} = \frac{\text{Number of amplifiers}}{\text{Number per hubs}}$$

This information can be used to determine the pace of the upgrade by calculating the number of nodes that will have to be upgraded each week or each month:

$$\text{Number of nodes per month} = \frac{\text{Number of nodes}}{\text{Number of months}}$$

Finally, the approximate number of amplifiers that will be needed each month to help establish shipping schedules can be figured:

$$\frac{\text{Number of amplifiers per node} \times \text{Number of nodes per month}}{= \text{Number of amplifiers per month}}$$

In the preceding calculations, whenever there are two formulas, the results are often somewhat different. During this initial planning stage, it is usually better to use the higher figure of the two. Remember, these are approximate results; final quantities will be determined by the actual system design.

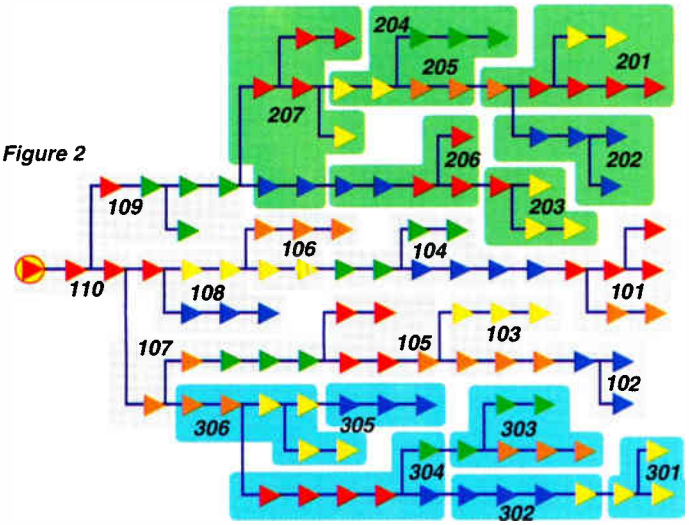
Putting it all together

Now that you know what you have, and what you want, you can map out a means of getting from one to the other. Begin by making a block diagram of the existing trunk and bridger amplifier system; multiple diagrams may be needed if there is more than one signal source, such as

existing microwave and/or fiber interconnects.

The block diagram should illustrate signal flow in the form of an amplifier "chain." This will assist in scheduling the upgrade so as to prevent any disruption of signal to the downstream plant. HFC upgrades are usually done from the last amplifier to the first for just this reason:

Figure 2



once a fiber node from the existing trunk cable has been isolated, the signal flow to the remaining downstream plant will be disrupted.

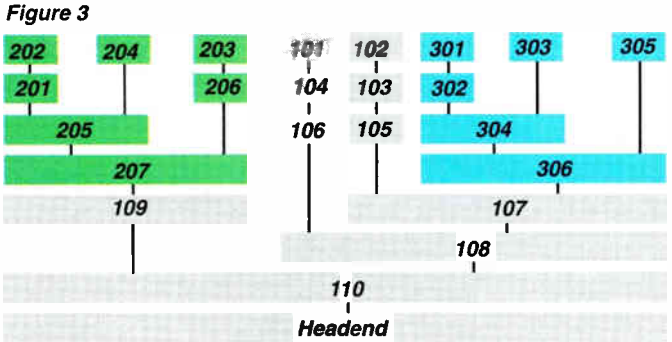
Next, indicate on the amplifier block diagram a powering diagram to clearly indicate which amplifiers are served by the same power supplies in the existing plant. Later, this will be of tremendous help in planning where power supplies must be moved or added, and in preventing a disruption of power to one portion of the plant while another is being upgraded.

Lastly, mark up the amplifier block diagram to indicate the number of passings per existing amplifier. This information is critical to grouping amplifiers into nodes so as to obtain the desired passings and amplifiers per node according to the earlier calculations. The block diagram should look something like the one shown in Figure 1.

Group amplifiers by node

Using the amplifier block diagram, begin to group amplifiers into nodes. Each node receiver may be located either at an existing amplifier location, or between two existing amplifiers, whichever best allows you to balance maximum amplifiers in cascade, maximum amplifiers per node and powering limits per node with desired passings and plant miles per node. To increase the number of plant miles and passings per node, try to locate the node receiver at an existing splitter location so that you can feed plant in three directions.

Figure 3



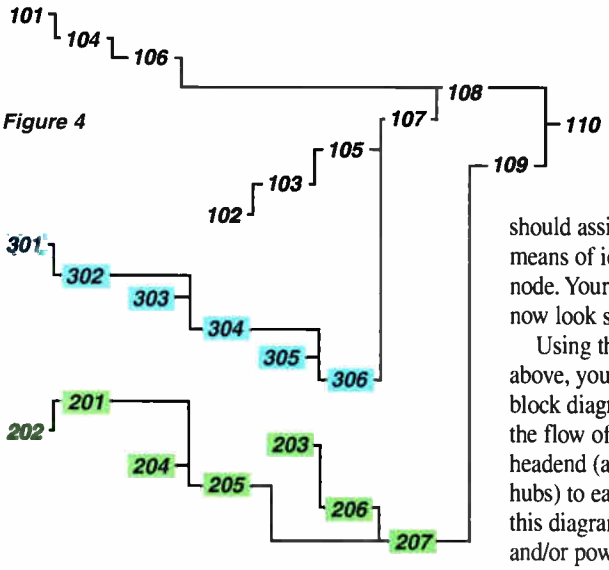


Figure 4

Next, group all the nodes into hubs. Approximate hub locations can be determined by maximum hub-to-node and headend-to-hub distances. You should assign numbers or other means of identification to each node. Your block diagram should now look something like Figure 2.

Using the groupings assigned above, you can now prepare a node block diagram which will indicate the flow of signal from the existing headend (and microwave or fiber hubs) to each node. Carefully check this diagram for any signal flow and/or power flow problems. Next, add comments to the diagram about anything that could potentially affect the progress of the upgrade; this should include special powering conditions, any geographical obstacles and lead times for securing and preparing hub sites, etc. The node diagrams should look like Figure 3.

If you turn the node block diagram sideways, with the nodes farthest from the headend on the left, you will see that it resembles a GANTT chart. The left-hand nodes must be upgraded before those immediately to their right, and so on, until you get to the headend. By proceeding with the upgrade in this manner, you can upgrade one node at a time without disrupting signal and power flow to the remaining plant. Using this as a guideline, convert your node block diagram to a simple GANTT chart that looks something like Figure 4.

Next, adjust the simple GANTT chart to reflect the number of nodes per week or per month that you calculated earlier. Delay starting dates to allow time for overcoming geographical obstacles, hub site acquisition and preparation, and for material and labor lead-times. If you are using project management software, apply its resource "leveling" feature to minimize manpower peaks and valleys in each of the different phases of construction. Be sure to include slack time for rain days, vacations and holidays. Compare your results to your overall timetable and completion date, and make additional adjustments as necessary. The final GANTT chart should look like Figure 5.

Carefully review the adjusted GANTT chart for any gaps in the flow of progress. Eliminate or minimize these gaps by looking for shortcuts such as temporary express fiber feeds to bypass one or more nodes that are blocking progress; these can be used to permit upgrading upstream from the offending node(s), instead of having to wait for the delay to be resolved.

RF design

As you begin the planning stages of your upgrade, you should give a great deal of consideration to the capability of your existing RF design system and whether or not this is the right time to invest in a new one. There are many good RF design packages available today. Some of these systems have the ability to automatically create and plot block diagrams from the as-builts of your existing tree-and-branch system. You should ask each company whether or not they can perform this function.

It is in the early stages of developing block diagrams that a good RF design/CAD software package can be a substantial time and money saver. Instead of taking several hundreds of manhours, this task can be done with the highest degree of accuracy in a day or two, at most.

I have found that the Cadix RF design system (Newport Beach, Calif.) will create the block diagrams you need, as well as let you transfer and scale both your existing and new system maps quickly and easily using either file conversion and/or scanning techniques.

Contractor/vendor selection

Contractors and equipment vendors should be selected not just on the basis of who bid the lowest prices, but on their past performance as well. You should also consider multi-sourcing for both materials and labor, so that a failure of one source doesn't shut down the entire project.

When negotiating contracts for equipment, be sure to require the vendor to maintain a specified minimum quantity of stock on-hand throughout the life of the project as well as for a reasonable period of time after the project is completed. Quoted prices should remain firm throughout the term of the project, even if it's

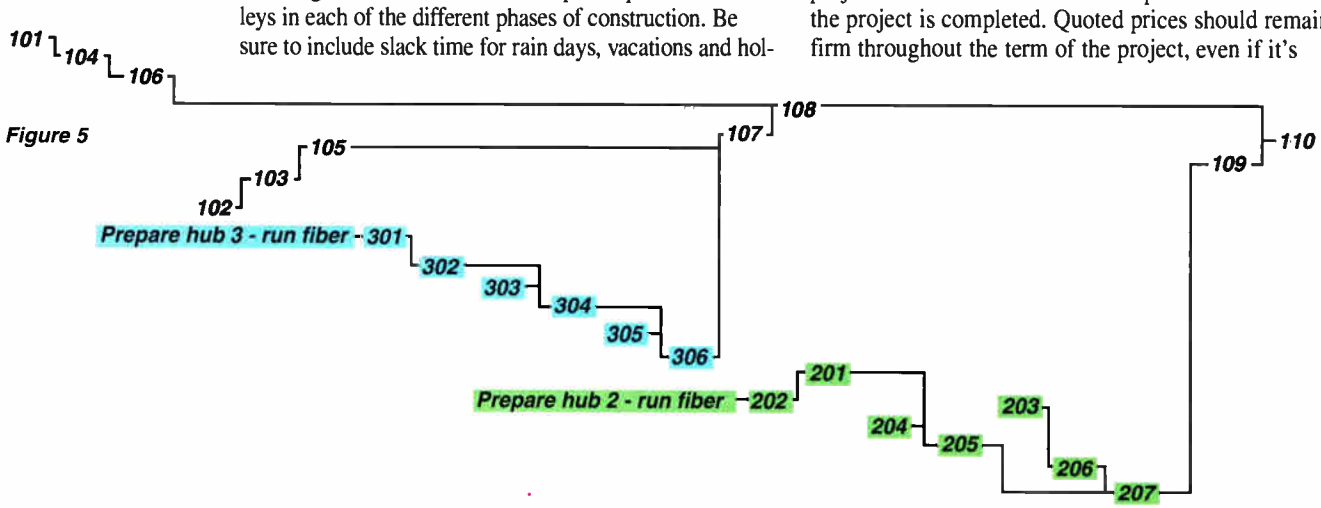


Figure 5

going to run for two or more years. The contract should also provide for specific quantities of each type of equipment to be delivered each month, such that your warehouse always has a one- or two-month supply on-hand. These quantities can be determined from the GANTT chart as well as from your earlier calculations.

Warranty provisions should be stated, and the vendor should guarantee availability of each type of equipment for an extended period of time following completion of construction. You should also include a provision to allow you to adjust these monthly quantities ±5 percent (or more) upon 30 days written notice. Maximum lead-times for each type of equipment should also be specified in the contract. A penalty clause should be included in the contract to reimburse you for down-time and for lost revenues resulting from delays in deliveries.

Remember when negotiating this (or any other) contract that you will be working with, and relying on, this vendor for an extended period of time. Try to arrive at a contract that is equally fair to both parties–a win-win agreement. A contract which is blatantly one-sided will only lead to the other party trying to "even the score" at some later date.

Negotiate contracts for one or more contractors as needed to provide the number of construction crews and supervisors to maintain the construction pace as dictated by the GANTT chart. Pay particular attention to the number of RF splicers and fiber splicers that will be required during each phase of the project. Include strict adherence to your inventory procedures, particularly if the contractor is going to maintain a separate warehouse for the upgrade project.

As was the case with equipment contracts, the labor contract should be equally fair to both parties, but should also include a penalty clause.

Tracking the project

Finally, all of your good planning will come to naught if you don't continuously track every aspect of the project to ensure that it is consistent with your projections. This includes monitoring the quantities of your materials on-hand and in the field, and comparing them with your requirements and upcoming shipments. Likewise, you will need to track equipment and labor costs against the bid prices and be aware of any timing issues that might result in temporarily running over or under budget.

Construction progress and costs should be constantly compared to the GANTT chart and any deviation corrected quickly. A slippage of only one node per week will leave you more than 100 nodes short at the end of a two-year project. Keep accurate records! CED

Keeping the lines of communication open

By Michael Lafferty

The fly-by-the-seat-of-your-pants aura that used to surround the cable television industry has all but disappeared in the industry's rush to defend its turf in the burgeoning telecommunications war. A good part of cable's colorful past revolved around wild and woolly stories about the interaction between the industry's dynamic and sometimes autocratic operators and its hard-working, often nomadic workforce—usually supplied by contractors and sub-contractors.

While the good old days may be good for a brief laugh now and then, Pete Smith, vice president of engineering for Rifkin & Associates, doesn't miss them all that much. "Oh God, you could sit around with a bunch of old cable guys and some beers, and you'd hear some real nightmare stories. There are stories of contractors holding materials hostage and all kinds of crazy stuff. And you'd always hear the stories that illustrate the famous saying, 'Well, the contractor gets paid on Friday at 5 p.m., and we go bail them out on Monday at 8 a.m.'"

Operator-contractor relationships changing with the industry

Smith readily admits that type of operator-contractor relationship is all but myth today. In fact, he believes the level of professionalism has increased on both sides of the coax.

"I've always looked at relationships with contractors as a partnership deal," says Smith. "About half the time it doen't work, it's the contractor's fault. The other half it's probably the operator's fault, simply because they never told the contractor, in enough detail, exactly what was expected of them. And it's not really fair to the contractor.

"Communication is absolutely the key. Contractors, I think, perform a valuable service for this industry. They always have, and I think they always will, if you treat them right. There are still some less-than-reputable ones. But hey, there are some less-than-reputable cable operators, too."

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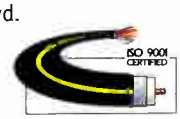

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Reader Service 307

CONTRACTOR DO'S & DON'TS:

- Be ready to have your personnel demonstrate their skills to operator representatives.
- Emphasize and enforce minimal dress code/appearance rules with staff.
- Keep vehicles clean and in good working order.
- Train staff in customer relations basics. Have staff on site or on the phone who are able to handle customer inquiries or complaints.
- Be sure to carry enough liability insurance. The nearly 20-year-old industry "standard" of $1 million may not be adequate for today's high-ticket systems.
- Be realistic about the number of workers you can supply at any given time.

Sign on the dotted line

Today's frenzied upgrade and rebuild activity, and the vital relationship between operator and contractor, revolves around one document—the contract. While there's plenty of legalese specifying who is the party of the first, second or third part, the heart of the document deals with the nitty-gritty of establishing a working relationship between the operator and the contractor.

And, while it may have all the details in black-and-white, that rarely guarantees a full understanding of the document's details by either party. Gary Odum, president of Gary Odum & Associates and former long-time director of construction for Times-Mirror, has found a little preemptive communication with prospective contractors goes a long way toward eliminating misunderstandings once the project is underway.

"I've always found it advantageous," says Odum, "and I know this isn't a normal procedure in the industry, to go over the contract with the contractors in person, even as a group, line-by-line. We used to call it a pre-bid meeting, and we would sit there and go over the contract and the work schedule line-by-line, so that if one of them had a question, then it would be

answered in front of the entire group. That way, there would be no misunderstandings, no misconceptions about what's to be expected."

Odum says the meetings focused on areas like work quality, quality control, insurance and work structure. This could include how the operator wanted each pole taken care of, how certain pieces of equipment were to be installed, and even such things as how the loop should be formed on the drop or how pedestals were to be installed. He says while reviewing such details may seem like nit-picking to others, these pre-bid meetings saved both money in the bidding process and expensive go-backs once the work was complete.

The pre-bid meeting makes sure everyone is on the same sheet of music

"The interesting part was that before we started doing these detailed explanations on a given line item," explains Odum, "we could get a variance between the contractors of 50 to 70 percent in a given line-item cost. We would scratch our heads and wonder if they didn't understand or if we weren't getting the facts across.

Yet, once we started this line-by-line review, the variances would generally be less than 10 percent. It was a huge, huge difference. The pre-bid meeting makes it very, very easy to make sure that everybody is on the same sheet of music."

Time Warner Cable's construction division Vice President Keith Burkley doesn't limit his pre-bid meetings to just talk. If need be, he'll get potential contractors involved in a little interactive show-and-tell. "We'll have a pre-bid meeting, usually in some good-sized hotel meeting room," says Burkley. "We tape the meeting. We have a schedule of events we follow. We review our contract in detail. We go over the scope of the project. If necessary, we'll put them in a bus and take them out and show them plant conditions.

"In turn, we give them a chance to tell us the assets they have, who the principals are, what employees they might put on the project for us, what their financial picture looks like."

Austin Shanfelter, president of Shanco Corp. in Fort Myers, Fla. and head of the Cable Television Contractors Council for the Power & Communications Contractors Association (PCCA), thinks the pre-bid meeting idea is something that needs to spread throughout the industry. "That truly needs to be done a whole lot more in the industry," says Shanfelter. "If it isn't done, there are a lot of assumptions made on everybody's part. I would tell you, in my experience, less than 50 percent of the people do that."

Paul D'Arcangelo, director of outside plant for Continental Cablevision Inc., has found that regular meetings, once projects have begun, reduce confusion and misunderstandings. "Keeping our contractors informed as to the objective of our organization has been key," says D'Arcangelo. "What we found over the last 18 months or so as we've begun to really

escalate our activities, is that we really didn't keep them abreast of what we're doing.

"We started to have formalized bi-monthly meetings with all the contractors. We review all the issues. Are there any delays? We review the status reports for each project. We're upgrading 40 communities this year. So we have, on average, six or eight projects going on simultaneously. We go through the schedules, and everybody who has input to that deadline sits in that room. I think that has been really beneficial."

CONTRACTOR/OPERATOR DO'S & DON'TS:

- Get everything in writing. Make sure the contract contains: specifics about safety issues and policies; detailed guidelines for taking customers offline to complete specific upgrade/rebuild tasks; details on sub-contract labor levels, including the operator's rejection/acceptance criteria for any sub-contractor labor/services.
- Don't forget to detail quality control (QC) policies, procedures, responsibilities and schedules in the contract. Have QC representatives from both sides develop these policies together and then disseminate them in person and in detail to all appropriate staff members in both organizations.
- Conduct detailed pre-bid meetings where the contract is reviewed and explained point-by-point to all concerned. If needed, take prospective contractors on-site to review existing plant conditions and/or problems.
- Establish regular (bi-monthly?) meetings to discuss the project's progress, problems and goals.
- Don't try to manage projects from the office. Get key supervisory personnel in the field often and on a regular basis.
- Keep your relationship on a professional level at all times. Eliminate or at least minimize the free meals or any other such perks aimed at your counterpart.

Quality: Job #1

One of the most important areas of any contract should deal with quality control (QC). Odum states that it wasn't unusual for contracts he dealt with to have QC sections that ran three or more pages. Smith notes that the whole purpose of an ongoing QC program goes beyond just guaranteeing that certain work is done. Bottom line, paying or not paying invoices is the final word in that regard, says Smith.

"The point of QC," he explains, "is not to go to somebody and say, 'You're an idiot, and you're doing the job wrong!' The point of QC is to find out what they don't know and correct that by training them. If you find you can't train them, you need to get rid of them. But, the vast majority of the time, you're simply looking for what don't they know. What did we miss in the training? And what training do we need to reinforce?"

Much of any potential QC confusion can be reduced before work commences, says Shanfelter. "I think the thing that you need to do," he says, "is take the people that are going to do the QC work for the project, both from the operator and contractor sides, and you get all those folks on the same wavelength as to what they're looking for in the final product.

"Basically, you take project coordinators from the construction company and the operator, put them in a room together and let them hammer out the QC parameters. Then, and this is especially important, they take the time to explain those parameters to their respective staff members. And, it wouldn't hurt for both project managers to be present when this is explained to both groups, either individually or all together in one room. We've only been able to do that a few times, and it's been tremendously successful."

D'Arcangelo makes a concerted effort to eliminate the "us vs. them" mindset that QC programs can sometimes produce. He does that by making QC checks a team activity. "It's actually a joint effort," says D'Arcangelo. "We perform a joint ride-out on the aerial side of the business. We'll do that with the supervisor at the end of each retrofit and cut-overs. As soon as an area has been cut over, we will ride out within a week, and we give them one week following that to do any clean up. This keeps our contractors involved in the process."

It's all in the details

Throughout the lengthy interviews for this story, a wealth of good advice was offered from the professionals who were queried. In fact, so much so, a much more lengthy report could have easily been written. For brevity's sake, those suggestions have been summarized on this page and page 14.

If you have some suggestions or procedures that have helped you work better with your peers on the other side of the coax, drop us a line, an e-mail, or give us a call. Got an area in operator/contractor relations that you think needs more attention? We'd like to hear about that, too. CED

OPERATOR DO'S & DON'TS:

- Check contractor references, both formal and informal.
- Visit a contractor's office and/or existing work sites for a close-up view of how they operate.
- After assuring confidentiality, ask for appropriate financial information from a contractor.
- Don't hesitate to verify a contractor's liability insurance coverage or policy, especially if the insurance company is unfamiliar or suspect.
- Finalize rebuild/upgrade designs and plans before contractors begin work.
- Make sure equipment/supplies needed for rebuild/upgrade projects are on hand before contractors begin work.
- Have appropriate powering sources ready for activation and/or finalize powering procedures with appropriate utilities/sources.

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Reader Service 310

Fiber preventive maintenance

A new product increases plant reliability by monitoring its highest revenue-carrying portion

By Wayne Pope, Fiber Network Manager, TCI; and John Chamberlain, General Manager, Norscan Inc.

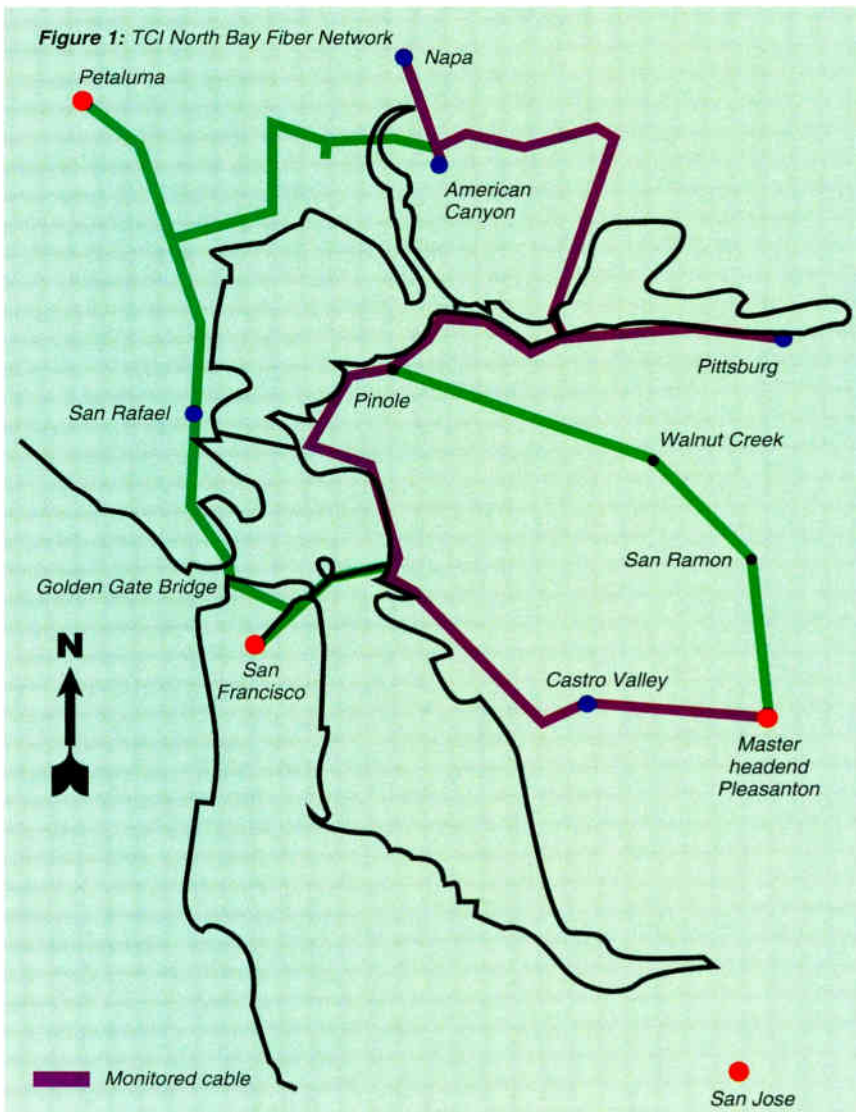


Figure 1: TCI North Bay Fiber Network

In the fiber optic industry, the '90s are the decade of cable TV fiber deployment. Fiber optic cable has been deployed during this decade at an unprecedented rate in what has been historically referred to as the "CATV" industry. Although much of the deployment has been in the AM distribution plant, traditional cable TV companies that started building fiber rings for headend reduction and redundancy have quickly become providers of high-speed transport of data to regional servers, residential phone service transport to points of presence (POP) and telephony competitive access providers.

Along with these new-found businesses have come new challenges, including voracious new competitors and government regulatory agencies. Competition and the nature of the telecommunications business demands a high degree of system reliability and survivability. Appropriately enough, system reliability and survivability have been defined in recent years as the reliability perceived by the customer. Enter "self-healing rings." Assuming adequate capacity, self-healing rings create a reliable plant from the point-of-view of the customer. Even in the case of a catastrophic failure, the customer rarely sees the problem, and therefore, has the perception of high reliability.

But do self-healing or Sonet ring systems designed to provide no interruption of service truly make the outside plant reliable? If the industry has learned anything in the past 10 years, it's that the outside plant facilities must be maintained in order to meet the objectives of long-term reliability and quality of service, as well as the system resale value.

Because of the increased need for plant reliability, there are now a number of outside plant preventive maintenance and monitoring systems available. This article explores the installation of a relatively new product that increases plant reliability by monitoring the highest revenue-carrying portion of the plant.

The Bay Area experience

Because of the high traffic and system requirements for reliability, TCI has installed such a system on its San Francisco ring. The system monitors the outside plant integrity of the entire length of the fiber ring and each of the fiber splice enclosures. It does so by using the protective armor of the cable as a long linear sensor. By using the armor as a sensor, any damage to the fiber cable's protective polyethylene jacket is immediately detected.

The splice enclosures are monitored with a special moisture detection tape and digitally-encoded sensor. Splice enclosures are frequently immersed in water, whether direct buried or in manholes or handholes (Figure 3). Should water enter the enclosure because of construction error, material failure, gunshot, or any other loss of integrity, the sensor is activated and sends a digital code back to the office equipment via the armor.

Both the outer protective cable layers and splice enclosures are monitored continuously without having to use a spare fiber. The system monitors the plant 24

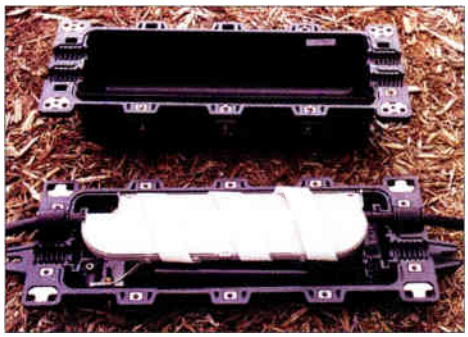


Figure 2: Moisture detection tape in enclosure.

hours-a-day and forwards sheath or splice enclosure alarms to designated maintenance or supervisory sensors or can be integrated into supervisory alarm systems.

The fiber optic cable sheath and splice enclosures represent the first layer of protection of the physical outside plant. By monitoring the integrity of these components, a true proactive outside plant preventive maintenance program can be established. Failures can be prevented by locating and fixing these components before they cause a transmission problem or fiber optic cable outage.

System design/engineering

As in any system, there are engineering criteria that must be met. This telemetry system is capable of monitoring a 75-mile radius of up to 600 sheath miles of fiber optic cable. The modular design is capable of being deployed with one to eight line cards, each of which is capable of monitoring 75 sheath miles and up to 200 individual splice enclosures per card.

In order to minimize cost, the monitoring office equipment should be placed for maximum coverage. Location is not important from the standpoint of access, because of the remote control and alarming capabilities. In the case of ring topologies, the office equipment should be placed to gain maximum reach, and consideration should be given to expanding the system to monitor AM plant in the future. In the case where a ring is larger than 75 miles, office equipment should be located at multiple locations.

The TCI system was installed on the east bay side of San Francisco Bay. In order to minimize the cost, the system office equipment was installed in Pinole. The system monitors the cable south to Pleasanton, east to Pittsburg and North to Napa (see Figure 1). If required in the future, spare capacity exists to monitor the AM plant in Pinole. In order to monitor the entire bay ring, another office system would be located on the San Francisco Bay side.

Only two 75-mile line cards are used to

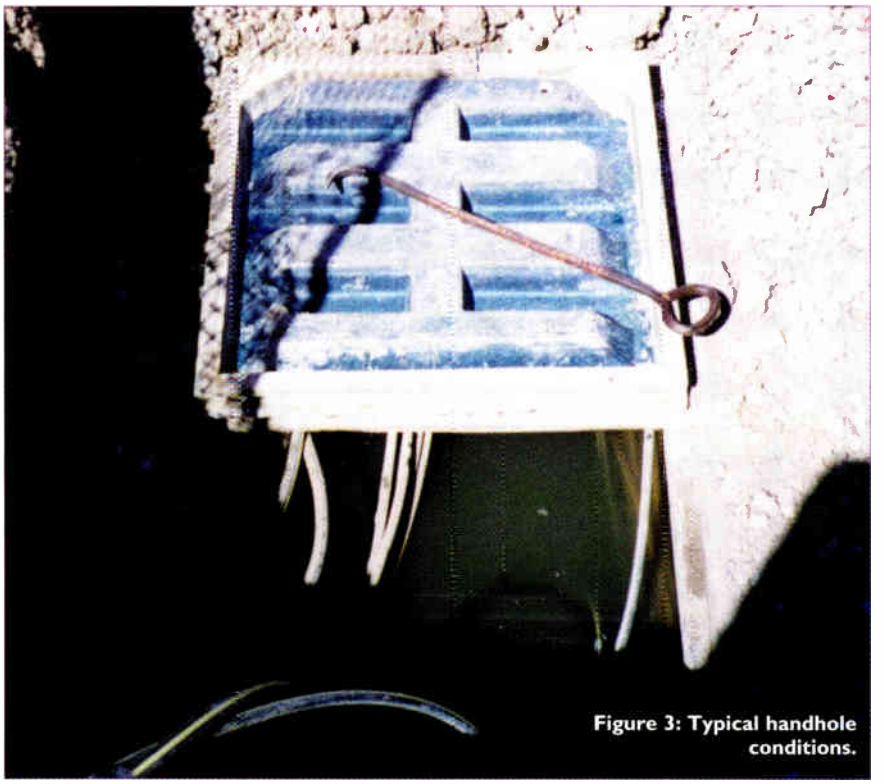


Figure 3: Typical handhole conditions.

monitor this entire route. One line card is used to monitor the cable to Pleasanton, and one is used to monitor the cables to both Pittsburg and Napa. There are 48 splice enclosures that are monitored on the east bay route. Each splice sensor is encoded with a different digital code uniquely identifying it.

Installation

The installation of the office equipment is straightforward. Six units of 19- or 23-inch rack space must be provided for the actual mounting of the equipment. Two fused 48-volt supply connections and either a telephone line, RS-232 connection, or both must be supplied for remote access to the system. An inside cable and connectors are supplied for connections to the armor of the cables being monitored.

In order to protect personnel in the office and effectively ground the armor, gas tube transient suppression devices and high current 60 Hz notch filters are installed from the sheath to ground on all monitored cables at the office.

The field equipment is best installed as the cable is deployed, but can be installed in a retrofit application. The splice enclosure sensors are usually installed after the cable is placed and the splice enclosures are being prepared for the fiber splicing. The sensors should be installed during the splice enclosure preparation after the cable is secured in the enclosure.

The splice sensor is connected electrically between the armor and earth ground. The armor can either be bonded through the enclosure or preferably brought out of the enclosure to an access point and bonded through at the access point. The armor remains effectively grounded through protection circuits in the sensor. The sensor is then tie-wrapped to an accessible point in the enclosure. A moisture detection tape is then connected to the input of the sensor and helically wrapped around the splice trays. The wires to the sensor should be dressed away from other splice components (see Figure 2).

The armor in the enclosure should be connected to #10 awg insulated copper and run though one of the closure ports to the outside of the closure. This method allows future access to the armor without having to re-enter the enclosure. The armor "leads" are then connected together in a small, accessible closure.

At TCI, underground power cable was used as a jumper cable between the splice enclosure and the access point. A combination sheath protection and sheath access box provided by the monitoring system manufacturer was mounted in a four-inch metallic pedestal (see Figure 4).

As each splice sensor is installed, a test set is used to check the condition of the sheath back toward the office. In addition, before the enclosure is sealed, the test set is also used to functionally test the sensor to verify that it was installed correctly. The technician then records the digital code and the location of the splice for later input into the system's outside plant database.

After the hardware is installed, the system database must be loaded. First the system data, including system

identification, cable runs, length of cable between splice points, splice point location, cable fiber counts, etc, is loaded into the database.

Alarm forwarding information is then loaded. Alarm forwarding information includes phone numbers that the system automatically calls, RS-232 port connection, where to call on weekdays during work hours, and where to call at nights, weekends or holidays.

To date, both splice enclosure and sheath alarms have been reported. Sheath violations are located by use of long-range fault locators and tone location equipment. The long-range fault locators are capable of locating the fault zone from distances up to 60 miles. Once the fault is located to within a few hundred feet, a tone location system and A-frame locator are used to identify the exact fault location.

Figure 4: Above-grade access to cable armor.

The four splice alarms received to date were all a result of having appreciable amounts of water in the enclosure. Splice enclosure alarms have resulted in finding poor splice enclosure construction practices and enclosures damaged by the various rigors of the outside plant environment.

Actual costs and cost savings

The initial hardware cost of the sheath and splice enclosure monitoring system, including office and field equipment, for the east bay side of the loop was $35,000. The additional cost of installation labor was $45 per splice. The total installed cost of the system to monitor 163 miles and 48 splice enclosures was about $37,160.

But the deployment of a fiber optic preventive maintenance system not only increases the reliability of the plant, but also saves money. At TCI, a fiber optic cable emergency restoration through permanent restoration can cost up to $25,000. The installed preventive maintenance system pays for itself when two outages are prevented from occurring.

In many locations around the country new franchise agreements have outage reimbursement clauses. Most of these clauses require a prorated rebate to the customer based on the duration of an outage. In the case of digital backbone feeder systems, a large number of video customers would be affected by a fiber outage. As an example, if a digital feeder system carrying video traffic to 45,000 customers were out for over three hours, a one-day rebate is typically required by these agreements. If, for example, given a rate of $38 per month, then the one-day rebate for loss of video service to those 45,000 customers would be $57,000 (1/30 x $38 x 45,000).

Depending on the data rate, one fiber optic competitive access ring cable can carry between $2,500 and $50,000 of revenue per minute. If the average fiber cable downtime is five hours (300 minutes), each cable outage prevented represents between $750,000 and $15 million in revenue that would have been lost. The most detrimental cost due to a fiber outage is the potential for loss of customer confidence. Although it's hard to put a price on, loss of customer confidence is reason enough to deploy preventive maintenance systems.

Proactive preventive maintenance is the clear direction for the future in maintaining telecom networks to high standards in the field. CED

Overhauling the employee tool box

Using technology to grow professional and personal skills

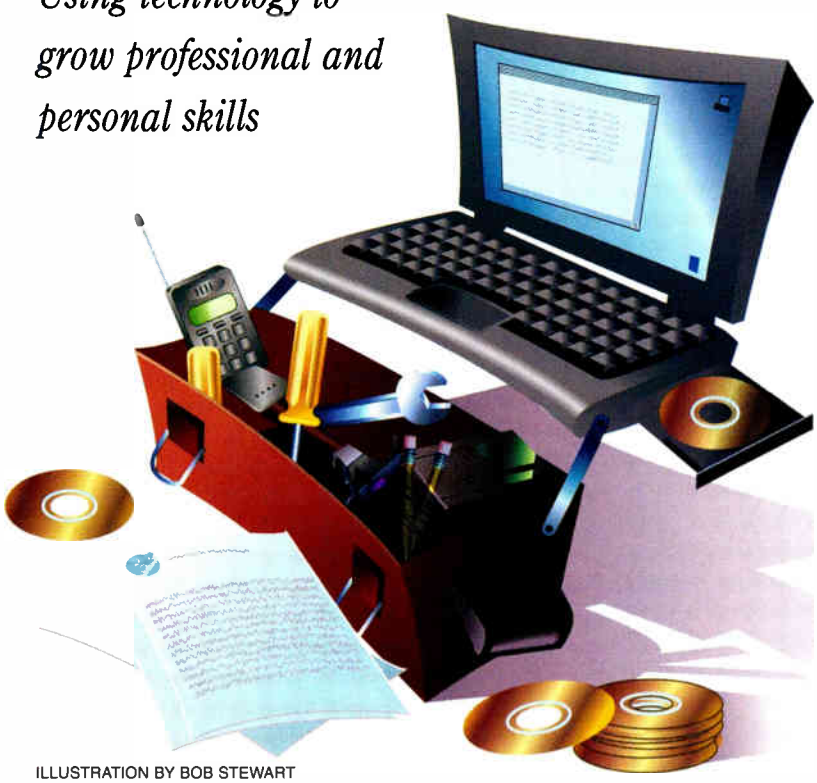


ILLUSTRATION BY BOB STEWART

By Craig Kuhl

Not long ago, front-line telecommunications and cable TV employees–technicians, installers and customer service representatives–could dip into their skill tool boxes and pull out a technology here, or a personal skill there that would solve an immediate problem or build on an existing skill. And that approach used to work. But now, that's all changing.

That same tool box is becoming a veritable hardware store of skill-building technologies, enabling employees to grow not only their business skills, but personal skills as well. Employers are finding that, when combined, the two can provide a powerful set of tools to help build a business and certainly build customer satisfaction.

Yet, just as advancing technologies are "empowering" employees to excel at their jobs, a new mindset is having at least as important an effect. This change of thinking among company trainers, educators and top executives gives employees more of a stake in the business, and when they know what their business really is, how it works, and what their roles are, they eventually can join the Hall of Fame of happy, high morale employees.

"In the past, companies could just send employees to training seminars. Now, corporate and competitive pressures are squeezing time-frames for employees to understand the business. We're using technology in every way we can to alleviate these issues," says Ray Vigil, group vice president/human resources for Jones Intercable.

Training and education rate high on the list of recipients of technology which is now being used as a tool for growing both professional and personal skill sets, says Vigil. "Technology has advanced beyond the 'page turning' computer training to new databases and video delivery, while education content is becoming more interactive. The newer technology is a challenge, but you can get your arms around it. It's execution that makes you perform, and it's people who help you perform. That's where the emphasis is: performance."

With performance the operative word, Jones went to its tool box and pulled out the Intelligent Customer Support Systems (ICSS), which includes a set of customer management applications used to accommodate numerous communications products including telephony, cable TV, interactive and other metered-use services, while being compatible with other billing systems. Though just now being tested in Jones' 12,000 subscriber system in Buffalo, Minn., this new technology has already sparked an interest among customer service reps at the system, who say it is making their lives easier, once they were able to move through their initial stages of fear and frustration.

"Since it (ICSS) was so new, and we had never experienced it before, we had a lot of mixed feelings," says Jen Leathers, customer care representative and pay-per-view coordinator for Jones in Buffalo. "But we were coming from a dinosaur technology, so we were really pumped. It's helping us deal with our customers on a more personal level," she added.

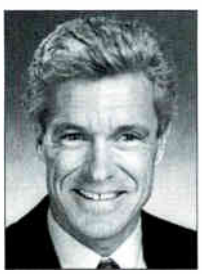
It includes a "smart" customer care work station and a multiple service, product and business capability, as well as other features allowing for the immediate introduction of new products, access to telemarketing, call centers and more.

ICSS is a technology that fits squarely into the

employee ownership mentality, which is being embraced by a growing number of cable and telecommunications companies. Says Greg Carlisle, president of Jones Cyber Solutions Ltd., "We want to give our CSRs more ownership in sales and other disciplines. After scouting the market for a solution to take us where we wanted to go, we asked several former CSRs to help design Cyber Solutions from the ground up. It will provide CSRs with new ways to do their jobs."

Key component of competition

Finding new ways to help front-line employees do their jobs better, while instilling in them an ownership mindset, is paramount to an employee's productivity and morale, says Denver-based training consultant Jackie Perrett, whose clients include top companies such as IBM, Hewlett-Packard, US West and several others.


Carlisle


McGuire


Vigil

"If you take old employee mindsets and try to fit them into new-world thinking, there's going to be a clash. There must be a connection between technology and the human element. Today's realities are that there's almost an insane rate of change in technology and employee expectations of competition, especially in cable, with the constant mergers and acquisitions. Every employee should have a CEO mindset and take complete ownership of their own career. I call it the 'Me Inc.' mentality."

With that attitude as a tool, employees can gain better control of their jobs and contribute to the company's–and their own personal–on-going successes, suggests Perrett. "I would look at the company's training opportunities, which include access to new technology, as a resource, not as a department that will dictate what training and education an employee needs. Employees should take responsibility for their own careers. Today, companies are looking at people who are self-managed and know their roles. And, most Fortune 500 companies consider investments in their employees a capital investment, and that includes upgrading and applying technology to train and educate them."

SCTE adds technology

However, adding tools to an employee's skill tool box can be an arduous task, with change being painfully slow. Says Jim Kuhn, SCTE's Region 7 director: "Slowly, the technology is helping–CD-Rom-based training and Internet training are now showing up–but the 'turning the page' mentality is dying slowly."

In the SCTE's tool box, Kuhn says, is a new Web site (www.scte.org) designed to offer technicians around the world answers to questions in minutes, instead of days. And it's not just for a select few. "If line technicians have a problem with a piece of equipment, they can get answers by going into a one-on-one conversation with a technician from a select list on the Web. Five years ago, it would have taken days to get these answers," Kuhn notes.

Kuhn says that a major change in how new technology and its attendant training is helping field personnel is the willingness of ven-

dors to train their clients on new equipment. Adds Kuhn, "Today, most vendors are very pro-active with training and want you to be comfortable. It's not just *price* and *performance* (when it comes to selling products), but *training* too."

Technology, most industry experts agree, will allow field personnel to become more autonomous, evidenced by Continental Cablevision's hand-held work stations. These state-of-the-art devices provide field technicians with updated information on a variety of subjects, including programming, billing and sales information. The hand-held stations are being pilot tested at Continental's Pompano Beach system, according to Allan Stern, vice president of research and development for Continental.

"Our hand-held work stations are tool sets to make our technicians feel more empowered. They're not just working with a list of work orders. In some of our regions, we want technicians to have a sales tool, so when they're in a customer's living room, they'll have access to programming, billing and other information," Stern says.

Technology is allowing for more autonomy and decision-making power in the field.

He added that the technology included in the hand-helds, and the company's new C2IT subscriber management and billing system, are giving CSRs and technicians more decision-making power, an issue that hasn't gone unnoticed at Continental. "The frustrations we kept hearing were that CSRs and technicians *really* wanted to help the customer. So, we wanted to develop the technology to help them use their skill sets," says Stern.

Stern admits, however, that the tool that must be included in every tool box is the human piece.

"We need human interaction. What drives the employee training and culture is the amalgam of how we, the company, treat our employees–that's how our employees will treat our customers. How CSRs operate and relate to customers goes hand-in-hand with how they are treated by the company."

Perrett agrees. "Most employees want dignity and value in their jobs–to know what they do counts. If the 'employer owns the business' mentality is used, there's traditionally been an attitude where employees just assume they don't have the authority to do something. Then, they fall into roles that don't support their successes."

Instructors matter, too

Support for the technology and training which allow employees to become, in Perrett's words, "Me Inc." is another compartment in the skill tool box. At Time Warner, the philosophy is that job training must be integrated with personal training.

"When we develop a training course, the person delivering the course is the key," said Kent Vermillion, director of Time Warner's national training center. "Our approach is to get the technology in front of people to let them touch, feel and experiment with. And we've found success depends almost totally on the person doing the showing and telling, while the tools become secondary to the people involved. Our tech experts teach the teachers, who in turn teach our front-line employees."

Vermillion insists that the more information front-line employees have, the better they feel, no matter how complex it is. "They're very good at breaking down complex issues, and they'll push you in a training session to explain something. They really don't want to put customers on hold, or not be able to answer their questions out in the field."

Time Warner, Vermillion says, is building a Web site to allow technicians and trainers to read updated information on a variety of issues, and is also exploring video conferencing. However, Vermillion concludes that "the needs will drive the technology to meet those needs. We won't employ a particular technology just because it's there."

Moving down the food chain

Being larger MSOs, Jones, Continental and Time Warner have significantly larger tool boxes to work with than say, a TCA Cable TV in Tyler, Texas, which serves a sprawling rural population and draws employees from classic smaller markets. Its tool box has fewer pieces, and its use of technology in training and education is different and less sophisticated. Says Linda McGuire, director of training and development for TCA, "I know there are lots of technologies available for training and education out there, but we're different. We're a smaller, classic company which uses more traditional methods, like those offered by the National Cable Television Institute (NCTI). Eighty-percent of our field people are NCTI graduates and have enhanced their capabilities, their financial incentives, safety and morale by taking NCTI courses." In addition to its traditional technical curricu-

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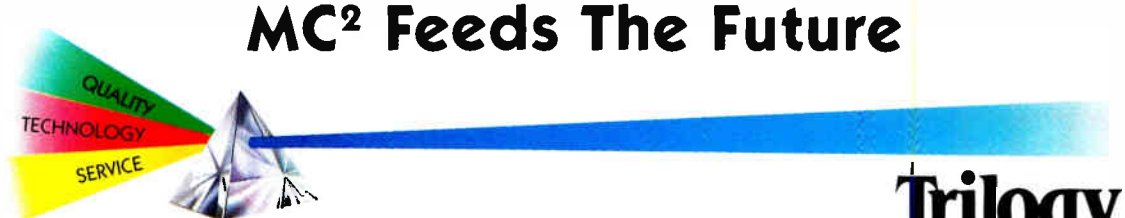

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Reader Service 316

lum, NCTI also offers non-technical courses.

TCA is a prime example of a company using a smaller tool box to achieve its training and educational goals. Says McGuire, "Our focus has been on what motivates an employee, and the 'me' factor is a key. For two years, we've been working with a group in Austin on employee accountability and what employees bring to the table. People have to have accountability for their performance and what they bring to their jobs."

The company is currently converting all of its 64 system locations to a new billing system (Cincinnati Bell Information Systems) and is rolling out PCS to several locations to "enhance our internal communication and billing systems. This will allow us to do 'just in time' training and begin terminal-to-terminal communications among CSRs," McGuire says. "Because of the advancing technologies, we're seeing an emphasis on training again. Installers and CSRs must know more about these newer technologies, and that requires more training," she concludes.

Employee accountability and performance are threads running throughout the whole fabric of employee skills, which are being elevated through technology and training. In the end, however, it's the human element, *supported* by advancing technologies, that will rule the day. Says Vigil, "Looking at all aspects of technology as a way to increase employee performance and their skills–including databases, voice response introduction, E-mail, Internet and so on–they all have a role to play. But, they must be kept in balance with the human element. Technology has a supportive role."

To keep that balance, Vigil suggests one answer is to design jobs that require as little training as possible in the first place. which could significantly reduce training costs and employee turnover. "You can't replace your entire workforce, so you have to grow it as fast as you can. You don't have the luxury to change everyone out."

And change can be painfully slow. Concludes Perrett, "If employees don't learn how to manage change, including the use of new technology in their careers. you get cynicism, anger. resistance, fear and paralysis. They become a deer in headlights."

With the varying sizes of tool boxes being used within the cable and telecommunications industries, technology will continue to lift front-line employees' skills and performance. But. when enhanced personal skills and motivation are tossed into the mix, an employee's tool box gets a whole lot bigger still. CED

About the author

Craig Kuhl is a Denver-based freelance writer. He is a former Denver Bureau Chief for Cablevision magazine and has written on a variety of cable and telecommunications issues.

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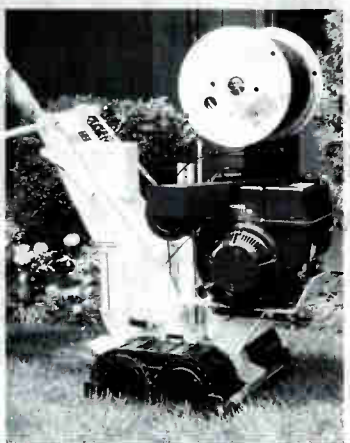

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Ground-mount enclosure

BELLINGHAM, Wash.–Alpha Technologies has added a new ground-mount enclosure to its line of cable television enclosures. The CTE is an all-aluminum, weather-resistant enclosure finished in a durable powder coat, providing corrosion resistance and long service life, says the company.

The new enclosure combines functionality and aesthetic design to create a solution that maximizes work space while minimizing visible neighborhood hardware intrusion. Expanded internal work space allows the co-location of power supply, standby batteries and other system active and passive devices, reducing the total number of enclosures required in the system. Fewer enclosure locations reduces the number of required easements and installations, and simplifies regular, ongoing maintenance and troubleshooting.

Alpha's CTE enclosure

The CTE enclosure is compatible with all Alpha AM and XM Series power supplies and can be configured in a variety of customer-specific applications. Engineered flexibility allows the power supply to be installed with additional batteries for extended runtime applications, the co-location of Alpha Amp Clamp surge suppressors, and/or the integration of necessary system active and passive devices.

Circle Reader Service number 326

Tripptec Model II

Directional boring system

SPRINGHILL, La.–Tripp Technologies Corp. has introduced the Tripptec Model II, a mid-range utility horizontal directional drilling system for making trenchless installations of 1,500 feet and longer, depending on soil conditions.

The compact unit makes pilot bores of 4.5 inches in diameter, which can be backreamed to diameters of 18 inches to install conduit for communications and power cable and larger diameter pipe. The Tripptec II produces 20,000 pounds of thrust and pullback. Maximum rotational torque is either 1,150 or 2,300 foot pounds from a two-speed system. Standard fluid pumping capacity is 40 gallons per minute, with optional capacity of up to 75 gallons per minute.

Circle Reader Service number 325

Portable cleaning kit

ORISKANY, N.Y.–Fiber Instrument Sales Inc. (FIS) has added a fiber optic cleaning kit to its line of manufactured products. The kit offers users all the necessary items needed for on-site cleaning, holds all cleaning supplies in one location and protects items from dirt and damage on the work site. Packaged in a rugged black carrying case are Canned Air, Kim Wipes, Optic Prep pre-moistened lens-grade tissues, non-aerosol spray alcohol bottle and 50, 2.5-mm Mini Foam Swabs.

FIS' cleaning kit

The new kit is rugged, but still a lightweight solution for transporting fiber optic cleaning supplies.

Circle Reader Service number 327

Fusion splicer

HICKORY, N.C.–Siecor Corp. has announced its new X77 fusion splicer, which combines splicing features of the Siecor M90 fusion splicer in a unit the size of the company's X75 micro fusion splicer. The X77 features the company's LID-SYSTEM unit for direct core alignment, and three-dimensional profile alignment system for improved accuracy.

The splicer provides a combination of precision operation and ease-of-operation, offering 20 programs for singlemode and multimode splicing in 12 languages to accommodate various applications' needs. While the standard parameters are preset in the factory, every individual parameter can be programmed by the operator. Results are displayed on a high-contrast LCD screen.

Siecor's X77 fusion splicer

Like its predecessor, the M90 fusion splicer, the X77 utilizes automatic fusion time to control splice loss, especially important with the increasing number of applications for splicing dissimilar and specialty fibers.

Circle Reader Service number 328

Optical meter

LACONIA, N.H.–Wilcom has introduced a new, handheld power meter designed to measure optical system power and attenuation over a wide range for a variety of applications. The FM8515B is a compact and easy-to-use instrument calibrated at three major wavelengths (850 nm, 1310 nm, and 1550 nm), but can be used for measurements from 800 nm to 1700 nm. Its wide dynamic range of absolute power measurements from +5 dBM to -60 dBM makes the FM8515 useful in most optical systems, while the relative power capabilities provide an accurate indication of gains or losses in singlemode or multimode fiber. The unit can display measurements in watts or dBm.

In addition, the meter has a new, larger display that is easier to read and can operate continuously on its internal 9 volt battery supply for up to 20 hours. The FM8515B meets or exceeds all Bellcore TR-TSY-000886 requirements, according to Wilcom.

Circle Reader Service number 329

Cable tie tool

MEMPHIS, Tenn.–Thomas & Betts is offering Ty-Gun, its new cable tie tool that has been ergonomically designed to lessen the strain often associated with repetitive use of similar tools.

The Ty-Gun features an adjustable handlespan, which permits users to widen or narrow the width based on hand size. The tool also has a tension wheel that allows the installer to adjust tension while still in position. In addition, the 360-degree rotating front makes awkward and hard-to-reach installations easier, as well as an anti-shock grip that eliminates the recoil often associated with cable tying.

Thomas & Betts' Ty-Gun

Circle Reader Service number 330

Philips' Diamond Series multi-taps

Multi-taps

MANLIUS, N.Y.–Philips Broadband Networks has introduced its Diamond Series line of multi-taps, which features 16 models. The series includes standard bypass taps, as well as telephony and extended-length units in both F-port and twisted-pair configurations.

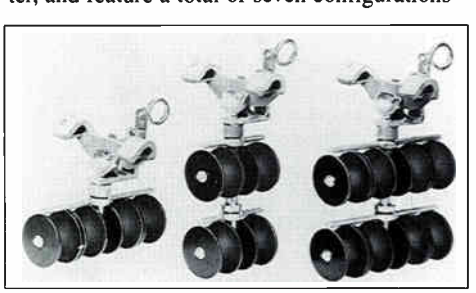
Designed with a 12-ampere current-handling rating, the 1-GHz multi-taps provide additional amperage for centralized network powering. In addition, each base model accommodates two-, four- and eight-output applications with the capability to retrofit into existing taps. The extended-length models feature a unique 9-inch housing that eliminates the need for extension connectors on aerial-mount upgrades.

Circle Reader Service number 334

Cable blocks

TREVOSE, Pa.–General Machine Products Company Inc. has introduced its new hybrid fiber/coax (HFC) blocks which offer the flexibility of multiple configurations.

The GMP HFC blocks are available in two roller sizes, 1 3/8-inches and 1-inch in diameter, and feature a total of seven configurations in various combinations for installation flexibility. The blocks are built with rugged, pliable, non-marring rollers that rotate on permanently lubricated bearings.



GMP's HFC blocks

Steel inserts within the blocks allow cable installers to slide HFC blocks along strands of cable for easier positioning. When cable is pulled through the rollers, the bi-directional locking cam firmly secures the block in position. The blocks can be installed and operated by a single individual.

Circle Reader Service number 331

Trailer-mounted lift

WESTMINSTER, Colo.–Mobile Tool International Inc. has added the MTI 10/33 Trailer-Mounted Lift to its line of aerial lifts.

The MTI 10/33 offers a working height of 10 meters or 33 feet via a telescoping boom. The lift is 68 inches wide and compact enough to fit through a standard set of double doors, and light enough to be moved by two people on job sites.

MTI's Trailer-Mounted Lift

The boom, which is DC powered with a built-in charging system that can be plugged into an AC source, weighs 2,850 pounds and can be hitched to the back of a truck.

Circle Reader Service number 332

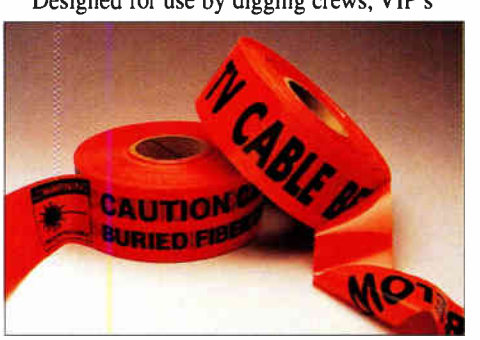
Curb markers

HOUSTON, Texas–VIP Products, a division of Mountain Products Inc., has introduced several new visual markers for cable and fiber optic installations. These include the company's CrystalCap Curb Markers, Buried Line Tape and Write-On Coverall Tags.

VIP's CrystalCap Curb Markers feature a clear, glossy urethane resin coating which allows the markers to maintain their clear appearance for up to five years outdoors. Dents to the surface of the curb markers are self-healing, and the CrystalCap makes the marker resistant to salt spray, most common solvents, detergents, alkalis and acids.

Stock markers are 2-1/2 inches in diameter, with custom colors, sizes and legends available.

Designed for use by digging crews, VIP's Buried Line Tape is available in both nondetectable and detectable versions. The tape resists acids, alkalis and other substances found in the soil. Custom legends, colors and widths are available.

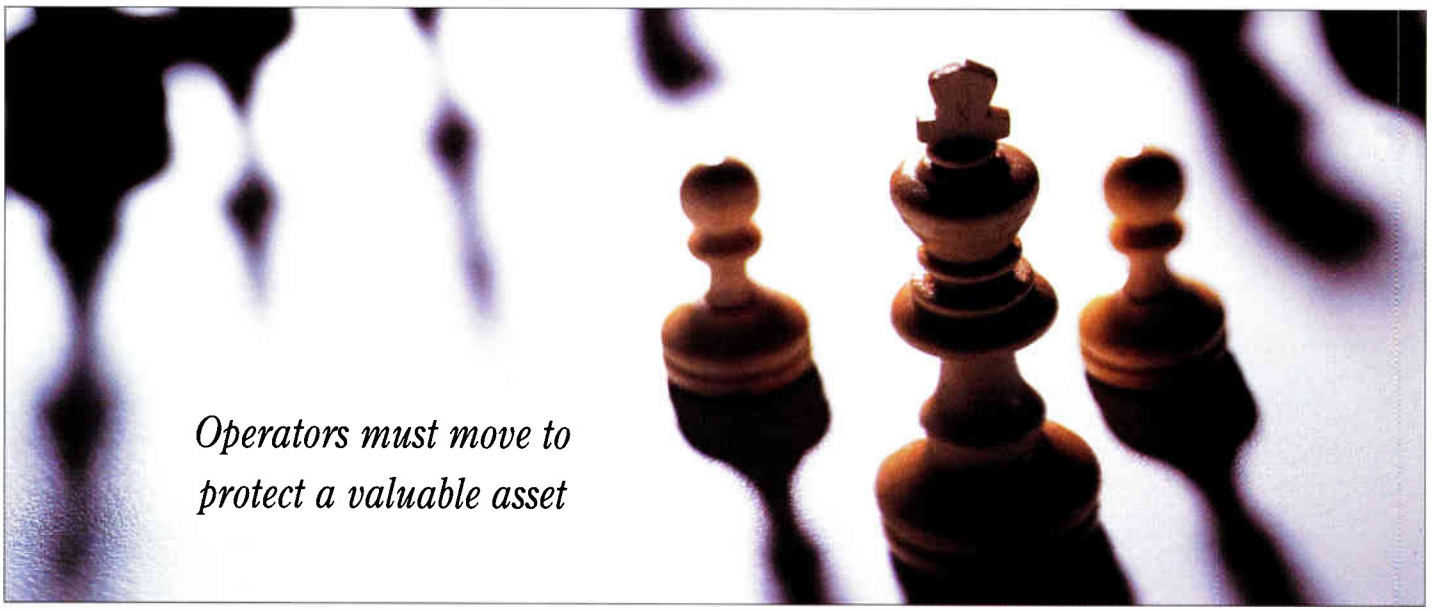


VIP's Buried Line Tape

The Write-on Coverall Tags feature a rugged vinyl surface with a self-laminating flap that protects the writing. Stock tags measuring 2 inches or 3-1/2 inches are available in yellow or orange with black lettering.

Circle Reader Service number 333

Fortifying the headend through engineering and performance testing



Operators must move to protect a valuable asset

PHOTO BY FRANK WHITE PHOTOGRAPHY INC.

By Harry Tankin, Director, NETadvantage™ Solutions Group, General Instrument Communications Division

The rapid change in broadband video provisioning and distribution technologies, coupled with the introduction of new communications services, has stimulated a number of business and operational changes among carriers and equipment manufacturers. For the carrier community, the advent of video-on-demand (VOD), near-video-on-demand (NVOD), narrowcasting, ad insertion, high-speed data communications, telephony, and Internet access services has forever changed the character of the headend.

To begin, today's emerging headend is responsible for the provisioning and distribution of transactional services. Such services are not only dynamic in nature (i.e., content and/or bandwidth may change frequently if not on demand), but dependent on varying levels of subscriber participation. Further, the emergence of transactional services is transitioning today's broadcast-oriented headend to that of a true interactive telecommunications resource.

In so doing, this resource is rapidly becoming a multi-vendor, multi-technology environment requiring a new set of principles for ensuring optimal performance against subscriber expectations and commercial service level agreements.

Finally, many carriers have begun implementation of various distributed headend architectures consisting of master headend and hubs for the dissemination of services and content across large geographies. Subsequently, the move to a distributed architecture necessitates the application of networking, configuration management and high availability technologies not previously considered for earlier systems.

This changing headend paradigm has presented a set of challenges for equipment manufacturers as well. Historically, headend equipment was often made available to system operators "on the cheap" to round out multi-million-dollar set-top convertor sales. Consequently, not only were marginal investments made in headend equipment technology, but the stature of the headend as a communications resource was never fully appreciated by the industry at large.

However, times have changed. Today, manufacturers have not only made a conscious decision to treat head-

end systems as an integral product line, but inject considerable investments in emerging technologies and complementary products such as digital transport, matrix switches, network management platforms and application servers.

Today, the headend is rapidly becoming the carrier's most strategic asset with its technologies, management systems and operational practices taking on some of the same attributes of telephony's central office. Subsequently, equipment manufacturers and systems operators must begin to give serious attention to, and make considerable investment in, the day-to-day tasks associated with headend engineering and performance testing.

Headend engineering

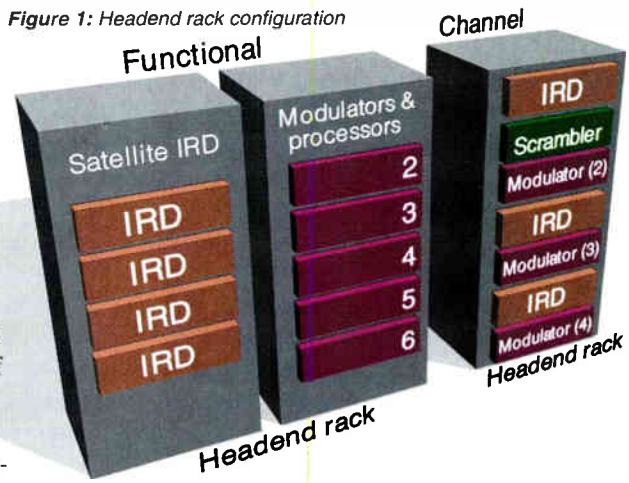
Performance testing is inextricably linked with assignments associated with headend engineering: system configuration, site survey, headend configuration, signal collection, decoding, encoding, modulation and design of the combining network.

The ideal system configuration of a headend would be centrally located to serve as many subscribers with the least amount of distribution equipment allowing for bandwidth per subscriber optimization for future services. However, special consideration must be taken when addressing distributed headend architectures consisting of master headends, remote signal collection sites, secondary headends or hubs and return system management. While the deployment of secondary headends or hubs should be based on the need to minimize the amount of distribution equipment at a local level, deployment is also based on the digital and other transport system (i.e., IF and video transport) constraints associated with master headend-to-hub networking. Further, while the master headend may have responsibility for acquiring and distributing off-air, satellite, remote local community access, and remote sporting/special event signals to secondary headends, the provisioning of given services and equipment such as ad insertion, narrowcasting, addressable customer set-top control, and Internet access may also affect headend/hub deployments.

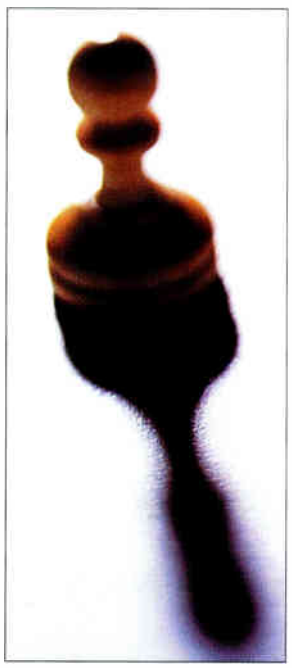
Importance of site surveys

Site surveys are essential for determining that ideal headend location. With respect to signal acquisition, site surveys determine location suitability for off-air, TVRO and possible transmission of satellite signals. Key tasks associated with off-air signals are: determination of signal strength from local broadcasters; distance from the receive site to the broadcast antenna; antenna azimuth setting; and selection of antennas.

Figure 1: Headend rack configuration



For satellite signals, survey tasks include: determination of receive site latitude and longitude, and magnetic variation for proper antenna aiming; calculation of satellite coverage footprint and size of dish polar mount angles; location of possible signal interfering structures such as buildings, cellular towers, utility poles, electric utility distribution systems, etc.; and the location and listing of all available satellites that can be received from the receive site along with their downlink Ku and/or C band frequency allocation, azimuth and elevation settings. Special attention should also be given to evaluating the potential for 2 degree spacing issues. To address the problem of multipath signals, the site survey needs to include a seasonal analysis of the desired signal over a minimum 24-hour period.



Headend configurations are incorporating systems to improve service reliability

Apart from signal acquisition, complete site surveys will include a series of land-based tasks to determine the nature of terrestrial interference; soil suitability for dish supports and antenna towers; soil conductivity for ground systems; and assessment of legal and physical access obstructions such as easements, rights-of-way, and streets. With regard to post-headend installation, the site survey needs to assess the ability of the site to maintain "environmental integrity"; that is, protection from future obstructions and interferences from adjoining properties.

Headend configuration of traditional equipment can be achieved via either of two methods (functional vs. channel) as described in Figure 1. The "functional" method locates all receivers together, while processors and modulators are located separately in numbered sequential order. The "channel" method concentrates all components related to one channel. Many system operators have system operational preferences. Regardless of what configuration method is employed, all equipment should be racked with spacer blanks to aid in heat removal, dissipation and air flow. As a rule-of-thumb, effective climate control should have headend operating temperatures at approximately 70 degrees with constant monitoring. Headend equipment configurations should include power requirements to accommodate future services as they become available, as well as uninterruptible power supplies (UPS) in the event of commercial power outages.

Increasingly, headend configurations are incorporating equipment and systems to improve overall service availability and reliability. Included are matrix switches, patch panels and headend management systems. Although matrix switches support channel sharing (e.g., one modulator sharing two video sources on a time-share basis), they are being deployed to alternate feeds for back-up capability, as well as supporting applications such as commercial ad insertion and cross-channel promotions. Further, the matrix switch can be employed as an "on/off" switch for compliance testing selected or all channels. Addressable systems that employ channel mapping and system configuration can also achieve channel/frequency allocation control.

Headend management systems have also gained considerable attention as operators recognize the need to keep revenue-generating services provisioned and available. Effective headend management systems should be designed to monitor all key headend equipment parameters, and permit reconfiguration of those parameters through controlled access.

These headend managers should support multi-vendor equipment in the headend through the use of industry standard network management agents, proxies and protocols based upon CMIP or SNMP, and employ common off-the-shelf software, as well as industry accepted or standard data communications protocols, operating systems and graphical user interfaces.

System operator staff concerned with improving headend reliability through the use of headend management systems need to take note of the following. First, improving reliability requires a systems approach. That is, the purchase and configuration of headend hardware alone to achieve some level of high availability, if not fault tolerance, can be expensive and fail to achieve desired goals.

The reason for this is that services sensitive to headend and/or network performance and availability require software applications that can sense pending availability issues and send "instructions" or "requests" to the management environment to ensure (a) dynamic reconfiguration of equipment to ensure the service continues to be available; and (b) logging of events or thresholds responsible for corrective action so engineering can determine if the cause was an isolated or systemic problem.

Second, with the introduction of diverse headend equipment including Sonet/SDH, proprietary digital transport, video servers, matrix switches, cable modems, ATM switches, etc., the ability to monitor and manage the headend as a system must be accomplished through the use of embedded network management protocols and agents and software platforms based upon industry standards. The continued use of proprietary protocols and closed hardware platforms for headend monitoring and control will only compound the costs and frustrations associated with compatibility with firmware changes, enhanced equipment features, and data sharing across multi-vendor equipment.

Signal collection

Signal collection is acquired through the use of satellite receivers, integrated receivers/decoders (IRDs), IRTS (digital QPSK), and low-noise convertors (LNBs). Satellite receivers having agile tuning will provide the most versatility for signal reception, be it analog or digital. IRDs, however, offer more efficient utilization of available rack space. VHF/UHF off-air signals require either signal processors and/or demodulators for processing. As operators plan to introduce services beyond traditional cable TV broadcast, return path data and video processing equipment, including optical receivers for node return traffic, are necessary for any future network enhancements.

The move toward interactive and transactional services, particularly Internet access, VOD, and NVOD, as well as premium video and audio services, has stimulated the demand for encoding and addressable systems. Current addressable systems have been developed for a targeted service class, most notably premium channels and pay-per-view programming. However, encoding and addressability will be essential for the emerging transactional services, and here is where proactive engagement by headend engineering is essential.

Figure 2: Matrix of tests required by new technology standards.

Test	Rule	Specification	Channels	Where	When	Equipment needed
Aural carrier frequency	76.605(a)(2)	+4.5 MHz ±5 kHz	7 for most systems	Subscriber terminal	2x a year, max 7 months apart	Tuned frequency counter, spectrum analyzer
Minimum visual signal level	76.605(a)(3)	0 dBmV or 3 dBmV TAP	All	Terminal or tap plus 100' drop	2x a year, max 7 months apart	SLM + cable
Visual signal change	76.605(a)(4)	Within 8 dB within 6 months	All	System location	2x a year, max 7 months apart, + 4 tests, 6 hours apart in 24 hours	SLM + cable
Adjacent visual signal	76.605(a)(4)(i)	Within 3 dB over 24 hours	All	System location	2x a year, max 7 months apart, + 4 tests, 6 hours apart in 24 hours	SLM + cable
Any visual signal in bandwidth	76.605(a)(4)(ii)	Within 10 dB for 300 MHz +1 dB for each add'l 100 MHz	All	System location	2x a year, max 7 months apart, + 4 tests, 6 hours apart in 24 hours	SLM + cable
Aural carrier level	76.605(a)(5)	-10 to -17 dB from VIS carrier	All	System location	2x a year, max 7 months apart, + 4 tests, 6 hours apart in 24 hours	SLM + cable
In-band channel response	76.605(1)(6)	±2 dB 0.75 to 5.0 MHz in channel	7 for most systems	System location	2x a year, max 7 months apart	Demod, waveform monitor, spectrum analyzer
C/N ratio	76.605(a)(7)	–	7 for most systems	Subscriber terminal	2x a year, max 7 months apart	SLM, spectrum analyzer, sweep
Coherent distortion (CTB, CSO, XMOD)	76.605(a)(8)	51 dB (47 dB for HRC)	7 for most systems	Subscriber terminal	2x a year, max 7 months apart	Manufacturing specifications
Terminal isolation	76.605(a)(9)	18 dB (Mfg specs)	Manufacturing specifications	Manufacturing specifications	Manufacturing specifications	SLM, spectrum analyzer, sweep
LF disturbances (HUM)	76.605(1)(10)	3% of VIS level	One	System location	2x a year, max 7 months apart	Demod, waveform monitor, vectorscope
Chroma delay	76.605(a)(11)	170 nSEC	7 for most systems	Headend	Triennial	Demod, waveform monitor, vectorscope
Differential gain	76.605(a)(12)	±20%	7 for most systems	Headend	Triennial	Demod, waveform monitor, vectorscope
Differential phase	76.605(a)(13)	±10%	7 for most systems	Headend	Triennial	Demod, waveform monitor, vectorscope

The deployment of compatible, if not integrated, addressable systems supporting a common subscriber management/billing interface across service categories is crucial for improved customer service, integrated billing, and managing the costs associated with operational support systems (OSS). While headend engineering may focus much of its attention on traditional equipment deployment and performance concerns, the escalating role of software-based systems for service provisioning and billing must be planned. Unchecked growth of service and/or equipment vendor-specific OSS will result in substantial maintenance costs and operational inefficiencies.

With regard to the combining network, headend performance can be improved through several simple practices. First, ensure test points are placed at strategic locations throughout the combining network for troubleshooting purposes. The depth of monitoring and control is highly dependent upon the level of true network management functionality associated between the headend management system and the combining network and independent channel equipment. In some instances, simple status monitoring of the combining network may be all that is warranted for troubleshooting purposes. However, should there be a need to (a) correlate faults and events between the combining network and other network resources (be they headend or distribution plant), and/or (b) extend true manageability or control over the combining network, then simple status monitoring of the combining network will not suffice. Investment in ensuring the combining network is a managed domain will be necessary.

The return path combining network is evolving as the most complex headend component. Hence, it must be engineered to protect against the loss of data during expansion and provisioning. Any pending loss of essential data must be reported and responded to in real-time. Considering the return path combining network is essential for satisfying multiple service requirements, true network management, and not simply monitoring, is necessary.

Second, it is safe to assume that post amplification will be required to feed multiple transmitters. Third, fiber

The return path combining network is evolving as the most complex headend component

The need to frequently calibrate test equipment can't be overstated

coupling and management requirements will be determined by backing into overall system plant requirements. The ability to plan the combining network against anticipated services, future plant needs, and manageability will produce an efficient combining scheme capable of saving the operator considerable capital expenditure.

FCC proof-of-performance testing consists of a suite of 14 separate tests, as outlined in Figure 2. The number of channels tested depends on FCC rule 76.601(c)(2) which specifies tests be made on a minimum of four channels plus one additional channel for every 100 MHz of upper frequency limit. In addition, measurements to be performed at subscriber terminals may be done at any convenient test point in the system, provided that data is included to relate the measured performance of the system as would be viewed from a nearby subscriber terminal.

Proofs should be made at six widely separated points for systems having between 1,001 and 12,500 subscribers. One additional point should be added for each 12,500 subscribers or fraction thereof. Points should be balanced throughout all geographic areas with at least one-third representative of extremities. System taps can be used if data recorded relates to what a subscriber would see.

As the headend and distribution plant become more complicated, accurate troubleshooting methods and diagnostic equipment will be crucial. Hence, the need to frequently calibrate test equipment cannot be overstated. Most diagnostic equipment used in network analysis is frequently-selective, and is subject to inaccuracies. This is particularly true for equipment used in the field, which is subjected to temperature extremes and DC power.

Equipment may be calibrated either internally or externally. External calibration involves providing an accurate external signal source for comparison to the equipment. Internal calibration consists of the equipment measuring and correcting itself. External calibration is the most accurate method, and the headend is the preferred location to establish an accurate and convenient point of external calibration. This is because headends are temperature-controlled, more closely-monitored, and usually centrally-located for most field personnel.

Test points located in the headend should be related to possible common failure points and meet the following criteria: (a) convenient for all personnel; (b) signals should be stable within ± 0.25 dBmV; (c) response may be flat or sloped, but flat inputs are required for laser inputs; and (d) levels should be measured and posted in a log daily.

Some of the more common headend system RF tests and measurements include: video carrier level; video/audio separation; video carrier-to-noise ratio; composite second order distortion; composite triple beat; hum; chroma/luminance delay inequality; K factor; differential phase and gain; group delay; video passband flatness; video and audio S/N; audio distortion and stereo separation; and C/N of received antenna and TVRO systems. It should be noted that the output signal level of the headend will depend on the number of channels on the system, the combining configuration, and the need for forward laser and return receiver input.

Considering the frequent churn of communications technologies, the ongoing provisioning of new services, and the increased prominence of remote or unattended headends, the application of effective Operations, Administration, Maintenance, and Provisioning (OAM&P) practices is not limited to investment in headend products, test equipment and performance testing techniques. Instead, operations and field staff must be viewed as valued assets in need of ongoing training in product and technology, as well as business practices. Subsequently, operators need to invest in assets (equipment, support systems, facilities and people) to realize a vision of the headend as a true telecom resource. CED

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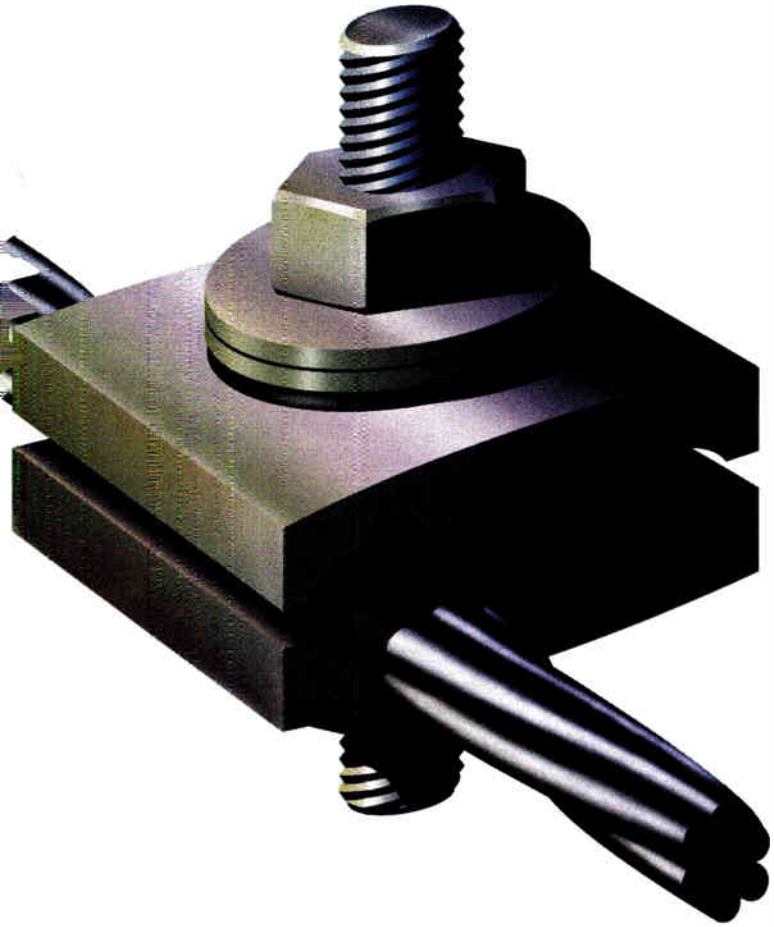

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constant, sequential voice traffic, but instead, to launch cable operators into the packet data business.

But execs like Craddock are now taking the business case for IP voice seriously enough that they are holding discussions with the MCNS cable modem standards group on the issue of building into the modem chips the capability to handle voice service. The voice service though, notes Comcast's Craddock, is still very much secondary to the goal of making interoperable cable modems available to consumers at retail.

The speed of the user's personal computer is another limiting factor. "If you are using a 486, you can forget it," says Craddock. "If you have a really fast Pentium, it's not so bad."

Another crucial issue is how to make certain that the data services cable operators have worked so hard to set up would coexist peacefully on the same pipe with voice. "Until you get Quality of Service that you can implement all the way to the desktop," says Craddock, "it's really tough to guarantee that a voice stream will have priority" (for more on QoS issues, please see the cover story, page 34).

Medin

To ensure a successful voice transmission, operators would have to make tradeoffs like buffering the voice packets; however, too much buffering could equate to serious, and noticeable, delays in a conversation. "All of a sudden, you begin to look like a badly-dubbed Italian movie," jokes Craddock. "And if you don't engineer it right, you start to get echo as it interfaces with the PSTN, or clipping caused by jitter, and that's ugly, too."

"Those voice packets have to have priority," says Bauer. "You get a heavily-loaded network, and you've got some concerns. But it's nice that this is happening at the time we are actually starting to build the MCNS modems, which means we can provision for that."

And then there's the question of application priorities on the PC itself. While IP voice "hobbyists" today are probably willing to tolerate the disconnection of their calls when they open another software application and their PC dumps the VON application in favor of, say, a spreadsheet program, future business users probably wouldn't be too thrilled to have their PCs making those decisions in the middle of calls.

Regulatory uncertainties

While cable operators have dropped full-scale telephony services down on their priority lists for many reasons, regulatory uncertainties seem to dominate the pack. Not surprisingly, the future regulatory picture for Internet telephony is also murky.

And as WindBreak's Bauer notes, "The telcos are not going to stand by and allow that revenue to disappear."

In fact, a trade association of interexchange telecommunications companies called ACTA (America's Carriers Telecommunication Association) petitioned the FCC in March of 1996, asking for the regulation of the Internet as a telecommunications service.

The group's arguments, says Brian Cute, associate with ACTA's counsel, Helein & Associates, P.C., are both legal and policy-

Flavors of voice over IP

As it is currently, and perhaps most widely being configured, an IP voice call requires that both callers have personal computers with sound cards or built-in audio, as well as microphones and 14.4 kbps modems (14.4 is probably the minimum for good sound quality; however, some programs will run at 9.6). In addition, they must have a direct Internet connection (a standard PPP or SLIP), and both must be running the same software package. (Actually, two callers using different phone software could, theoretically, talk to each other if their software shared the same type of compression and utilized the same transport protocol, in addition to a few other technical requirements. In practice, however, few of the applications will work together.[2]) There are now dozens of companies which are offering IP voice software.

In addition, all parties to the call must be on-line at the same time, which requires some type of advance communication to actually set the call up (possibly a voice call over the PSTN, or an e-mail, etc.).

In this application of the technology, software codecs are translating the analog voice conversation into packets of data, and at worst case, the process can cause delays in the hundreds of milliseconds.

The compression/decompression process can also be accomplished in hardware, in the form of a card that plugs into the PC.

There's also a new wave of Internet telephony applications arriving on the scene which will give users the power to make phone-to-phone calls via the Internet. VocalTec Ltd., which introduced its Internet Phone software in 1995, has introduced its Telephony Gateway servers which connect the Internet to the PSTN. As VocalTec's literature explains the application, a user would dial the gateway from any phone; an Interactive Voice Response (IVR) system asks the caller to enter the number he wishes to dial; the call then travels over the Internet to a second gateway and the call's destination. If the phones at either end of the connection happen to be linked to their gateways via a PBX, the only charges incurred would be those of the Internet connection. The Telephony Gateway also contains features for security, billing and call monitoring, according to the company.

In December of last year, VocalTec announced that Telecom Finland had integrated the company's Internet telephony technology into its new Web-based telephone services.

Another company, IDT Corporation, which entered the Internet access business in 1994, says that its Net2Phone technology makes it possible for users of Internet telephony systems to call regular phones. A caller with a "sound-equipped" PC would make the call from his/her computer. The call is then transmitted over the Internet to IDT's central telephone switch, which relays the call to a telephone. "The result is real-time, uninterrupted, full duplex voice communication between two parties," according to literature posted on the company's Web site.

The company also reports that callers can use any ISP to reach the other party.

While there is a charge for the call itself, the company says that its service can reduce phone bills "by up to 95 percent off the cost of traditional long distance calls."

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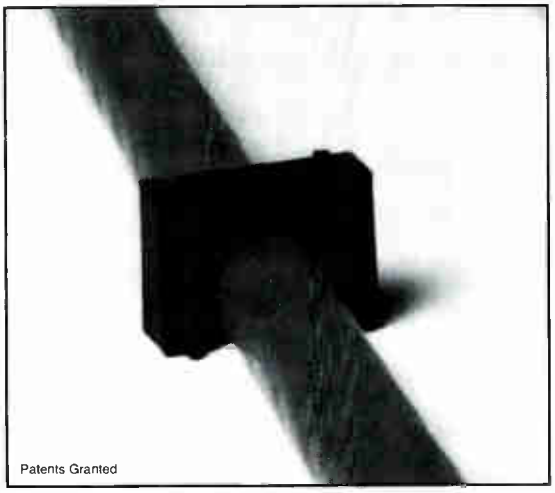

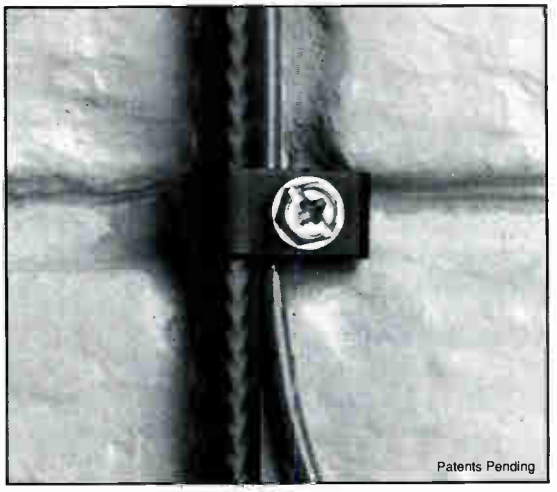

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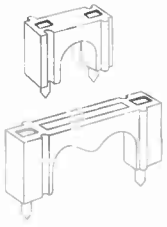

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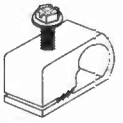

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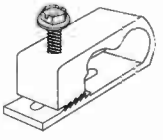

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driven. As for the legal argument, under the Federal Communications Commission's rules, if an entity offers telecom services to the public for a fee, then that entity is treated as a common carrier, says Cute. ACTA is basically concerned about the disruption of a level playing field for telecommunications carriers. Cute adds that to date, the FCC has not acted directly on the petition.

There are also standards issues which need to be resolved before progress can be made. Right now, the industry is moving to a defacto to standard of either G.723.1, backed by Microsoft and Intel, or G.7291, of which AT&T is a proponent.

These standards would make the quality of IP voice actually better than that of toll-quality voice, according to Bauer.

Will users bite?

Ultimately, the question becomes, is it worth it for cable operators to pursue IP voice services—would consumers use them? "Right now, voice over the Internet is a hard to use, low-quality service—but it's really cheap," says Gary Kim, a telecom industry consultant and president of Itibiti Ventures Inc.

"IP voice is a new type of voice quality that is becoming available to consumers for the first time. There will be room in the marketplace for absolutely reliable, high-quality voice, and I think that digital PCS will move the expectation for wireless a lot closer to wireline. And I also think that there will be a continuing and huge market for people who say, for a cheap enough price, I don't mind having this Internet connection . . . It doesn't replace your standard phone; it's a supplement to your standard phone."

Bauer

Where cable operators could shine would be in the combination of video with voice and data in multimedia versions of Internet phone. Suppliers of packet-telephony products like VocalTec, VDOnet and others now have products which include support for video connections.[1]

"There are real possibilities for videoconferencing and streaming video and those kinds of things," says Bauer, "but it's not quite there yet. You're going to do some struggling. You have to come out of your network and hit the Internet, and there will be some delays, jitter, etc. It's not the panacea that we want, that would enable full-motion, full-screen video, and hearing the other person in CD quality sound."

For now, both the technology, and the market, are still maturing. As for cable's involvement, when will the market see significant movement on the part of MSOs?

"This will be very exciting about a year from now," says Craddock. CED

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Gaining momentum

Coax vs. telephony return using two-way coax plant for data

By Alon Carmeli, Senior Product Marketing Manager, Terayon Corp.

Internet access holds great promise for all levels of cable operators–from large MSOs to small independents. Data services represent a new and potentially significant, fast-growing revenue stream. However, use of first-generation cable modem solutions requires operators to upgrade their cable plants from one-way coaxial plants to hybrid fiber/coax (HFC) networks, thus spending up to $200 per home passed. Because 80-85 percent of the U.S. cable infrastructure is still one-way coaxial plant, projections are that it will require several years and a large capital investment to upgrade the cable infrastructure.

In the interim, some cable operators are considering cable modem solutions with telephony-return to capitalize on the market for Internet access, as a means of reducing system upgrade costs and time to market. Others are considering delaying data services until their cable network upgrade is completed.

However, cable modem systems based on S-CDMA technology provide a viable alternative, allowing cable operators to deploy data services over two-way, pure-coaxial plants. Based on their robust upstream capability, these cable modem systems operate effectively over noisy, two-way, pure-coaxial plants, reducing the capital investment for system upgrade down to $11 per home passed. With minimal plant upgrade required, S-CDMA-based systems accelerate time-to-market, enabling operators to offer data services with about the same amount of start-up time as telephony-return solutions.

Furthermore, Quality of Service (QoS) capability enables operators to generate three times the revenue of telephony-return-based service in recurring monthly revenue per subscriber, given a mix of residential, SOHO (small office/home office), and corporate users. It can therefore be argued that S-CDMA-based two-way systems provide a more attractive business proposition for data services than that of telephony-return solutions.

This article compares S-CDMA access systems running over two-way, pure-coaxial plants with telephony-return cable modem solutions. It is first necessary to review several technical issues related to the deployment of high-speed services over coaxial plants, compared to HFC networks, such as downstream channel availability and upstream channel characteristics.

Downstream channel availability

Unlike HFC networks based on 750 MHz systems, coaxial plants operate over systems from 280 MHz to 550 MHz. Depending on the

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demographics, some of these systems use the majority of downstream channels for video programming, thus limiting data services to a single or a few downstream channels. There are, however, several regions that are not used for video programming because of the high level of interference, but which become available for data services when S-CDMA technology is used (see Table 1). These include:

✔FM band. The FM band, located between 88 MHz and 108 MHz, is used in some systems for RF radio transmission over cable TV, but is not used for video broadcasting because of the high level of interference from RF signals over-the-air. Because many cable systems do not deliver FM radio programming, these channels are often unused.

✔108 MHz though 121 MHz RF spectrum. The portion of the RF spectrum from 108 MHz to 121 MHz is generally unused for video broadcasting because of the high level of interference from aircraft navigation system signals.

✔Roll-off region. The roll-off region consists of the upper frequencies–the upper 6 to 12 MHz in each system–which are not used for video broadcasting because of severe amplitude tilt distortion, high group delay, and the low signal-to-noise ratio. Amplitude tilt distortion is a result of high attenuation over the cable in high frequencies and the non-linearity characteristics of amplifiers at the edges. The low signal-to-noise ratio is a result of higher attenuation in high frequencies and lower amplifier gains in its non-linearity region.

All of the above unused frequencies occupy 45 MHz of the RF spectrum, or slightly more than seven 6-MHz channels. Utilizing a robust S-CDMA transmission technology, these channels can be used for downstream data services. By spreading the signal over frequency and time, S-CDMA provides high noise immunity against narrowband and impulse noise interference, such as over-the-air interference.

A robust adaptive equalizer compensates for the severe amplitude tilt and group delay presence in the roll-off region. The high code gain enables operation with a signal-to-noise ratio below 15 dB, thus combating the relative high in the roll-off region (see Figure 1).

Table 1: Unused downstream frequencies for video programming.

Region	Source	Counter-measure
RF band	• High interference from over-the-air RF signals	• Spread spectrum gain • Trellis coding
108 MHz through 121 MHz	• High interference from over-the-air aircraft navigation signals	• Spread spectrum gain • Trellis coding
Roll-off	• Severe amplitude tilt distortion • High group delay • Lower signal-to-noise ratio	• Robust adaptive equalizer • Robust modulation technique

Upstream channel characteristics

Without an advanced cable modem solution, the upstream channel characteristics of pure-coaxial plants severely limit deployment of high-speed data services. These characteristics include:

✔Low signal-to-noise ratio. Unlike HFC networks with a service area of 500 to 2,000 homes passed and five to six amplifiers in cascade, the service area of traditional coaxial plants covers 5,000 to 20,000 homes passed, with 20-30 amplifiers in cascade, resulting in a low signal-to-noise ratio.

✔High group delay. The high number of amplifiers in cascade increases overall group delay, specifically in the corner channels–5-11 MHz and 36-42 MHz–thus limiting overall upstream channel availability.

✔High common path distortion. The high number of connectors can cause severe common path distortion, resulting from corrosion or oxidation on connections of dissimilar metals, producing a diode-like effect. When forward-path signals pass through this diode, potentially harmful second- and third-order beats every 6 MHz can be created in the reverse path.

✔High impulse noise. The long antenna created by the coaxial plants may cause severe impulse noise in the return path.

Recent field trials in November 1996 and January 1997, running over cable systems from two MSOs, demonstrate the throughput and error performance of an S-CDMA-based access system under severe channel conditions. Each of the two trials was conducted over a 6 MHz channel–the first between 11 and 17 MHz and the second between 5 and 11 MHz. Cable modem performance in both trials was excellent. The following is a detailed description of the three test scenarios in the first trial:

✔One clean fiber node with 3,400 homes passed and 2,890 cable TV subscribers.

✔Unclean fiber node (installed, but not tuned) with 6,200 homes passed and 5,270 cable TV subscribers.

✔Aggregation of eight fiber nodes with 30,000 homes passed and 25,500 cable TV subscribers.

All tests were conducted over a 6 MHz channel between 11 and 17 MHz, with severe channel conditions, including:

✔Signal-to-noise and interference ratio of 13 dB

✔Narrowband interference

✔Shortwave at 11 and 12 MHz

✔Ham radio at 14 MHz

✔Telemetry at 17.5 and 18 MHz

✔Severe ingress noise

✔Severe impulse noise, predominately from power-line signals.

As indicated in Figure 2, the S-CDMA access system operated error-free over 98.3 percent of the time in all cases. In the case of the "unclean node," which was not tuned, S-CDMA provided 99 percent levels, indicating that this system delivers high-performance data

Table 2: Two-way vs. telephony-return

		Telephony return		Two-way coax	
Up-front costs/subscriber		**Min.**	**Max.**	**Min.**	**Max.**
	Modem	$200	$300	$400	$450
	Headend cable modem	$8	$13	$16	$27
	Modem pool	$115	$224	-	-
	T-1 installation	$24	$41	-	-
	Return-path activation	-	-	$60	$75
	System powering	-	-	$6	$8
Total up-front costs		**$347**	**$578**	**$476**	**$551**
Revenue/ month/ subscriber	Residential	$25	$30	$35	$45
	SOHO users	-	-	$150	$200
	Corporate users (dedicated T-1)	-	-	$800	$1,000
	T-1 usage costs	$4	$6	-	-
Effective recurring revenue/month/subscriber		**$19**	**$27**	**$62**	**$80**

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services in the return path with virtually no network tuning.

The S-CDMA-based system successfully overcomes noise from severe multiple narrowband interference and impulse sources. This demonstrates the resilience of the system over either pure-coax or HFC cable plants, with no need to install high-pass filters. This provides a new level of flexibility for cable operators, who can now deploy data services rapidly, without the expense or time associated with major plant upgrades.

Figure 3 demonstrates the bit error rate (BER) distribution for a five-second interval over an unclean node. The system operated at zero BER 96.2 percent of the time, and it quickly recovered from several incidents with BER less than E^{-8}.

Based on these rigorous tests, the conclusion is that S-CDMA-based systems can operate error-free:

✔Over *both* pure-coaxial plants and HFC.
✔In the high-noise portion of the upstream spectrum below 20 MHz, which until now has not been considered practical for high-speed data services.
✔Over noisy, untreated plants.
✔Over systems with large and highly aggregated nodes.

Economic comparison

Among the assumptions,* telephony-return systems require installation of a modem pool at the headend location, at a ratio of 1:3 to 1:5 for the number of simultaneous users vs. the number of subscribers. T-1 lines are used to transmit the multiple dial-up analog circuits from a telco's central office to a cable operator's headend location, with a resulting impact on the net monthly revenue. We have made the conservative assumption that subscribers will use their existing telephony line connections.

In the case of two-way coaxial plants, it is assumed that the cable plants begin as two-way capable, thus requiring return-path module installation, system balancing and changes in the powering systems. In other cases, they may require a complete installation of new housings or new amplifiers. The average return-path activation cost per amplifier is $150 for a return module and $50 for installation and balancing at 1.5 hours. In order to calculate the cost per mile, four and five amplifiers were used in 450 MHz and 550 MHz systems, respectively. The changes for the system powering were calculated at 10 percent of the overall return-path activation cost. The overall return-path activation cost per cable modem subscriber was based on 100 miles per home passed, a 67 percent basic cable penetration rate, and a 10 percent cable modem penetration rate. It is assumed that return-path activation costs are amortized 50/50 between data services and other advanced interactive services.

As for recurring monthly revenue, it is assumed that a two-way solution with QoS controls enables operators to capitalize on the existing demand for broadband access from a mix of residential, small office/home office (SOHO) and mid- to large corporate users. A conservative mix of users is based on 88 percent residential users, 10 percent small office/home office users, and 2 percent corporate users. Furthermore, it is assumed that two-way data service over cable commands a premium over telephony-return because of its service superiority–providing continuous connection and faster access.

The following comparison between two-way, pure-coaxial systems and telephony-return solutions is based on the above assumptions, as well as current prices for telephony-return cable modems, modem pools, and T-1 lines (see Table 2 for detailed cost breakdown). The potential average monthly revenue from two-way service is estimated at $61 to $80, compared to $19 to $26 for telephony-return, because of the ability to capture higher paying users. This translates to three times greater monthly recurring revenue (or up to $720 per cable modem subscriber per year) for two-way systems. The telephony return solution requires an additional $6 per subscriber to provide a connection between the central office and the headend site. If one assumed a requirement for a second telephone line, telephony-return service would be even more expensive–about $35-$40–yet provide the same upstream speed as current dial-up Internet access services.

An S-CDMA-based solution protects operators' investment in network equipment, because it operates over both coaxial plants and HFC networks. Telephony-return solutions could become obsolete in two years, thus lowering the overall return-on-investment of telephony solutions.

As for the network access issues, telephony-return solutions share similar problems with current analog and ISDN dial-up access systems, including blocking in the network, tying-up subscribers' phone lines, lack of a continuous line connection, and system scalability. Furthermore, TCP/IP protocol has severe limitations in asymmetric configurations such as telephony-return, thus reducing downstream throughput for many applications and limiting system scalability.

In a more global sense, two-way solutions provide a strategic advantage for cable operators, enabling them to build expertise with two-way plants faster—a necessity for success in the competitive telecommunications market. Telephony-return solutions, on the other hand, require cable operators to transfer more than $15 per month to local tele-

Figure 1: Available bit rate vs. SNR

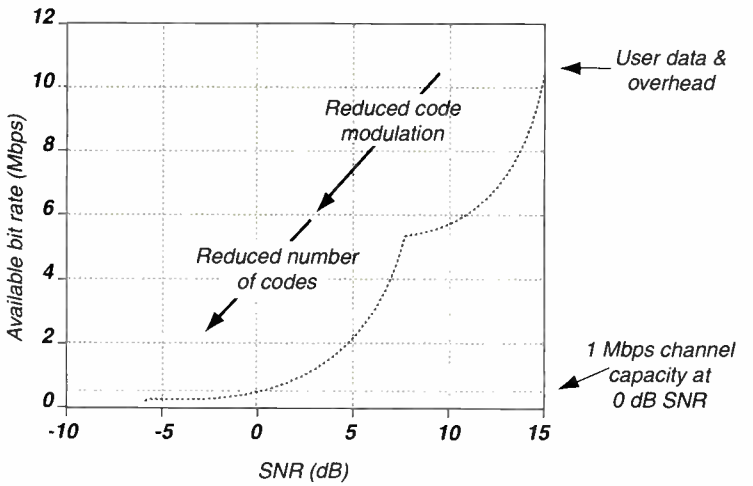
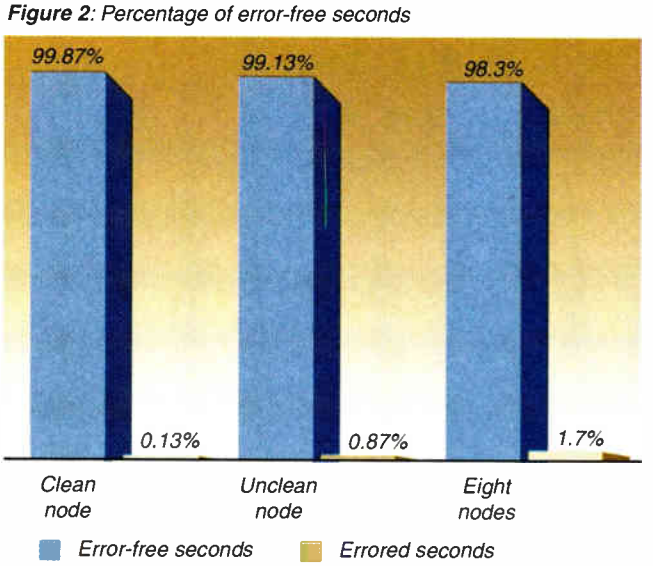


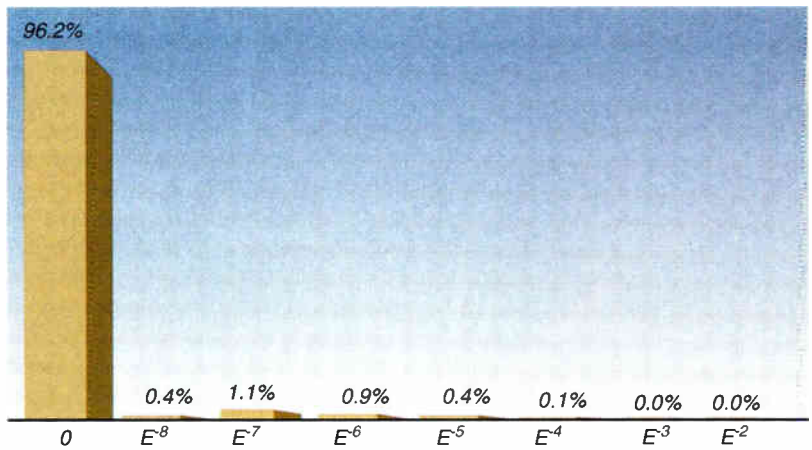
Figure 2: Percentage of error-free seconds



phone carriers for each cable modem subscriber to cover the T-1 connection between the central office and the headend site, and an optional second telephone line.

Up-front costs per cable modem subscriber are $346 to $578 for telephony-return, and $475 to $551 for two-way activation, making the initial costs of two-way slightly more expensive, but not significantly. It is important to note that up-front costs for telephony-return are primarily variable costs, whereas two-way coaxial plants have a combination of fixed up-front costs for return-path activation, and variable costs for the customer-premises modem, which scale to provide lower costs as more subscribers are added. In addition, up-front costs for two-way, pure-coax activation can be amortized over a longer period, because the return-path module can be used as part of the overall system upgrade, thus lowering the overall costs.

Figure 3: Percentage of unclean node BER histogram



It should be noted that telephony-return requires no changes to the existing infrastructure, while activating the return-path of two-way, pure-coaxial plants requires about four months to activate a 50,000-home passed system, assuming a crew of five technicians. In the scope of rolling out new services, these delays are not significant, as the service can be rolled out in phases over several areas.

In summary, two-way, pure-coaxial data services are a better investment for cable operators than telephony-return. Return-path activation over pure-coax provides a better solution for cable operators, given the ultimate goal to upgrade to HFC networks. S-CDMA-based systems allow faster activation of two-way systems, thus building a stronger market position in the race to provide broadband data services. CED

Footnote

*We have simplified the following economic analysis by excluding costs that are common to both two-way pure-coax and telephony-return systems. These include up-front costs, such as cluster servers for the headend and local content servers, as well as ongoing maintenance costs, such as Internet access charges and customer support.

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Data modem spec inches closer to reality

Prices plunging for high-volume orders

By CED *staff*

As National Shows go, long-time industry observers could argue that this was one of the least "newsy" shows in recent years, at least from a technology point-of-view. There were no flashy press conferences, no surprise announcements of exciting new hardware, and there was a dearth of interesting sound bites.

Instead, the long march toward interoperable high-speed data modems took another step or two forward in New Orleans, site of the annual show that is hosted by the National Cable Television Association. In fact, a press conference that took place before the exhibit floor even opened set the tone for the week, as the MCNS (Multimedia Cable Network System) consortium of operators and CableLabs set forth final cable modem interoperability specifications.

Then, for the next couple of days, a flurry of cable modem vendor announcements came forth, with numerous vendors lining up in support of the specification and predicting that product would be available early in 1998.

CableLabs also issued a request for proposal for "immediate fabrication and delivery" of prototype modems, as it plots a course to ensure that cable modems from varying vendors are truly interoperable.

"The specification is done, we've kept our schedule, and now we'll move to a sort of laboratory incubator environment for the developers, so they can work through any issues of interoperability," said Dr. Richard Green, CEO of CableLabs. Manufacturers have until April 7 to notify CableLabs of their intent to participate in the interoperability testing. Final proposals are due on May 9.

Cable operators have said they expect to see MCNS-compliant, interoperable cable modem components early next year. Until then, MSOs will continue to deploy "first-generation" cable modems made by companies like Bay Networks, Com21 Corp., General Instrument Corp., Hybrid Networks Inc., Motorola Inc., Scientific-Atlanta Inc. and Zenith Electronics Corp., while waiting for newer modems built to the MCNS spec.

Other manufacturers planning cable modem products include 3Com Corp., Cisco Systems Inc., Intel Corp., NEC, Panasonic Inc., Sharp Electronics Corp., Terayon Corp. and US Robotics Inc.

Another important piece of the cable modem supply chain is the chipsets that drive the cable modems themselves, because the more functions that can be spun into silicon,

the lower the cost. Companies including Broadcom Corp., ComStream Corp., Stanford Telecom, Ultracom Communications Inc. and VLSI Technology Inc. are all making cable modem chipsets.

The specification supports downstream data rates in the range of 27 to 38 million bits per second (Mbps), and upstream rates from 320 kilobits per second to 10 Mbps, CableLabs executives said.

Com21 Inc. was the first cable modem vendor to link itself to the finalized MCNS specifications with a plan to develop interoperable products for high-speed data applications. In a separate announcement, Com21 said it will participate in a series of high-speed data trials slated by MCI Communications. MCI plans to test cable modems and ADSL technologies in its Sergeant Bluff, Iowa serving area. Com21 will lend cable modems for a "small trial of residential and on-line service users," executives said.

3Com has announced it will develop and deliver modem products based on the MCNS specification and ATM technology for its end-to-end cable networking solution. Each technology offers datacom solutions for different markets. The MCNS modem is geared toward the U.S. residential consumer market, where there is a need for low-cost, high-speed Internet access. Company officials predicted beta test MCNS modems in the latter half of 1997, and the availability of production quantities in early 1998.

Although they anxiously await MCNS compliant modems, major MSOs stated emphatically their intent to continue to roll out hardware that is available today, even if it does become obsolete sometime next year. Several operators are even planning to deploy telephone-return modems in their quest to enter the market quickly and beat the telcos in the fight for marketshare.

Terayon Corp.–with multiple field tests of its advanced S-CDMA technology under its belt, proving that the robust modulation works in the face of severe upstream noise–said that it, too, would support the MCNS cable modem spec but will not likely join the Broadcom Corp. list of vendors using that silicon. Instead, Terayon will use its own silicon in its TeraPro cable modem line.

Terayon said in a statement that it will offer "next-generation" products based on the specification. It is not likely to join the MCNS licensing pool, said Zaki Rakib, CEO of Terayon.

Motorola gains new modem orders

Signaling its intention to continue aggressively deploying high-speed data service to consumers, Time Warner said it would purchase 250,000 more cable modems from Motorola's Multimedia Group. The agreement builds on an earlier order for 50,000 CyberSURFR modems.

Significantly, the high-volume order allowed Motorola to give Time Warner a price break on the modems, driving the price below $300 each. "The extraordinary market demand for cable modems has enabled us to drop the price significantly for this order," said John Battin, senior VP and general manager of the Motorola Multimedia Group, in a statement.

The CyberSURFR modem offers throughput speeds of up to 10 Mbps in the downstream direction and up to 768 Kbps in the return band. Each modem is connected to a

Motorola's CyberSURFR modem

router in the headend, which is, in turn, connected to the local or remote Internet.

Comcast Corp. also chose Motorola's CyberSURFR cable modems for six of the company's @Home high-speed Internet access service launches. All six deployments are expected to occur by the end of the second quarter. In the next few months, Comcast plans to launch @Home using the CyberSURFR modems in the greater Philadelphia area of Pennsylvania, the greater Detroit area of Michigan, in northern New Jersey and in Orange County, Calif. Launches have already taken place in Sarasota, Fla. and Baltimore, Md.

Motorola Inc. has also announced that it's offering a software upgrade to the CableComm Data System that will simplify operation and installation of cable modems. The company is introducing auto provisioning and IP filtering features with the upgrade.

Bay Networks Inc. announced that, to date, it has deployed more than 50,000 cable modems to business and residential end users worldwide. At the National Show, Bay presented an interactive demonstration of its cable modem products, including remote video conferencing and real video capabilities.

Zenith Electronics Corp. has announced enhancements that will be embedded in its new MetroAccess System "Release 10" software for the company's HomeWorks Universal family of cable modems. The company has also initiated a new modem pricing schedule that drops list prices to $399 from $495. In quantities of 1,000 or more, the unit price is now $299.

New enhancements include "level-of-service management" which allows operators to adjust subscribers' transmission speeds to provide more uniform service levels. This feature also allows operators to offer tiers of service. Another feature is protocol filtering, which selectively passes only Internet protocol (IP) traffic to certain modems, while blocking non-IP traffic. In addition, the software enables operators to configure telco-return modems to full two-way cable modems without a truck roll. With this capability, operators can begin offering telco-return modem service and then upgrade to full, two-way, 4 Mbps service as plant is upgraded for two-way.

Saying that it is keeping a low profile while the industry charts a specific course to high-speed data deployments, Intel Corp. was at the Show with a $289 cable modem. Designed as an internal card that slides into the PC, the Intel "CablePort" card includes an integrated, 100 Megabit network interface card, said Matt Diethelm, general manager of Intel's Cable Products Division.

"We showed prototypes of this card at the Western Show, but this is the first production-ready version," Diethelm said. The CablePort is a telco return modem, which works with the telephone modem that comes with consumers' PCs, Diethelm said. While the current CablePort complies with DAVIC/DVB specifications, Diethelm said that a modular change-out in the headend could ready it for MCNS cable modem specification compliance.

On the component side, Broadcom Corp. jammed a press conference room with news of low-cost, interoperable chipsets for cable modems. Broadcom is a key supplier of modulation chips to set-top and cable modem manufacturers, and said it will collapse what is currently a three-chip cable modem solution into one chip that costs $30 in "consumer quantities."

3Com Corp., Com21 Inc., Bay Networks Inc., Hewlett-Packard Corp., Cisco Systems Inc., General Instrument Corp. and Scientific-Atlanta Inc. all plan to adopt the

Broadcom platform as soon as it is available, later this year.

"This means there will be a wide availability of MCNS-compatible modems to provide to operators and consumers at very affordable prices, and from multiple vendors," said Henry Nicholas, president and CEO of Broadcom.

Libit Signal Processing has announced the availability of its new 64/256 QAM component solution for cable modem and set-top box applications. According to company officials, the LBT4010C enables manufacturers to use more cost-effective physical layer components, which can now be brought in under $50.

The device, which is available now, is a highly integrated 64/256 QAM demodulator with a forward error correction component solution, packaged in a 100-pin PQFP and is DVB and DAVIC compliant. At the end of the second quarter of 1997, Libit will release its LBT4020, which will be MCNS-compliant. Jacob Tanz, Libit's vice president for sales and marketing, says a functional LBT4010C component was on display at the company's suite.

A matter of perspective?

Even though there's been plenty of progress on standards, there are still those who say modem roll-outs are slow, compared to earlier expectations. Cable modem rollouts may not live up to some earlier projections simply because of delays in cable system upgrades, says a new study published by Warren Publishing and written by Michael Harris of Kinetic Strategies. The study, which was compiled from interviews with industry officials, says cable modem service was available to 2 million homes-passed by March 1, and it predicts that cable systems will have 200,000 modem customers by the end of this year, and 1.6 million by the year 2000, increasing to 3.2 million by 2002.

"Cable Modems & High Speed Data Services: Technology, Content & Business Strategies," says that cash flow can turn positive by the third year, based on a pro forma operating forecast for a 100,000-subscriber upgraded cable system.

As for the technical highlights of the study: early trials show few technical problems, with modems being generally reliable, and tests showing little degradation of effective data rate, even with a large number of simultaneous users; and vendors will ship 192,000 two-way modems this year.

New Media Communication and Online System Services (OSS) have announced an agreement to promote high-speed modems made by New Media to OSS clients. OSS, a Denver-based company, develops and markets Internet and intranet products, including high-end, interactive business products. The OSS' Cable Access America business unit is a turnkey product and service package designed to help cable and wireless television operators offer Internet services to their customers. New Media recently signed a $30 million agreement to provide 100,000 modems to wireless LMDS provider CT&T for use throughout the world.

On the actual implementation side, small office/home office users of the Internet in the City of Fairfax this month will be testing high-speed cable modem access via their local cable operator, Media General Cable (MGC).

TCI said it was dramatically accelerating the deployment of digital headends and set-tops

What makes the beta test unique, says MGC, is that it's being conducted over interactive coaxial cable, and the content is being "mass-customized" for the businesses. MGC's cable plant has been interactive since it was installed in 1983. Community Networks Inc., a subsidiary of BTG, is providing a "personal gateway page" which targets the Web sites based on specified user interests.

Internet services

PeRKInet, Internet Ventures Inc.'s high-speed Internet access service, is scheduled for a full launch late this month in a California cable system. The system made its commercial debut on Avenue TV Cable, a 12,000-subscriber system serving portions of Ventura, Calif.

PeRKInet technology uses one 6-MHz RF channel to deliver 120 simultaneous 256 kbps connections to cable customers, and uses an upstream data path via a telephone modem at up to 33.6 kbps, or via an ISDN terminal adapter at up to 128 kbps. An Ethernet interface connects the cable modem to a single computer or a network hub.

Community Networks Inc. (CNI) showcased its new Pulse Internet service for Show attendees. According to Leland Phipps, senior vice president of BTG, CNI's parent company, CNI and Pulse allow cable operators to "make every neighborhood an electronic village." With Pulse, cable operators and their customers can personalize content on the Web, package community content for subscribers and expand MSO branding opportunities as they provide subscribers customized Internet service.

Community Networks Inc. also announced business relationships with five MSOs for cable modem on-line services. Four of the five CNI charter affiliates are in Virginia: Cable TV Arlington, Cablevision of Loudoun County, Media General Cable of Fairfax and Rifkin Associates of Bedford. The fifth charter affiliate is Susquehanna Cable of York, Penn.

Digital set-tops debut

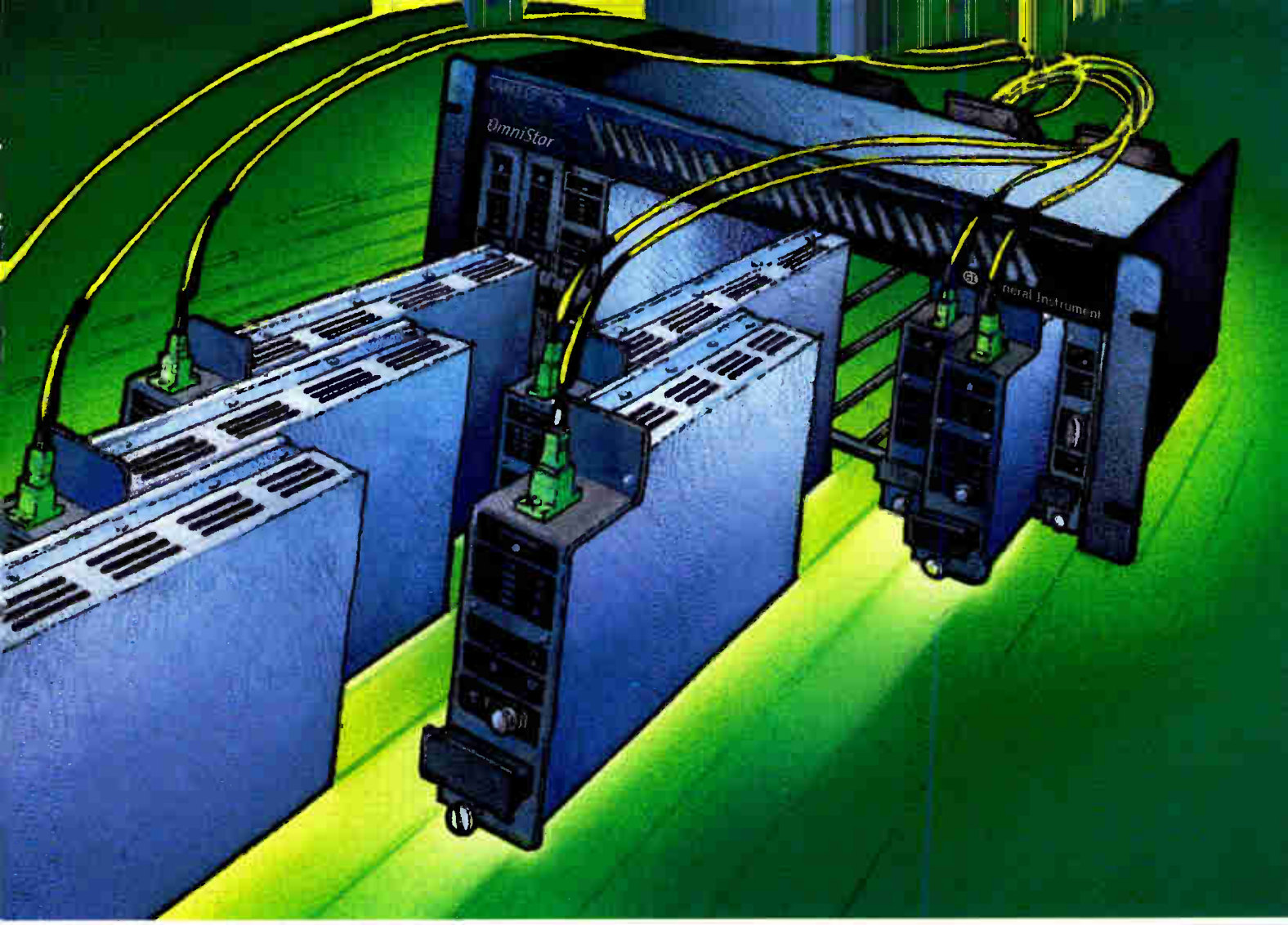
Beyond the data hoopla, news surrounding set-tops dominated. For example, General Instrument's NextLevel Broadband Networks Group debuted two new digital set-tops to round out its family of in-home products, and announced major new commitments to the digital video platform by both Tele-Communications Inc. and TCI's Headend in the Sky (HITS) service.

The new DCT-600 set-top is designed to be an entry-level, broadcast-only set-top that will sell for $50 to $100 less than the DCT-1000 set-top that is already being shipped by GI to customers. Also, GI has developed the DCT-5000, a feature-laden box designed to accommodate session-oriented interactivity that will cost roughly $50 more than the standard set-top. Counting the company's DCT-1200 box, which is based on 256-QAM technology, GI now offers four different digital set-tops to cable and video network operators.

It's the DCT-1000 that HITS is buying to help offer small operators digital boxes and headends at prices they can afford. HITS intends to purchase 500,000 set-tops "for hundreds of CATV headend sites," according to statements made by HITS executives. The purchase order will allow HITS to offer small- and medium-sized operators equipment at discounted prices made possible by a large order.

Meanwhile, TCI said it was dramatically accelerating the deployment of digital headends and set-tops, planning to be able to offer its digital "AllTV" service to 90 percent of its subscribers within the next year or so, according to Camille Jayne, who's in charge of TCI's digital deployment effort. TCI now has the service up and running in three markets to about 800 customers, but plans to turn up service in hundreds of headends in the near future. For competitive reasons, Jayne refused to disclose which systems would be brought up to digital capability and when this would occur.

Finally, GI said it had shipped 24 digital headends to date and had manufactured 200,000 DCT-1000 boxes. Headends have been delivered to TCI, Cox, Comcast, Shaw



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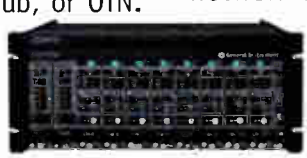

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and seven other operators, according to Ed Breen, president of the Broadband Networks Group at NextLevel.

Breen said that an additional 60 to 70 headends would be manufactured and delivered over the next 90 days, and that the company had added a new headend manufacturing facility in Hatboro, Pa. to meet the demand. Company officials also disclosed that the factory in Taiwan was capable of manufacturing about 75,000 set-tops per month, but that a new production line would soon be turned up to increase capacity.

Joining the fray was Comcast Corp., which announced it will order up to 300,000 digital set-tops from Scientific-Atlanta, with plans to purchase additional units from Pioneer Electric Corp. and Toshiba Corp. Notably, those are the three key vendors also supplying Time Warner Cable with its "Pegasus" digital platform.

A non-binding letter of intent between S-A and Comcast calls for completion of a definitive contract within a month. An initial order for 50,000 of S-A's "Explorer" set-tops kicks off the Comcast purchase. Under the terms of the contract, S-A will supply "up to 250,000 more" Explorer boxes. S-A will also provide headend gear.

Brad Dusto, senior vice president of engineering for Comcast, said that the Explorer architecture lets the MSO leverage its set-top investments in its larger metro clusters. Dusto also said Comcast will begin launching new services on the Explorer platform as early as January 1998.

Meanwhile, after a long, self-imposed nap, Pioneer New Media Technologies Inc. said that after four years of relative inactivity in terms of a set-top plan, the manufacturer is boot-strapping its strategy and wants to become a leader in the advanced analog and digital set-top space.

"For the past three or so years, we've pretty much been asleep, and not responsive to the market–now, we've restructured ourselves into a very different organization," said Jim Slade, vice president of business and product development for Pioneer. "We expect to become a leader in set-top solutions. The time is ripe for there to be a new leader."

Pioneer resurfaced late last year with an order from Time Warner Cable for its "Pegasus" digital video project. Those boxes, named "Voyager," will be ready to ship in January 1998, Slade said. However, no details or information about the box was available at the Show.

Before that, Pioneer will begin testing the advanced analog set-top it unveiled in New Orleans. Called "Entertainer," the new box includes Wink Communication Inc.'s interactive TV engine as a standard feature, as well as real-time return and encrypted security. It will be beta-tested in two unnamed cable systems in June.

Pioneer also formed two new divisions to support the company's new set-top products. The Network Systems Division, based in Salt Lake City, Utah, will initially focus on the development of a new generation of network control systems that are designed to provide a smooth transition from legacy systems, while offering a growth path to next generation advanced analog and interactive digital services. Meanwhile, in Burbank, Calif., the company has formed its new Broadband Applications Division to develop the navigation software for new interactive digital set-tops as well as other application software.

Zenith announced that Time Warner Cable is expanding channel offerings (to 117 channels) and service in its 285,000-subscriber system in San Antonio, Texas with 750 MHz versions of Zenith's MM2500 analog set-top. Claimed to be the largest, real-time, two-way

Pioneer's Voyager Digital Terminal

interactive system in the world, the San Antonio system is expanding its interactive capabilities for opinion polling, system status monitoring and impulse pay-per-view.

In an interesting development that could have widespread ramifications, programs from TCI's Headend in the Sky service were being received on Scientific-Atlanta's digital video system at the Show, a development made possible by a recent agreement between the two companies for HITS to carry programs encrypted with the PowerKey conditional access system.

The letter of intent calls for TCI to support full compatibility of the transmission, encryption and decryption of HITS programming and services with S-A's new Explorer 2000 digital set-top as well as those offered by PowerKey licensees Pioneer and Toshiba, which also feature the PowerTV operating system.

The agreement allows operators who choose to deploy S-A set-tops to receive HITS service. With this agreement, and with the set-top interoperability specification that was recently hammered out by CableLabs, cable operators can choose to purchase set-tops from virtually any manufacturer and not be precluded from offering any specific programming packages.

Divicom Inc., the company providing the insides of the Zenith Electronics Inc. set-tops earmarked for the Americast telco consortium, said it will assist US West Communications in its digital video strategy. Under the terms of the agreement, DiviCom will assist the telco in developing the architectural specifications for consumer set-top boxes and distribution systems.

And finally, there was good news for operators who want to launch digital video services, but don't have the cash to buy digital set-tops for their customers: A leasing program. Itochu Cable Services Inc. said it will "immediately launch" an off-balance sheet leasing program for General Instrument Corp.'s DCT-1000 digital set-top. Participating operators will pay a monthly rate of less than $10 per box, company executives said.

Transmission/distribution

While some of the country's largest cable operators may be putting off some upgrade projects, there are ample signs of life in other, smaller operators. Evidence of that life was shown at the Show when Suburban Cable TV Co., a subsidiary of Lenfest Communications, signed an $80 million hardware deal with full-line supplier Scientific-Atlanta.

The agreement calls for Suburban to purchase S-A transmission equipment over a four-year period, when the entire 18,000-mile Suburban network is scheduled to be upgraded. Suburban Cable presently provides service to nearly 1 million subscribers in southern New Jersey, northern Delaware, and southeastern and central Pennsylvania.

The operator is upgrading to a 750 MHz, hybrid fiber/coax network with return path capability, allowing Suburban to deliver more channels, digital services and other advanced multimedia services. When finished, the network will have 80 analog channels and expansion capability for 860 MHz.

Equipment included in the deal includes 1550-nm externally modulated transmitters and erbium-doped fiber amplifiers for the backbone; 1310-nm transmitters and nodes designed for the distribution network and reverse path; RF electronics that include gallium arsenide integrated circuit technology; and multimedia taps and passives for the drop portion of the plant.

Meanwhile, operators who have been scared away by the high cost of Sonet technology will want to take note of an announcement from Fujitsu Network Communications Inc. and General Instrument Corp. The two companies say that they will work together to provide an

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affordable Sonet (synchronous optical network) backbone solution for cable operators, dubbed "N-Able."

The two companies intend to pursue an agreement that broadens the market reach and applications of Fujitsu's Sonet equipment. The N-Able solution features Fujitsu's Sonet transport and access systems, optimized for cable TV network applications, and coupled with FLEXR and FLEXR Plus network management software.

"The entry into Sonet transport is a natural extension for GI, because it is the ideal technology for transporting the more sophisticated services that broadband operators are offering their customers," said Charles Dougherty, vice president of marketing for GI's Transmission Network Systems business unit.

The N-Able Sonet package complements GI's recently-introduced family of broadcast-quality video codec products, allowing the transport of up to 96 video channels over a single OC-48 link. Specifically, the N-Able package consists of a 2.5 gigabit per second (Sonet OC-48) add/drop transport system, optimized for asymmetrical communications for broadcast video transport. GI officials said the Sonet solution costs only 10 to 15 percent more than a proprietary, uncompressed system.

Also on the transport side, Philips Broadband Networks introduced its new Diamond Link 1550 nm broadband transport system, which provides long-haul trunking alternatives to digital transport applications. Diamond Link accommodates high-split ratio, wide area distribution architectures. With advanced predistortion to 862 MHz, the system provides good channel loading capability to prepare networks for future migration paths, according to the company.

Ortel introduced its digital fiber optic receiver, the first in a new generation of its digital products

In addition, Diamond Link's dual optical outputs accommodate distribution redundancy from a single transmitter. With several transmitter models and a variety of optical amplifiers (EDFAs), operators can easily specify long-range trunking or high-count splitting applications. The transmitters and amplifiers are 1 rack unit high and 19 inches wide, providing flexibility for maintenance and system upgrades.

ADC Telecommunications Inc. introduced its Homeworx 860 MHz, 1310 nm DFB optical transmitters, as well as a new fan and power supply component for use with its Homeworx (HMX) modular equipment shelves. The Homeworx 860 MHz transmitters have been designed to provide increased bandwidth to support additional analog channels or digital services and high RF input isolation, while rejecting unwanted, out-of-band signals. Additionally, each RF input can support the full 50 to 860 MHz operating spectrum.

The company is also making available a new fan and power supply package, HW PSFAN, for its Homeworx modular equipment

shelves. The HW PSFAN offers AC-to-DC powering options, integrated cooling and can power one or two HWX shelves in a single or redundant manner. Each DC output on the HW PSFAN provides -48VDC at 300 watts.

ADC's new CDV3000 system, a new MPEG-2 transmission system, was on display at the Show as well. Designed with encoding and decoding capabilities for multichannel video transport applications, the CDV3000 transports multiple, real-time MPEG-2 video streams over a variety of standards-based networks through an open, scalable and modular architecture.

In a related announcement, ADC said it has developed new pricing packages for its DV6300 single-channel transport system. The DV6300 system supports a large variety of input video signal options, including baseband video, modulated video and telephony/data signals.

Integrated Photonic Technology (IPITEK) introduced the IMTRAN CQ-1, a standalone, single-channel, digital fiber optic transmission system. The new system provides studio quality video and audio transmission in a compact unit. The lightweight, 1 3/4-inch rack-mount unit is designed for "hands-off" operation (no setup or maintenance adjustments). Typical applications include point-to-point or multipoint links for cable television, broadcast and distance learning systems.

IPITEK has also announced a new broadband AM fiber optic transmitter series. The DTX 1310 DFB Laser Transmitter Module is a direct modulation transmitter for a variety of architectures, including narrowcast and broadcast applications. The transmitter has global 862 MHz bandwidth and 110-channel NTSC rating.

The module plugs into the new DTX chassis system, which houses and powers up to eight laser transmitter modules. An optional "hot swap" cooling fan bay assembly is available that mates with the chassis.

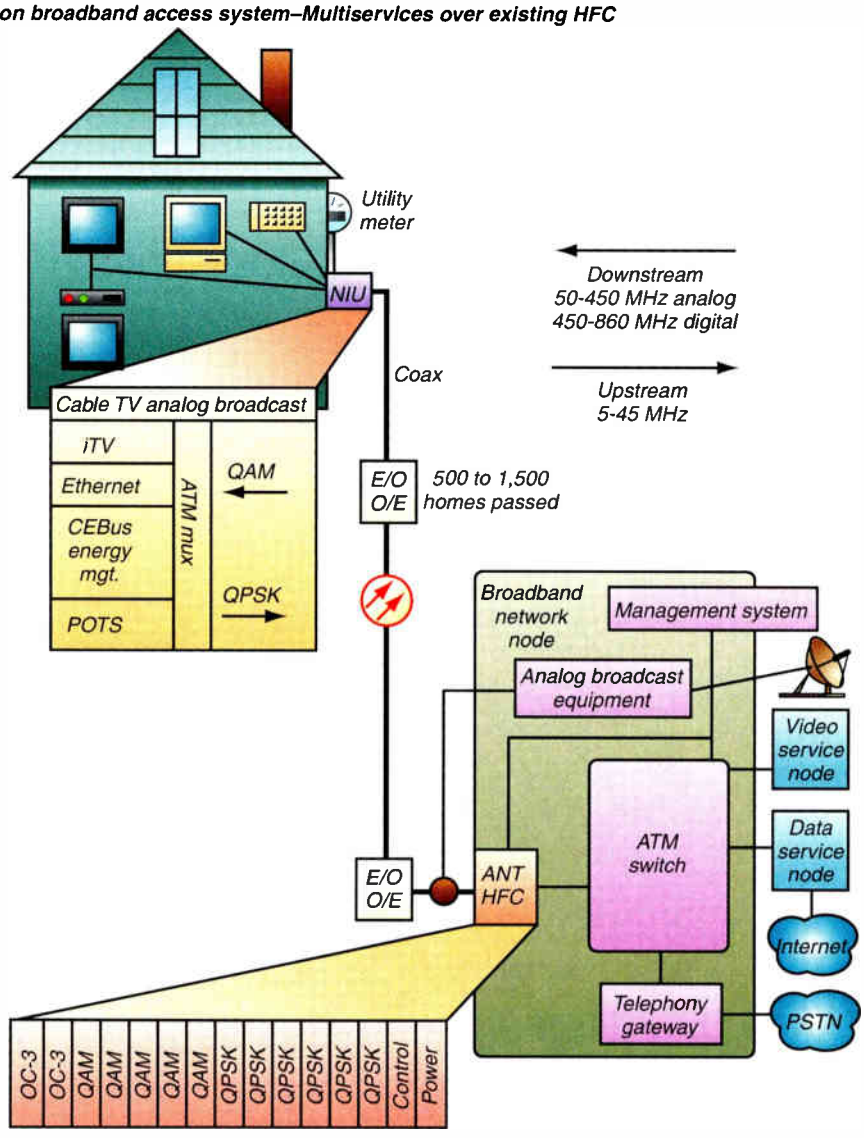
And, IPITEK has introduced a new broadband AM fiber optic receiver. The DRR-9 is a standalone, multi-powered AM optical receiver for mounting in a 19-inch or 23-inch rack. Located at either a headend or a remote site, the receiver is an alternative to outdoor-mounted receivers with bulkier environmentally-sealed and ruggedized housings. It's available with 45-862 MHz bandwidth and is offered with FC/APC, E-2000, or SC/APC bulkhead connectors for ease of installation.

IPITEK has also announced a new fiber management system, consisting of the Fiber Management Chassis, IPITEK multiport modules and bulkhead connector plates. The new system provides modular, secure mounting and protection for fiber optic components, plus high-density termination and routing of fiber optic lines, says the company.

And finally, IPITEK demonstrated a dense wavelength division multiplexing (DWDM) system for use in fiber optic transmission. The demo showed the immediate and practical application of DWDM by combining eight optical wavelengths to transport 80 channels of uncompressed digital video on one fiber.

In the realm of high-speed and high-capacity, Ortel Corporation introduced its OC-48 digital fiber optic receiver, the first in a new generation of Ortel digital products. The new receiver, which combines high-speed photodiode and integrated circuit technology, offers a

Ericsson broadband access system–Multiservices over existing HFC



high performance solution for OC-48 transmission at speeds up to 2.5 Gbps.

The receiver integrates ultra high-speed PIN diodes with GaAs HBT amplifiers to convert digitally modulated light to electrical signals for subsequent recovery of digital information. Operating in the 1310 nm and 1550 nm bands, the receiver's standard configuration is an eight-lead butterfly package with two differential high-speed outputs and a singlemode fiber input.

Ortel also unveiled a new line of broadband laser products–the Platinum Performance Series. The new series includes the Platinum Laser Module, Platinum Plus Lasers and Platinum Premier Lasers. The product series incorporates new packaging designs, product configurations and a wide range of price/performance options.

Amphenol Fiber Optic Products introduced Splice Guard, which has been designed as an alternative to bulky splice enclosures. Splice Guard, which can be installed anywhere fiber optic cables are used, can be assembled in less than five minutes and does not require the use of heat shrink or epoxy.

The company also announced the addition of 1310/1625 nm wavelength division multiplexers (WDM) to its optical product line. The new WDM is based on Amphenol's proven fused biconic taper (FBT) technology. The inherent wavelength sensitivity in the couplers is optimized to produce devices which act as WDMs between 1310 and 1625 nm wavelengths.

Amphenol's FiberGrip connector is the latest addition to its interconnect product line. The connector's unique collet retention mechanism provides reliable, high-performance field termination without the need for epoxy, glues or other adhesives.

The connector exhibits excellent thermal performance and yields an average insertion loss of .25 dB.

Taps and passives, security

Electroline Equipment Inc. says that its new CAT-T addressable splitter units, which provide on/off or two-tier addressable control of up to 64 tap ports, will be commercially available this summer. The new units are part of the company's Compact Addressable Tap (CAT) product family.

Currently, the existing CAT splitters, which each contain FSK data receiver and power supply circuitry, are available in 4-, 8-, 12- and 16-output versions. The new CAT-T units will allow cable operators to increase the subscriber capacity of a CAT unit to control up to 64 drops, without replicating the control and power supply circuitry.

The CAT-T units are essentially slave units which connect to an addressable CAT splitter via its 9-pin "D" connector. Up to three CAT-T splitters may be connected to a CAT.

Electroline also demonstrated its CLEARPath ingress detection system at the Show, a remote ingress location system that can rapidly isolate the source of ingress down to the level of a single drop. When used with the company's SuperTap (an addressable tap), cable TV and telephone networks can automatically identify and disable the source of an interfering signal in the reverse path.

Meanwhile, Lindsay Electronics announced that Time Warner Cable has selected Lindsay's nine-inch LGT Series Advanced Tap and 100 Series Line Passives for its 9,000-mile Raleigh-Durham, N.C. Division upgrade. The design of the upgrade will allow the future expansion of services like two-way data, as well as reduced node sizes, without extensive plant modifications, say Lindsay officials. The taps and passives will be manufactured in Lindsay, Ontario and Rochester, N.Y.

Time Warner Cable has chosen Lindsay's taps for its upgrade in Raleigh-Durham

And Secure It Specialists has introduced a new security device for cable operators who experience J-Box vandalism and unauthorized drop hookups. The J-Vault add-on theft deter-

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rent device and the J-Box enhanced security cover are designed to fit existing junction box enclosures. Installation can normally be performed in about 20 minutes, without interrupting service, says the company.

Cablephone and integrated services

Ericsson executives say the company has developed the technology to deliver multiple services–telephony, Internet access, interactive video, digital cable television and energy management–across existing two-way HFC cable networks, using ATM as the transport mechanism.

Rather than using multiple, standalone modems to implement new services, the system utilizes an integrated network interface unit (NIU) containing an ATM multiplexer, which sits on the outside of the customer's home. "The operator's residential broadband network can now deliver voice, video and high-speed data–all in one box," said Staffan Nilsson, director of broadband for Ericsson.

Last April, Ericsson announced plans to test the integrated system in Cox Cable Communication's Oklahoma City system. Those plans are underway now, said Nilsson. "We'll start turning it up in April, then scale it up to about 50 customers in June," Nilsson said of the project. Cox executives have said they like the approach because instead of paying $1,300 or more for a digital set-top, cable modem and telephony box, they'll pay around $600 for the consolidated Ericsson unit.

Philips Broadband Networks launched its Crystal Line broadband telephony and data system, an access platform that enables HFC network operators to deliver two-way voice and data services, plus traditional video broadcasting.

The platform consists of headend and subscriber equipment, as well as an element management system. Operators can pay as they go, say Philips executives, installing necessary components incrementally, adding or upgrading equipment as subscriber demand, and revenues, increase.

The components of the system enable voice and data services to be delivered simultaneously with video services, supporting on-line services, high-speed Internet access, video conferencing, work-at-home, long distance learning, broadcast video and other interactive multimedia services.

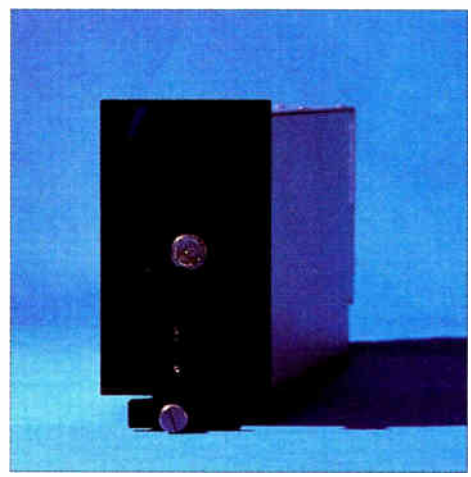
DSC Communications Corp. demonstrated a variety of advanced digital solutions, including its Mediaspan product, a hybrid fiber/coax-based service delivery system, along with fiber optic access for synchronous optical network (Sonet) and synchronous digital hierarchy (SDH) networks.

Mediaspan is designed to integrate with HFC-based infrastructures and provide voice and data services to both residential and business subscribers. It uses discrete wavelet multi-tone (DWMT) modem technology developed by Aware Inc.

Headend equipment

Harmonic Lightwaves Inc., a manufacturer of optical transmission products, debuted a line of new digital headend products. First off the line in the new "TRANsend" family is a suite of quadrature amplitude modulation (QAM) and MPEG-2 encoding gear, putting it in direct competition with incumbents General Instrument Corp. and Scientific-Atlanta Inc., among others.

Harmonic executives described the 64-QAM modulator and MPEG-2 encoder as "second-generation" products, such that many



Harmonic Lightwaves' QAM modulator

key components are spun into silicon. That makes the support of varying standards easier because they are software selectable. The modulator can be configured to meet ITU/SCTE, DAVIC and DVB standards, making it both "future proof" and up to 30 percent less expensive than competing products.

It also supports variable data rates from 1.84 to 52.2 Mbps, bandwidths from 1.1 MHz to 8 MHz and QAM constellation size from four to 256, depending on spectral and carrier-to-noise requirements. The real-time encoder takes an analog input and turns it into a single, MPEG-2 program that is compressed and multiplexed into an MPEG-2 transport stream at an output rate of 2 to 15 Mbps.

Supporting both the modulator and encoder is Harmonic's "video transmission platform," that holds up to 10 modulators or two MPEG-2 encoder modules. Data and control paths among the modules are handled by a bus system in the backplane that reduces the amount of external interconnects and supports data control and exchange transfers, executives said.

Next year, Harmonic expects to debut more digital video compression products, likely to include a statistical multiplexer to rival Imedia Corp. and General Instrument Corp.

Mitsubishi Electronics America Inc. has announced its new Digital Media On-Demand server, which can deliver up to 64 channels of on-demand or broadcast programming, as well as optional channels for menu and interactive services. The server stores audio and video data in MPEG-1 or MPEG-2 and includes 16 on-demand programming channels and eight two-channel MPEG decoders.

Blonder Tongue Laboratories Inc. displayed three commercial digital receiver/decoders to supplement the analog model IRD-6185-RS Video Cipher II RS. The model CDSR-440 DigiCipher II commercial IRD can be used to receive and decode a wide range of DigiCipher II encoded programs available on the C1, C3, C4, G1 and G7 satellites. The unit contains 16 Mbytes of video DRAM, has both high-speed and asynchronous data outputs, cue tone output and has one audio and one video output.

The model CDSR-4500 has all the features of the CDSR-4400, plus some additional outputs. A second audio output allows transmission of programming in two languages. A second video output allows the OSD information to be displayed on a monitor at the headend without interrupting video service.

The model CDSR-6197 supports the commercial reception of digital video programming from the Echostar satellites. The single-rack-space unit features a menu-driven LCD display and interfaces for remote PC control.

SkyConnect announced that it has reduced prices for the Mediaplex system, due largely, says the company, to the introduction of the SC 4-Plus, the company's new four-channel combined switch/decoder.

This newest member of the model HE 240 is fully compatible with the current product and also provides up to 40 channels in one rack. For customers that have an installed Mediaplex system, the HE 240 can be integrated with the existing headquarters system and MPEG-2 encoder to provide digital capabilities to additional headends in a region.

In a contract announcement, United and Philips Communications b.v. (UPC) has selected the SeaChange International Inc. Movie System for multichannel pay-per-view services for its cable television systems in the Netherlands and Austria. The two installations will be at A2000 in Amsterdam and Telekabel in Vienna.

The $1.6 million contract calls for SeaChange to provide UPC with two Movie Systems, which are fully-integrated video server-based systems for the delivery of long-form video onto cable television channels.

Syntellect Inc. was at the Show with an "interactive Web response" platform, designed for high-volume transaction processing on the Internet. Syntellect executives said the server handles transactions including pay-per-view ordering, appointment scheduling, premium channel additions and other types of transactions that require billing systems integration.

"The Internet provides customers with a distinct advantage over the telephone, because of its visual interface," said Roger Reece, vice president of marketing for Syntellect.

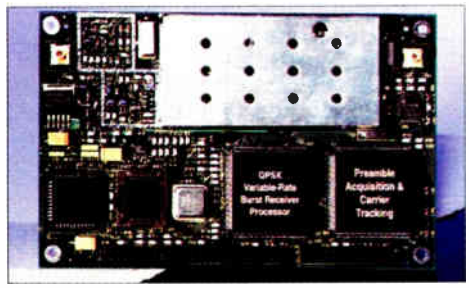
Cadix International Inc. announced a PC-based CAD system for fast design of both fiber and coaxial cable TV systems. The CX-P21 "Light Speed Design System" software is a network mapping and modeling solution for cable operators of various sizes. The beta version was available for viewing at the National Show. Cadix markets the CX-2001 v3 for RF, telephony and fiber on an HP Unix platform.

Using the system, cable operators can design a plant depicting fiber routes, trunk and feeder lines, taps, splicing charts and unused or "dark" fiber. The first Windows 95 and Windows NT release of the product, available this spring, focuses on designing new fiber optic systems or rebuilds. The second release will incorporate RF design and fiber design into a single module.

Also, FrontLine Communications announced that it was selected by DiviCom to supply key components to a digital Emergency Alert System. The Frontline EAS system will interface to DiviCom's digital broadcast systems, allowing digital cable and wireless services to meet upcoming new EAS requirements.

Designed around FrontLine's All-Channel Message system, the new equipment will take EAS data that is received on standard EAS receivers and decoders and pass it to the ACM gear, which will insert text and/or audio messages on specified channels. EAS text messages are sent to DiviCom's broadcast system and decoded by the set-top.

General Instrument Corp.'s NextLevel Satellite Data Networks Group used the Show to announce its REMUX remultiplexing module, an addition to the Magnitude DVB Encoding System, which enables real-time, all-digital mixing and editing of MPEG-2 compressed signals. The module is being offered as a plug-in addition to the standard



Stanford Telecom's STEL-9257

Magnitude DVB encoding system.

GI also introduced StatMuxPlus statistical multiplexing software, a new package for the Magnitude DVB Encoding System which increases bandwidth capacity by 67 percent, according to the company. Cable MSOs or satellite broadcasters can now send 10 broadcast quality channels in a 27 MHz transponder, or 6 MHz cable channel, respectively.

Stanford Telecom introduced its new generation board-level demodulator receiver for very small aperture terminal (VSAT) systems. The STEL-9258 offers variable data rates, which allow VSAT systems to operate at the lowest possible bandwidth, and provide for system expansion by eliminating the need to exchange one fixed data rate receiver for another when data rate requirements increase.

Customer premise equipment

Suddenly, interdiction is becoming fashionable. For its part, Scientific-Atlanta Inc. has announced a new line of four- and eight-port, 750 MHz Addressable Interdiction units.

Interdiction units eliminate the need for most analog set-top terminals by delivering premium, pay-per-view and tiered services directly to customers with cable-ready TV sets.

For cable operators, addressable interdiction facilitates the introduction of new service tiers, promotes penetration of premium services, reduces the number of home service and repair visits, provides improved signal security, eliminates most set-top losses from theft or damage and improves customer satisfaction, says S-A.

The new four-port interdiction unit is designed to serve up to four subscribers, while the new eight-port is primarily for multiple dwelling units. Both models feature a wider forward bandpass of 750 MHz, and an expanded 5-40 MHz reverse path.

Blonder Tongue has developed a multiple dwelling interdiction unit for its VideoMask Interdiction System. The unit is available in 8-, 12- and 16-port configurations and is housed in a rugged, outdoor steel enclosure. It is suitable for wall mounting and includes a backing plate for quick installation. A removable bottom panel provides easy access to connections and subscriber drops, and room has been provided for directional couplers for system designs requiring cascaded MDU interdiction units.

OSS/network management/monitoring

Integration Technologies and Superior Electronics Group Inc. announced a partnership and joint marketing agreement to support an integrated operational support system (OSS) infrastructure for hybrid fiber/coax (HFC) networks. Under the agreement, the two companies will build an interface between Superior's CheetahNet network monitoring software and Integration Technologies' "model.it" system.

CheetahNet provides performance and fault domain solutions for monitoring and analysis of audio, video and data services in an HFC environment. Integration Technologies' model.it provides end-to-end physical network management and engineering for HFC broadband networks.

Cox Communications Inc. said it has chosen Superior Electronics as its equipment supplier for monitoring HFC plant at nine Cox locations in the U.S. Superior will provide integrated hardware and software solutions for monitoring headends, power supplies, fiber nodes and ends-of-line. The company's CheetahNet software will run on Unix and NT platforms and will provide status and performance monitoring applications.

The Cox systems that will be installing Cheetah monitoring systems include San Diego and Orange County, Calif.; Phoenix, Ariz.; Oklahoma City, Okla.; Omaha, Neb.; Hampton Roads, Va.; the New England area; metro New Orleans; and Pensacola/Ft. Walton, Fla.

Electroline Equipment Inc. displayed its new CLEARPath Network Management System (CNMS) during the Show. The CNMS controls operations of the CLEARPath remote ingress system, and guides terminal operators through searches of cable television or telephone company HFC plant for unwanted signal interference.

The CNMS, which runs on a standard Windows PC, includes such features as on-line control of remote switches, computer-aided search process for terminal operators, on-screen display of network elements, and on-line work order and report generation. The new system will be available for commercial release in mid-April 1997.

Philips Broadband Networks and AM Communications said they will jointly develop and deploy an advanced network management

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C ❑ **Engineering Management:** Corp Engineer, Sr Engineer, VP Engineering, Engineering Director/Supervisor, Chief Engineer

D ❑ **Technical Management:** Director Technical Operations, Chief Technician, CO System Manager, MTS, Installation Manager/Supervisor, Tech Supervisor

E ❑ **Engineering:** Engineer, Staff Engineer, OSP Engineer

F ❑ **Technical:** Headend Tech, System Tech, Line/Bench Tech, Technician, Installer

G ❑ **Other** (please be specific) _____

❸ What is the approximate dollar value of the annual budget you are responsible for? (check only one)

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❑ d. 100,000 - 250,000 ❑ e. 50,000 - 100,000 ❑ f. less than 50,000

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Telecommunications Operations

❑ 2a. Local Telephone Co. ❑ 2b. Regional Bell Operating Co.

❑ 2c. Long Distance Telephone Co. ❑ 2d. Cellular Telephone Co.

Others Allied to the Field

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❑ 4. Cable TV Equipment Manufacturers and Distributors
❑ 5. Cable TV Investor, Financial Institutions, Brokers, Consultants
❑ 6. Cable TV Network
❑ 7. Telecommunications Consulting Firms
❑ 8. Telephone Equip Manufacturers and Distributors
❑ 9. Data Communications (Systems Integrators, Software Development,Service Provision)
❑ 10. Data equipment manufacturers/distributors
❑ 11. Wireless Operations
❑ 12. Wireless Communication Operations (Cellular, PCS, Mobile Communications)
❑ 13. Wireless Video Operations (MMDS, LMDS, MDS)
❑ 14. Commercial TV Network
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❑ d. Distribution Equipment ❑ e. Headend Equipment ❑ f. Contractor/Construction

Telecommunications Equipment

❑ g. Network Management Systems ❑ h. Test Equipment

❑ j. Operational Support Systems ❑ k. Switching Systems

❑ l. Transmissions/Outside Plant Equip. ❑ m. Other Telecommunication Equip (Type)

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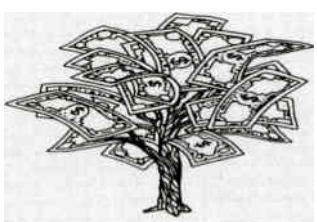

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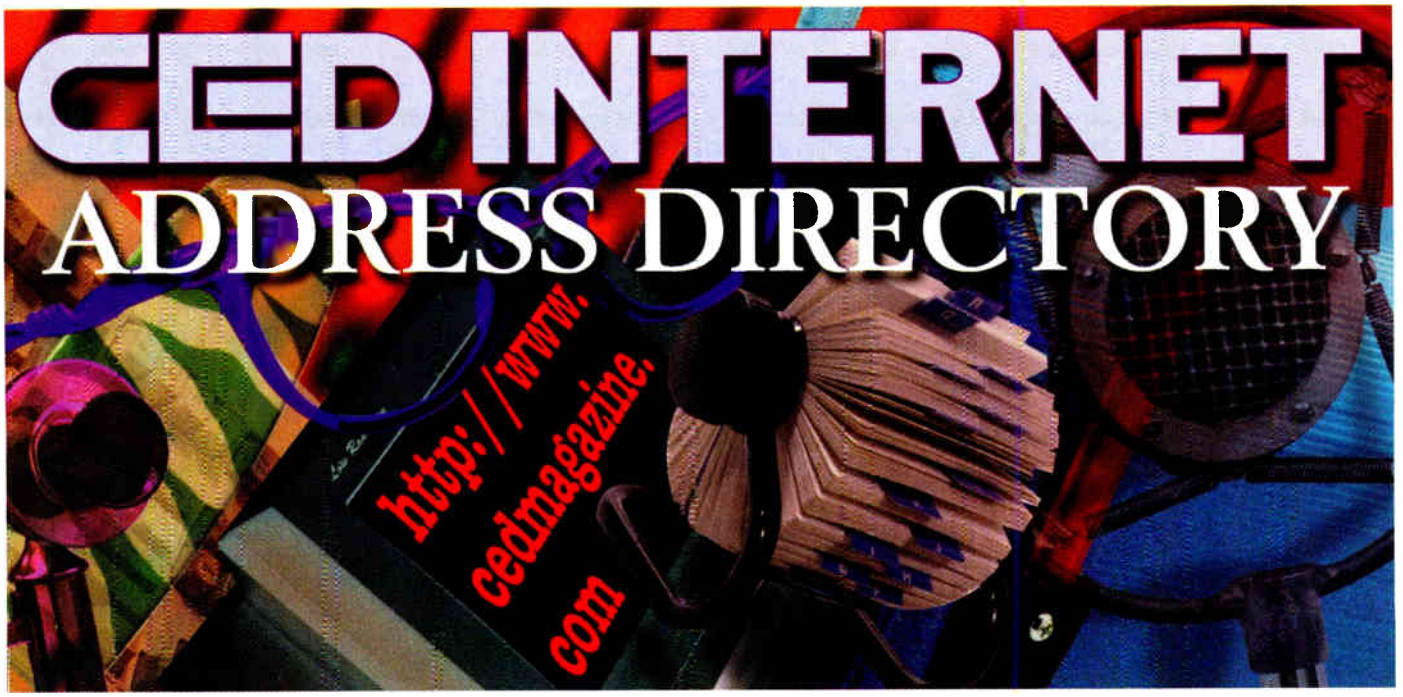

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system throughout the integrated voice, video and data network owned by Telstra of Australia.

The "Diamond Diagnostics" element management system utilizes AM Communications' OmniStat technology for transmission equipment, as well as a higher-level domain management system, which monitors and controls all systems and services on the HFC network.

When fully deployed, the network management system is expected to manage more than 50,000 transponders. Telstra's network build-out is scheduled to be completed in 1999, with six headends, 6,200 miles of plant and passing four million homes.

AM Communications also announced the availability of monitors for the General Instrument Star Gate 2, BLE and Minibridger products utilizing the FlexStat design module. The new transponder technology is compliant with the OmniStat element management system, and provides industry essential functionality such as frequency agility, downloadable protocol and application specific software.

The FlexStat module is a business-card-sized unit which contains all the circuitry required to perform common status monitoring functions. The FlexStat module core includes advanced features such as frequency agile RF modems, downloadable firmware and programmable I/Os.

Billing and subscriber management

CSG Systems Inc. was on hand to preview Phoenix, its new customer care and billing system. The system, under development for three years, enables communications providers to offer new products and services, package and price these services, handle multiple delivery networks, and cross-sell to existing customers through targeted marketing efforts.

The system utilizes a three-tier, client/server, Unix-based architecture with a layered software architecture and the Oracle relational database. The three-tiered architecture, says John Martin, Phoenix project leader, consists of "the database as the bottom tier, the desktop and end-user on the top tier, and the middle tier is a transaction processing monitor called Tuxedo." The system will also be configured with a graphical user interface in multiple languages.

CSG's Phoenix is currently in beta testing with Continental Cablevision, with a pre-production release planned for the second quarter of 1997, and a fully operational version scheduled for the following quarter.

Wiztec Solutions Ltd. and its U.S. subsidiary BSI Systems Inc. unveiled the client/server version of the WIZARD subscriber management and billing system. The new solution is geared toward providing scalable solutions to cable, wireless and direct broadcast satellite operators by incorporating advanced transaction processing functionality. Based on a client/server approach, the new system uses an open systems architecture and offers an intuitive GUI (graphical user interface), says Wiztec. In developing the WIZARD client/server, Wiztec utilized the Unix operating system, Oracle database and compilers, working in the X-Open standard.

International Billing Services (IBS) demonstrated a new statement delivery technology at the National Show–electronic billing capabilities via the Internet. The technology allows IBS to receive end-user account activity information from communications service providers' various data streams and create electronic statement templates.

The demo delivered subscriber info directly to field installers and techs

CBIS (Cincinnati Bell Information Systems) announced the implementation of customer care and billing support for Time Warner's offering of broadband on-line service and Internet access via high-speed cable modems.

CBIS is providing its CableMaster 2000 Subscriber Management and Billing Solution to support Time Warner's Road Runner service in the Akron-Canton, Ohio market, which has 330,000 homes ready for cable modem installation. The CableMaster 2000 utilizes a fully integrated, on-line, real-time relational database, giving all functions and departments the ability to update and access data at all times.

Workforce management

Arrowsmith Technologies introduced Fleetcon 2.1, a new release of its existing workforce management software solution, at the Show. The new functionalities introduced with this release include automated routing, regionalization, work order modification and signature capture.

The automated routing function uses computer-aided dispatch algorithms which automatically choose the most efficient routes for installation and service calls. David Musser, manager for product marketing, said this function can route as many as 1,000 work orders in less than five minutes. Regionalization offers efficient, real-time use of centralized and distributed dispatch operations by consolidating multiple dispatch sites into one or more that manage all regions collectively.

The work order "modify-lite" function enables field technicians to add, delete or modify service information on work orders while in the field, without calling into dispatch. With this capability, technicians can sell additional services while in the customer's home and input data directly into the handheld terminal for quick processing. Musser said the company is developing an even more complete modifying function for later release.

The signature capture function is a feature that allows customers to sign directly onto a technician's handheld mobile computer for work completed, which reduces the need for paper work orders. Musser said operators can have their franchise agreements amended so that such electronic signatures can be accepted for other transactions. With that, technicians could complete sales for new services in the field.

Alliance Systems Inc. displayed its latest family of inter-networking software products during the Show. With Alliance's RM System software, operators can link dispatch operations wirelessly to field resources to streamline management and tracking processes and improve field productivity and communication.

The RM System software package can be set up in a Windows-based format that is installed on mobile, pen- or keyboard-based terminals from a variety of vendors, including Motorola, Norand, Itronix and Telxon. Service personnel can log into the RM System from their mobile data terminals to report on jobs completed, on service troubles or to learn of new job orders or emergencies. All information goes into the system in real time. Service personnel can even trigger an automated phone call to their next service call to make sure the client/subscriber is at home.

CableData, teaming with AT&T Wireless, Mitsubishi Wireless and Unwired Planet, demonstrated TechConnect–an extension of CableData's customer care software. The demo uses the Internet, along with Web browser display technology developed by Unwired Planet, CDPD technology such as that of AT&T Wireless, and Internet-enabled cellular phones like those provided by Mitsubishi Wireless, to deliver subscriber information directly to field installers and techs.

With TechConnect, field personnel can view, in real time, pending jobs, customer account information, subscriber services, account history, etc. CED

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A role for ATM in managing local traffic?

Answer elusive as alternatives grow

PHOTOGRAPH BY JOSE FUSTE RAGA, THE STOCK MARKET

By Fred Dawson

Cable and other competitors to the local exchange carriers are at a crossroads when it comes to choosing how they will interface their networks with the networking world at large. In a nutshell, the question comes down to figuring what role, if any, ATM (asynchronous transfer mode) should play in managing local traffic. At a moment when the answers should be getting easier, they appear to be getting harder.

"There has been a religious-war-like quality to the discussion about ATM," said Mario Vecchi, senior vice president of network technology for Time Warner's Excalibur group. While the war is far from over, he added, the cable industry must approach its data network buildouts one stage at a time, taking care to ensure that, as "the bubbles continue to grow," the local data backbone linking hubs to headend servers and routers can handle the volume requirements.

This could well mean selecting a new technology like IP (Internet Protocol) switching or tag switching to support efficient interfacing of routers with ATM networks in the long-haul carrier domain, Vecchi said. But those technologies are still in flux, and, in many cases, operators need to make decisions now, especially when it comes to linking hubs and headends.

"There are decisions directly affecting scaling up the networks that are hard to make without knowing whether we're ultimately going to ATM," said another engineer at Time Warner, asking not to be named. "You can err on the side of conservatism and stay with FDDI (fiber data distribution interface) while the protocol stack is sorting itself out, but you risk running into Quality of Service problems if you get good market penetration of the service."

Many MSOs are avoiding making the choice by limiting their rollouts to single hub service areas. But it's likely they'll have to commit to interhub data trafficking techniques long before the ATM debate is resolved.

On one side of the war, telcos, which have driven ATM as their preferred design solution to marrying public switched and data networks since the late '80s, now believe ATM is in shooting range of becoming cost effective end-to-end. As a result, they are deepening their commitments to the cell-relay switching technique as they prepare to use DSL (digital subscriber line) technology to tap the mass market potential for data services.

But, at the same time, ATM is becoming a focal point of disappointment and contention within the data community, despite early successes in "edge" applications that distribute data traffic across multiple networks within a single corporation. "The ATM market is up in the air today," said Jennifer Pigg, vice president for data communications at The Yankee Group, one of many speakers noting this fact at the recent ComNet conference.

The issue of what role ATM is going to play in data communications has been center stage at major shows devoted to enterprise networking, where publicity surrounding new options like gigabit, IP and tag switching signal that ATM has yet to gain ascendancy in the datacom market. "This is the first year we've heard so much gloom and doom about ATM, which is especially noteworthy after so many years of upbeat predictions," said Frank Dzubeck, president of Communications Network Architects Inc., a consulting firm.

Pigg cited a failure of multimedia to take off in the corporate LAN (local area network) domain as one reason for the uncertainty. Moreover, the failure of carriers to push ATM as a voice as well as data switch, as opposed to being a mere aggregator of combined traffic or a router of data traffic only, has hampered its usefulness as an integrator of circuit voice and data traffic at the LAN level of business operations.

"Voice is not a good idea over ATM at this point," Pigg said, adding that this will change once next-generation ATM protocols are resolved, and carriers implement the advances in new switches. "Carriers are rethinking their approaches to solutions for data traffic at the edge, in the core and on the global level," she said.

Many people charged with building national data networks believe there are means and the facilities in place to exploit them that can meet their trafficking requirements cost-effectively without moving data through switches. As a result, they contend the business end-user market will not be drawn to ATM equipment,

choosing instead to build on the embedded base of Ethernet and other widely-used data network protocols. This, in turn, will make ATM unnecessary for the consumer market as well, they say.

"I predict we never will see ATM as an end-to-end solution," said Milo Medin, senior vice president of technology for @Home Networks, speaking at a recent conference on bandwidth solutions in San Francisco. "Fast Ethernet is eating ATM's lunch in the enterprise market, and gigabit Ethernet is going to have it for dessert."

Coming from a man who, two years ago, spoke exuberantly of building a national ATM network to bypass Internet bottlenecks, Medin's comments suggest the new infrastructure design ideas sweeping through the data networking community may be cause for serious rethinking of migration strategies in cable. But drawing too firm a line right now based on current falterings of ATM risks ignoring several significant trends, including the growing support for ATM as an end-to-end solution in the telephone industry, as well as technical solutions that promise to make ATM a better choice over the next year or two.

Clearly, ATM, as a vehicle through which the telephone companies draw the data transport business of the enterprise sector, is already a pretty good working engine offering cost-competitive alternatives to private networks in the wide area backbone, which is why analysts have given it strong support. But that doesn't mean it's a viable solution for most companies, said Christine Heckers, vice president for broadband services at TeleChoice Inc., a consulting and research firm.

"The ATM services that are out there work very well and are affordably priced in terms of carrier rates and costs of equipment," Heckers said in a ComNet presentation to business managers. "But unless you are prepared to make a very strong investment in human resources and time on your staff to train people to adapt to ATM, you should stay away from ATM, this year and probably next."

That's a long way from saying "never" to ATM to the desktop. Or to the home, especially if, as Nynex, Bell Atlantic, SBC Communications, Ameritech and other telcos believe, the cost curve for ATM to the home is pointing toward deployment within the next two years, possibly as early as a year from now.

Those who claim ATM end-to-end will not be practical anytime soon "are operating on outdated assumptions," said Tom Eames, co-president of General Instrument Corp.'s NextLevel Communications, which is soon to be the name of the reconstituted and spunoff GI Communications unit. NextLevel recently was named supplier for Nynex's planned deployment of switched fiber networks, which envisions use of ATM all the way to residential premises.

"When you get down to 0.5 and 0.35 micron silicon technology, the cost penalty for deploying ATM all the way to the customer premises goes away," Eames said. Within a year, he added, the circuitry in the ATM chips will be reduced to 0.25 micron dimensions, which will cut chip costs by a factor of four.

"What was once a $40 problem becomes a $2 or $3 problem, and, in two years or so, becomes a 50-cent problem, which is no problem at all," Eames said.

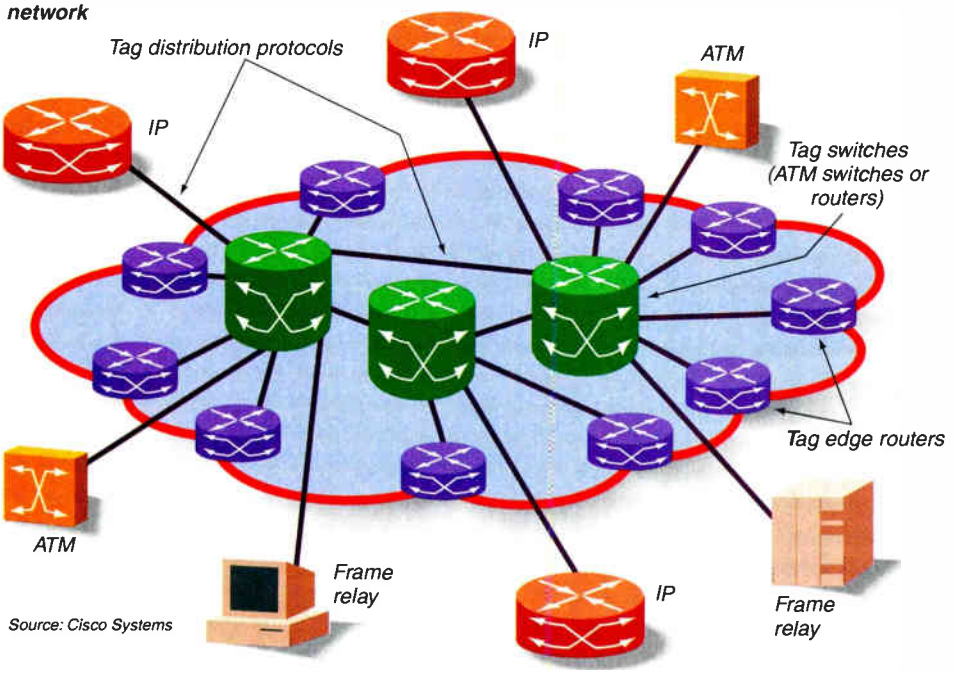
Like Bell Atlantic, which recently announced plans to build switched fiber networks starting in Philadelphia this year, Nynex plans to position itself for delivering broadband services by installing fiber loop systems that derive immediate cost benefits on the telephony side, starting in the Boston area by the end of the year. Assuming the technology performs as expected, Nynex will be in a position to easily add video and high-speed data services by inserting ATM circuit cards at the broadband digital terminal in the central offices and at the ONUs (optical network units) in the field, officials said.

But Nynex has not issued an RFP for ATM switches, which would be required to support the move to full service over the fiber networks, said Walter Silvia, vice president of broadband at Nynex. He noted the company would also have to select a video software system for supply of that type of service over its fiber networks.

"We don't have a (broadband services) market trial planned at this point, but we'd expect that, over time, we would conduct such a trial before moving forward," he added.

The facilities topology used in the NLC system entails extension of fiber to ONUs serving eight or 16 subscribers, with a hybrid drop consisting of a coaxial cable and two twisted-pair copper lines extending to each household or business from the ONU. In the

Tag switching in a multiservice network



Source: Cisco Systems

broadband mode, signals are delivered to the ONU in a 155 megabit-per-second (OC-3) Sonet stream from the broadband digital terminal (or host digital terminal, as it is more commonly referred to), which can be located at the central office or in a remote terminal or hub.

For broadband applications, signals are all mapped to the 53-byte cell of ATM and converted at the set-top, telephone or PC interface to the native device protocol, Eames said. "We load the TDM (time division multiplexed) traffic as well as data and digital video into the ATM cells and broadcast them to all devices in the home," he explained. The ATM throughput is based on the 51.84 Mbps data rate endorsed by DAVIC (Digital Audio Video Council), he added.

NLC plans to make available an ATM-based network interface card for PCs to avoid the process of converting the ATM signal to Ethernet protocol, noted Peter Keeler, NLC's other co-president. "We dedicate up to 19 Mbps per customer in the upstream," he added.

Given the telephone industry's recent swings from one network topology to another, there's no certainty that, this time, the plans will be executed as described, although Bell Atlantic officials reported construction on that carrier's FTTC installation in Philadelphia has begun. But the consistent theme, no matter which topology is the flavor of the day, remains ATM.

For example, while FTTC deployment is barely getting started, DSL (digital subscriber line) technology, delivering high-speed data at various rates over twisted-pair copper lines, has a shorter time-line and a bigger head of steam at this point, with most carriers saying they'll begin offering commercial DSL services this year. And, in many cases, the transport format of choice is ATM.

The universality of the ATM factor is much more important to the pace of telco broadband rollout than the differences among topologies, noted a consultant working with americast, the video venture involving Ameritech, BellSouth, SBC Communications, GTE Corp. and SNET Corp. "If you look at what the partners are doing (from a facilities standpoint), you can say they're at odds with themselves with a lot of different strategies," the consultant said, asking not to be named. "But ATM is the way they get to cross-platform scales of efficiency in terms of overall integration and service profiles, and we feel that's moving ahead very well."

Perhaps the biggest threat to ATM is the emergence of IP switching schemes that would allow data networks to interface efficiently with ATM-switched networks without forcing users to abandon the cost efficiencies of using IP to build functionality into their Intranets. IP and tag switching, developed, respectively, by Ipsilon Networks Inc. and Cisco Systems Inc., use simple protocols to identify and dynamically find long flows and put them in virtual circuits in front of an ATM switch, thereby exploiting ATM backbone efficiencies while preventing penetration of ATM beyond the private network edge.

"The hardware of an ATM switch is about 10 times faster in terms of just raw bits through the box as it is for a router, typically at perhaps half, down to a fifth of the price, depending on the features you want," said Larry Lang, vice president for product management at Ipsilon Networks Inc., the first to introduce IP switching. "Unfortunately, that ATM hardware is buried under a lot of ATM software with a lot of jargon attached."

Cisco Systems' tag switching variation on the IP switching theme is especially appealing to many cable operators, given the substantial penetration of Cisco 7500 routers in the cable data networking infrastructure. The system uses message tags rather than direct insertions into the IP header to identify flows and put them on virtual circuits at the router. As with IP switching, this avoids the lookup process at other routing points while allowing ATM switches to participate at the layer 3 routing level.

"Tag switching will allow us to do edge-based source routing, which allows us to use IP and ATM in a single network much more intelligently," said Paul Bosco, director of broadband infrastructure and service development at Continental Cablevision. "By some time (this year), we'll have to get beyond the DS-3 limitation at the edge of our network, which means moving to the next generation router with or without ATM."

But tag switching, like the other proposed solutions, is in flux, with vendors at loggerheads over achieving the standardization that is essential to widescale market acceptance. In February, IBM, 3Com Corp. and Cascade Communications lined up behind Ipsilon's IP switching in an effort to thwart Cisco, which could lose its dominance of the router business if IP is chosen over tag switching.

And even greater uncertainty surrounds gigabit Ethernet switching, which, unlike options like IP and tag switching, would supplant ATM altogether with devices that match ATM's raw throughput speed while retaining the native Ethernet format in the backbone. Gigabit switches won't be available until late this year at the earliest, and another great standards debate looms before the market will see an interoperable multivendor solution.

It's true that "ATM standards are moving slower than a senatorial debate on C-Span," acknowledged Roger Kosak, industry solutions project manager for IBM and chairman of the ATM Forum's network management working group. But, he added, that's because getting software to do all the things everybody is looking for in ways that meet everyone's specific requirements is tedious.

"There are still a bunch of competing proprietary solutions out there," Kosak said, noting that IBM's backing for IP switching in no way represents a loss of support for all-ATM solutions. "I'd submit to you that for (IP switching) to be a viable technology, it's going to take a little time to figure out how to really do Quality of Service and make it work right for all the people that want to implement the technology."

Telcos are gambling the headstart for ATM and the mass market base they can build to drive chip costs ever lower will translate into an end-to-end broadband solution that is ideal for their networking environment. Betting against them and the use of ATM in the cable modem environment translates into a bet on the ability of the datacom world to standardize on alternate solutions.

It may be a good bet, but it's not as sure as some data pros might make it out to be. CED

The issue: Data over cable

It's the hottest issue on everyone's agenda: Deploy high-speed data services to compete with the telcos and to differentiate from the satellite broadcasters.

But to date, roll-out has been relatively slow. When will that change? Give us your opinion.

The questions:

1. Are you either testing or implementing high-speed data services over your cable system?

❑ Yes ❑ No ❑ Don't know

2. If not, do you expect to test or roll out such services within the next 12 months?

❑ Yes ❑ No ❑ Don't know

3. Do you intend to offer a service with local content, such as @Home, RoadRunner or something similar?

❑ Yes ❑ No ❑ Don't know

4. If so, do you intend to develop that content yourself, or work with a service provider to gain access to that content?

Develop it ❑ Work with someone ❑ Don't know ❑

5. How familiar are you with the MCNS group and its efforts to standardize cable modems?

Very ❑ Somewhat ❑ Little ❑ Not ❑

6. How much of your cable plant is presently two-way active?

100% ❑ 75-99% ❑ 50-74% ❑

25-49% ❑ Under 25% ❑

7. Do you have plans to significantly increase the amount of plant that is two-way active this year?

❑ Yes ❑ No ❑ Don't know

8. Do you think you can roll out high-speed data services faster than the telcos can offer ISDN or xDSL services?

❑ Yes ❑ No ❑ Don't know

9. What do you think will be the major obstacle for cable operators who want to offer high-speed data services?

❑ Two-way activation ❑ Cost of modems

❑ Standards ❑ Return path noise ❑ Other

Your comments:

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Official rules: No survey response necessary. Enter by returning the completed survey via fax or mail to the locations indicated above, or print the words "CED Return Path" on a 3"x5" card and mail it along with your name, address, daytime phone number and signature. To be eligible for the drawing, entry forms must be received by 5 p.m. on May 31, 1997. 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 June 1, 1997. Winner will be required to provide his/her social security number and proof of identification and is solely responsible for all federal, state and local taxes incurred. Prize is not transferable to any other person. Sweepstakes participants agree to waive any and all claims of liability against CED magazine, Capital Cities Media Inc., Capital Cities/ABC Inc. and its affiliated and independent contractors for any injury or loss which may occur from participation in this sweepstakes or receipt of the prize. Winner consents to publication of his/her name for publicity purposes without further compensation. Participants must be 18 years of age or older. Employees of CED magazine, Capital Cities Media Inc., Capital Cities/ABC Inc. and its affiliated and subsidiary companies, and their respective employees, agents and independent contractors, and their immediate families are not eligible to participate. Void wherever prohibited, license required, restricted or taxed by law. Sweepstakes sponsors reserve the right to change or modify the sweepstakes rules while the sweepstakes is in progress. Participation in the sweepstakes constitutes acceptance of all sweepstakes rules.

RESULTS

The issue: 1997 construction plans

This coming year promises to be exciting, as MSOs begin to prepare their networks for real competition in the local loop, whether it be video only, high-speed data or telephony services. DBS has already made a dent in some operators, and the telcos are gearing up for some fights, especially in Los Angeles. This survey asked cable operators what steps they are taking to compete in this new environment.

As expected, a large majority of those who responded do have a significant network upgrade planned or already underway, primarily to add bandwidth, new headend electronics and fiber optic technology. A large percentage are also firing up the return portion of the plant, as well as adding network telemetry. Fewer are actually adding telephony or data services yet, but a wide majority report that their companies are keenly interested in doing so.

The size of the rebuilds varies in scope and cost (with most being under 100 miles or over 250 miles, and most costing between $1 million and $5 million), but most are planning to install either 550 MHz or 750 MHz equipment in order to make room for more video channels.

Finally, few are presently rolling out digital compression gear, which would allow them to dramatically increase the number of channels they're offering. In fact, a majority say they have no current plans to ever roll out digital, owing perhaps to the high cost of the equipment, and that it's unproven in the marketplace.

Congratulations to Laura Montagano of Continental Cable in Jacksonville, Fla., who won $50 just for sending us her thoughts. To become eligible for a future drawing, fill out the survey on the other side and fax it in!

The results:

1. Does your system have a significant plant upgrade planned for 1997?

Yes	No	Don't know
77%	**8%**	**15%**

2. If so, approximately how much money will be expended to perform the upgrade, not including labor?

Less than $1 million	$1 million to $5 million
30%	**70%**
$5 million to $10 million	More than $10 million
0%	**0%**

3. What will the upgrade consist of? Check all that apply:

Bandwidth expansion	Addition of fiber optics
85%	**69%**
Activation of two-way plant	Status monitoring
38%	**23%**
Digital electronics	New headend equipm't
15%	**77%**
Phone over coax	Data over cable
15%	**31%**

4. If your system plans to expand bandwidth, what type of electronics are you planning to purchase?

550 MHz	750 MHz	1 GHz	Other
31%	**54%**	**0%**	**15%**

5. How many miles of upgrade are you planning to do in your system this year?

Under 50	50 to 100	100 to 250
25%	**33%**	**17%**

More than 250
25%

6. Why is your system being upgraded?

Franchise requirement	Need more channels
18%	**72%**

Competition	New services	Other
26%	**49%**	**11%**

7. Does your system intend to roll out digital compression to customers in:

1997?	1998?	Later?	No current plans
8%	**15%**	**23%**	**54%**

8. How interested is your system in providing high-speed data and Internet services?

Very	Somewhat	Not interested
54%	**31%**	**8%**

9. How interested is your system in providing telephony services over the coax plant?

Very	Somewhat	Not interested
31%	**38%**	**23%**

Your comments:

"We need more bandwidth. With DBS on our backs, we need to lead the way, or it won't be long before we're at the back of the line."
– Larry Langevin, Greater Media Cable, Ludlow, Mass.

"It's time! Some operators need to decide if they're staying in the game. If they delay any longer, they will lose . . . and lose big."
– George Buchan Jr., Tri-State Cable, Troutville, Va.

Trade shows

APRIL

2-4 Philips Mobile Training, produced by Philips Broadband Networks Inc. Location: Dallas, Texas. Call (800) 448-5171 (800-522-7464 in New York State) to register.

4 Design, Test and Installation of Cable Television Systems seminar. Produced by Multicom Inc. Location: Orlando, Fla. Call Multicom at (800) 423-2594.

9-11 Philips Mobile Training, produced by Philips Broadband Networks Inc. Location: Denver, Colo. Call (800) 448-5171 (800-522-7464 in New York State) to register.

11 2nd Annual Vendors Fair, produced by the Delaware Valley SCTE group. Location: Williamson's Restaurant, Horsham, Pa. Call Dave Jackson (215) 256-8878.

22-24 Global DBS Summit. Location: Denver, Colo. Call Globex (713) 342-9826.

22-24 Operating Hybrid Fiber/Coax Systems, produced by Scientific-Atlanta Institute. Location: Atlanta. Call SAI (800) 722-2009, press "3."

22-24 Cable Television Technology, produced by C-Cor Electronics Inc. Location: Seattle, Wash. Call C-Cor Technical Customer Services (800) 233-2267 for more information.

22-25 Fiber Optic Training, produced by The Light Brigade. Location: Cleveland, Ohio. Call (800) 451-7128.

23-24 Fiber Optic Technical Seminar, produced by ADC Telecommunications. Location: Cincinnati, Ohio. Call (612) 946-3086.

April
6-10 NAB '97. Location: Las Vegas. Call the National Association of Broadcasters (202) 429-5300.

May
5-9 Networld + Interop '97. Location: Las Vegas. Call (415) 578-6900.

June
1-5 Supercomm '97. Location: New Orleans, La. Call the U.S. Telephone Association (202) 326-7300.

4-7 SCTE Cable-Tec Expo '97. Location: Orlando, Fla. Call the SCTE (610) 363-6888.

July
28-31 Jornadas de Television por Cable '97. Location: Buenos Aires, Argentina. Call the Argentina Cable Television Association (011) 54-1-342-3362.

August
18-20 Great Lakes Cable Expo. Location: Indianapolis, Ind. Call (317) 845-8100.

September
10-12 PCS '97 (Personal Communications Showcase). Location: Dallas, Texas. Call PCIA at (703) 739-0300 for more information.

21-25 NFOEC '97. Location: San Diego, Calif. Call (619) 467-9670.

28-30 Atlantic Cable Show. Location: Baltimore, Md. Call (609) 848-1000.

December
10-12 The Western Cable Show. Location: Anaheim, Calif. Call the CCTA at (510) 428-2225.

29-30 Activating and Troubleshooting the HFC Return Path, produced by Scientific-Atlanta Institute. Location: Atlanta. Call SAI (800) 722-2009, press "3" for more information.

MAY

11-14 Canadian Cable Television Association's Annual Convention & Cablexpo. Location: Toronto, Ontario. Call the Canadian Cable Television Association (613) 232-2631.

13-14 Wheat State SCTE Chapter, Testing session. BCT/E certification exams to be administered. Location: Wichita, Kan. Call Vicki Marts (316) 262-4270.

20-21 Understanding Sonet and Other Broadband Technologies, produced by TRA. Location: Adam's Mark, Tulsa, Okla. Call Louis Greene (800) 872-4736.

20-22 Broadband-CATV Laboratory, produced by C-Cor Electronics Inc. Location: State College, Pa. Call C-Cor Technical Customer Services (800) 233-2267.

21 New England SCTE Chapter, Testing session. Installer certification exams. Location: Worcester, Mass. Call Tom Garcia (508) 562-1675.

22-24 SCTE Regional Training Seminar: "Introduction to fiber optics." Location: San Bernardino, Calif. Call SCTE national headquarters (610) 363-6888.

26-29 Fiber Optic Training, produced by The Light Brigade. Location: Toronto, Ontario. Call (800) 451-7128.

JUNE

9-13 Broadband Communications Network Design, produced by General Instrument. Location: Denver, Colo. Call Lisa Nagel at (215) 830-5678.

10-12 Digital Network Engineering Training, produced by General Instrument. Location: Denver, Colo. Call Lisa Nagel at (215) 830-5678.

13 49th ARFTG Conference, sponsored by Automatic RF Techniques Group (ARFTG), IEEE Microwave Theory and Techniques Society. Location: Denver, Colo. Call Roger Marks, NIST (303) 497-3037.

16-20 Plant Maintenance, Proof of Performance and Signal Leakage Training, produced by General Instrument. Location: St. Louis, Mo. Call Lisa Nagel at (215) 830-5678 for more information.

19-20 Understanding ATM Application and Implementation, produced by TRA. Location: Denver, Colo. Call Louis Greene (800) 872-4736.

23-25 WCA '97, produced by the Wireless Cable Association International. Location: Anaheim, Calif. Call (202) 452-7823 for more information.

25-26 Understanding Hybrid Fiber/Coax Design, produced by Scientific-Atlanta Institute. Location: San Diego. Call SAI (800) 722-2009, press "3."

25-27 Broadband Communications Technology, produced by C-Cor Electronics Inc. Location: Providence, R.I. Call (800) 233-2267 for more information.

25-27 SCTE Regional Training Seminar. Topic: Technology for Technicians II. Location: Chattanooga, Tenn. Call SCTE national headquarters (610) 363-6888.

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TEST & MEASUREMENT

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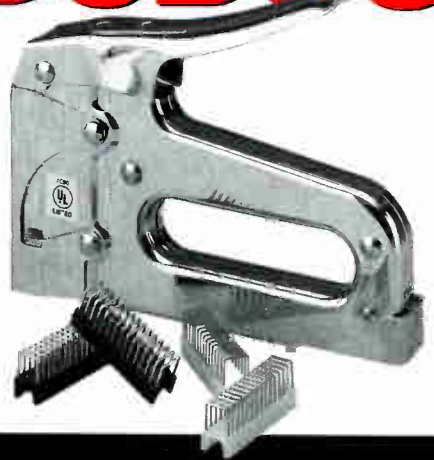

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TEST & MEASUREMENT

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Patterson Comm. (800) 420-5452
Canada: Capella Telecomm. (800) 668-0175

Reader Service 43

Cable modem test set

NORCROSS, Ga.–Hukk Engineering has announced the CR-1151B QPR monitor, with an extended frequency range to 598.75 MHz, and cable modem service monitoring of Scientific-Atlanta's new "dataXcellerator" cable modem. The CR1151B QPR Monitor test set enables users to monitor and test QPR-modulated signals such as those used for S-A's implementation of the Sega Channel, DMX digital audio and the new modem.

Hukk's QPR monitor

Measurements include error count, bit error rate, errored seconds, severely errored seconds and signal level. Testing can be performed anywhere from the headend to the subscriber's residence. A data logging feature is now standard, allowing unattended plant monitoring for preventive maintenance and intermittent fault location. The monitor is rugged, portable, battery-operated and weatherized, says Hukk.

Circle Reader Service number 51

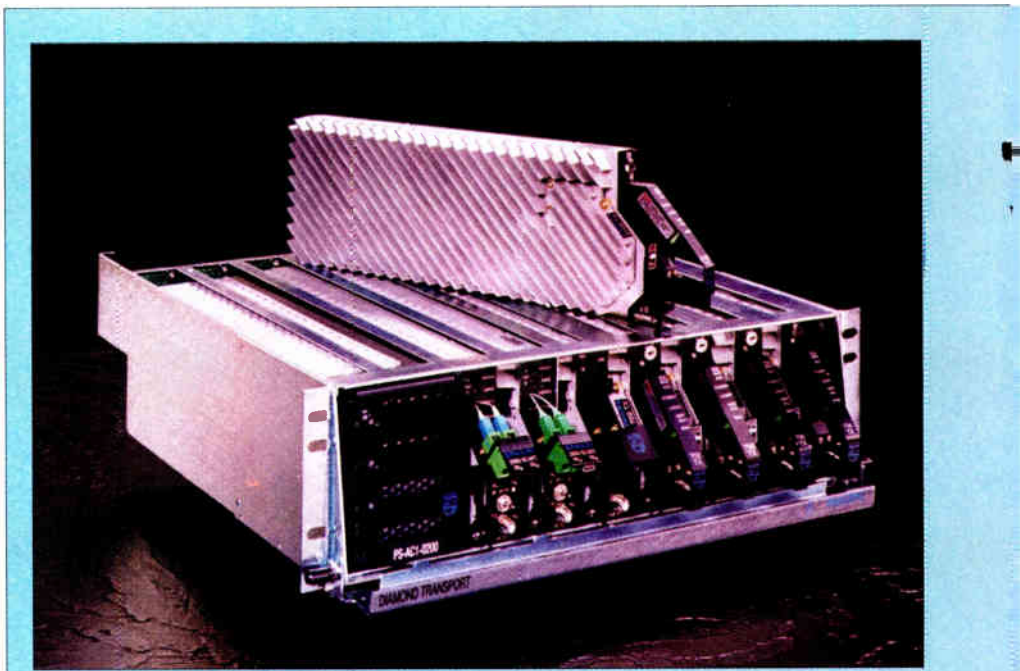
Temp-controlled switch

BERKELEY, Calif.–DiCon Fiberoptics Inc. has announced that its GP700 Fiberoptic Switch is now available with a built-in automated temperature controller. This feature

DiCon's temperature-controlled multichannel switch

provides insertion loss stability of better than ± 0.02 dB for long-term test and measurement applications. The temperature-stabilized GP700 Switch can be ordered with up to 16 individual 1xN, 2xN, or 3xN switching elements integrated within the same benchtop or rack-mountable housing.

Circle Reader Service number 52



Fiber optic transport system

MANLIUS, N.Y.–Philips Broadband Networks has introduced Diamond Transport, its new fiber optic transport system. The universal shelf system accepts up to 84 modules per 6 feet of rack space, reportedly 30 percent more modules over comparable systems.

The system's line of transmitters,

Cable organizers

RIVERDALE, N.J.–Designed expressly for use with any of DataTel's 45-space relay racks, the company's new CK Series of cable ducts is suited for managing extremely large cable bundles. Featuring rugged steel construction and a durable powder-coat finish in either black or aluminum, each of the units measures six inches wide by nine inches deep (4.5-inch front; 4.5-inch rear).

DataTel's CK Series of cable ducts

Two model configurations are offered. When bolted between two racks, the CK Series Organizers manage cable front and rear, while facilitating left and right cable exit. CK Series End Organizers offer selectable left or right cable exit by simply turning the duct when mounting. Adding an aesthetically pleasing, clean appearance to the installation, CK Series Organizer Covers fit either Center or End Organizers and are split for user convenience. Like the Center and End Organizers, the Organizer Covers come finished in powder-coated black or aluminum.

Circle Reader Service number 53

Fiber testing software

VANIER, Quebec–EXFO E.O. Engineering Inc. has introduced the IQ-12001 Maestro Fiber Assembly Testing Application Software for insertion loss and return loss testing of fiber optic patchcords, pigtails and multi-fiber assemblies. As part of the IQ-200 Optical Test System, this application performs fully integrated, cost-effective production testing of fiber optic assemblies. On-screen images and detailed instructions ensure systematic and repeatable measurements with minimal training. The turnkey software controls the mea-

Philips' fiber optic Diamond Transport system

designed for use in both 750 and 862 MHz networks, includes modules for short-haul targeted service applications and high-power modules for high-count splitting or 40 km long-haul trunking applications.

The Diamond Transport's advance dual-return receivers (two in one module), combined with its high-density system design, allow the use of 168 receivers in a six-foot rack. A full line of optical transition node (OTN) modules includes forward receiver modules, forward amplifier modules (862 MHz), return amplifier modules (200 MHz) and high-performance return transmitter modules.

Offering a full range of powering options, the system features AC (at 110V and 220V) and DC (at +24V and -48V) power redundancy.

The system features front-panel accessibility for convenient removal or replacement of modules. A safety interlock system automatically shuts off lasers when adjusting optical connections.

Circle Reader Service number 50

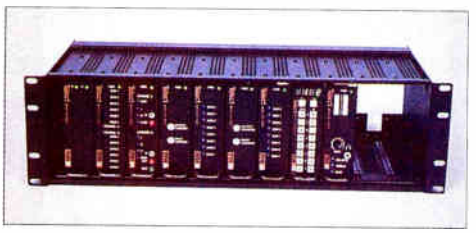
surement procedure, from start to finish, according to user-selected parameters. It eliminates the possibility of data entry, interpretation and reporting errors, says EXFO, while avoiding procedural mistakes. In addition, features like Autoprint, Pass/Fail testing and automatic prompting for the next assembly under test increase the system's efficiency over traditional test methods, says EXFO.

Circle Reader Service number 54

Signal management

SPOKANE, Wash.–Telect Inc. has enhanced its VersaFrame 2000. A versatile modular frame, the VersaFrame 2000 now supports several new audio and video modules, including a color bar and tone generator, a 16x16 digital video routing switcher, and a digital distribution amplifier, providing more options for custom system configuration.

The VersaFrame supports analog and digital audio and video signal management, all with "hot swapping" capabilities to allow reconfiguring without shutting down the system. In addition, the system simultaneously supports conversion modules, control modules, routers



Telect's VersaFrame 2000

and switchers, all in the same frame. The UL-listed VersaFrame power supply utilizes universal input and switching power supply technology for power management within the frame.

Circle Reader Service number 55

DFB laser diode module

DALLAS, Texas–The Electronic Device Group of Mitsubishi Electronics America has announced a distributed feedback laser diode (DFB-LD) module for cable television return path applications. The DFB-LD module offers a stable, low distortion, 1.3-micron emission wavelength light source without a thermal electric cooler system, making it ideal for outdoor use.

The DFB-LD module, FU-436SDF series, offers low distortion to +85 degrees Celsius and exhibits maximum second-order and third-order distortion characteristics of -50 dBc and -60 dBc, respectively. It also has a maximum relative intensity noise (RIN) of -145 dB/Hz. At an operating temperature of +25 degrees Celsius, the DFB-LD module has typical fiber-coupled output power of 3 mW. At +85 degrees Celsius, the laser has a typical threshold current of 20 mA and typical operating current of 50 mA.

Samples of the FU-436SDF-4M1B DFB laser diode module are available now, with volume production scheduled for the second quarter of this year.

The company also announced a family of optical laser modules that are targeted for cost-effective fiber-in-the-loop, Sonet and passive optical network applications. The family features a plastic-molded package and a maximum tracking error of 1.5 dB across an operating temperature range of -40 to +85 degrees Celsius.

Circle Reader Service number 56

Composite cables

RICHMOND, Ind.–Belden Wire & Cable Company is offering a new series of composite cables that feature multiple twisted pairs with high-quality coaxial cable. The cables have been designed for such applications as digital compression, data communications, video-on-demand, HDTV, interactivity and personal communications services.

The new cables feature Siamese-type construction and are available in a wide variety of custom configurations. The coax cables feature copper-covered solid steel center conductors, and size choices include Series 6, with an 18 AWG center conductor; Series 7, with a 16 AWG center conductor; and Series 11, with a 14 AWG center conductor. Twisted pair options include 2-, 3-, 5-, or 6-pair constructions, with either 22 AWG or 24 AWG solid copper conductors in either shielded or unshielded configurations.

Belden's composite cables

For underground applications, the cables can be specified with filled coax and twisted pairs; for self-support aerial applications they can be ordered with a high-strength galvanized steel messenger wire. All cable configurations are available with either polyethylene or PVC jacketing.

Circle Reader Service number 57

Signal generator

MOUNTAIN VIEW, Calif.–Telulex Inc. has introduced its Model SG-100A Synthesized Function /Pulse/Arbitrary Waveform Generator based on Direct Digital Synthesis technology.

The SG-100A generates modulated sinewaves from DC to 20 MHz, arbitrary waveforms, function and pulse waveforms. Featuring direct digital control of the frequency, phase, level, and I and Q rails using a DSP processor, the generator offers a wide range of operating

Telulex' Model SG-100A Generator

modes including: Linear/Log Sweep, AM, FM, PM, SSB, BPSK, FSK, Burst, DTMF generation, DTMF detection and power level measurement. For each modulation type, users may select a modulating waveform that is either internally generated or externally supplied.

The arbitrary waveform function allows users to design any waveform needed and download it to the SG-100A.

Circle Reader Service number 58

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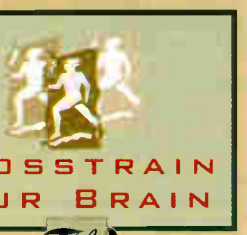

WOMEN IN CABLE & TELECOMMUNICATIONS

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Japanese operator tests Terayon modems

TOKYO–Jupiter Telecommunications Co. Ltd. and Sumitomo Corp. have announced a joint field trial, running Internet data services over the cable network, using modems developed by Terayon Corp.

The trial, which was slated to start in March, is being held at the Urawa Cable Television Network Co. Ltd. (UCT), operated by Jupiter Telecom. The field trials, which will include 50 subscribers living in the Urawa area, will use Sumitomo's Internet server and UCT's cable plant.

The main purpose of the trial, says Terayon, is to demonstrate the effectiveness of its modem in the high-noise upstream environment of a cable plant in Japan, without any noise filtering. For that reason, the trial will be conducted using UCT's "pure-coaxial" network, without any plant upgrades.

Nortel unit inks cablephone contract

TOKYO–Northern Telecom Japan Inc., a business unit of Nortel, has signed a five-year agreement for the supply of telecommunications systems to Jupiter Telecommunications Co. Ltd. for cable telephony service. The products covered by the agreement are Nortel's DMS-100 large-scale digital switch, DMS-10 small-scale digital switch and the Cornerstone Voice cable telephony system.

One of Jupiter's franchises, Suginami Cable TV, began technical testing last December using Nortel's DMS-10 switch and Cornerstone Voice, and plans to offer full, commercial service beginning sometime this summer.

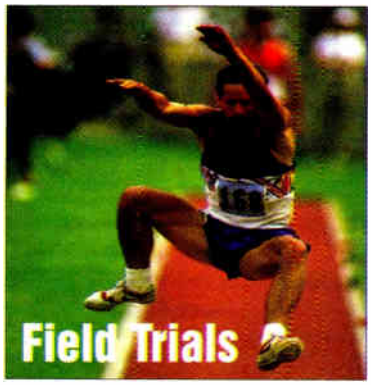
CSG signs contracts with Time Warner

ENGLEWOOD, Colo.–CSG Systems Inc. has signed several new multi-year contracts with Time Warner Cable. Time Warner-Los Angeles has purchased CSG VantagePoint; Warner Cable Communications Inc. of Cincinnati bought CSG Enhanced Statement Presentation; and Time Warner Cable-Columbia Division of South Carolina purchased CSG Vantage, Communications Control System, ESP and PayBill Advantage.

"Time Warner is aggressively pursuing convergence opportunities," said Neal Hansen, CSG chairman and CEO, "and we continue to assist them as they enter new markets like high-speed data."

Philips to supply Marcus upgrade

EINDHOVEN, Netherlands–Philips Broadband Networks will provide about 750 miles of fiber optic and RF transport equipment for a two-year Marcus Cable system upgrade in Morristown, Tenn. Marcus Cable's Morristown



system will incorporate Philips' new Diamond Transport transmitters and receivers in an optical transition node application, and will also add the supplier's Diamond Net nodes and network amplifiers to its network.

"Philips' Diamond Transport transmitters and receivers will play an integral role in preparing our network for possible implementation of telephony, data and other interactive services," said Marcus Cable's Bob Haney.

Jones buys SeaChange ad insertion gear

MAYNARD, Mass.–SeaChange International Inc. will provide its SPOT System to Jones Intercable Inc. for the operator's Chicago cable operation. As part of the $1.7 million transaction, SeaChange will deploy a franchise-wide digital ad insertion system for Jones, enabling the company to deliver advertising on more than 180 channels to its 260,000 subscribers throughout the Chicago metro area.

The system will serve nine geographic zones, with 18 channels per zone. In addition to offering local advertising on its current lineup of cable networks, Jones will add its own networks, Great American Country and Jones Computer Network, for insertion.

The SPOT System will replace the hundreds of analog videotapes that Jones accommodated on a weekly basis. Now, Jones will digitally encode the advertisements and use data networks to distribute the ads to any, or all, of its nine geographic zones in the Chicago area.

Time Warner picks SkyConnect ad gear

BOULDER, Colo.–Time Warner Cable has chosen SkyConnect to provide digital ad insertion technologies for nine cable headends in its Eau Claire and Milwaukee service areas.

As Time Warner's needs increase, SkyConnect's scalable system will allow each location to increase its number of channels without revamping the system. The current configuration will take Milwaukee from a 12-16 channel unit to one that supports 20 channels. The company will take one week sometime this month to switch Milwaukee's eight 20-channel headends to Mediaplex.

Digital Equipment Corp.'s Alpha server is the core of the technology solution, while SkyConnect provides cable industry expertise, and handles custom software, hardware and other enhancements; as well as marketing, installation and service and support.

Continental launches data in Detroit

BOSTON, Mass.– Continental Cablevision, the domestic cable arm of US West Media Group, has launched two-way, high-speed Internet access service in the Detroit metro area, bringing to three the number of major markets in which the company is providing residential high-speed data service over its upgraded broadband network.

This past winter, a majority of trial residential users in an area of the Detroit suburbs agreed to begin paying for the service, marking the launch of high-speed Internet access in the metropolitan area. Since that time, Continental has begun to market the product, featuring Internet access via LANcity personal cable modems, to a list of about 1,500 consumers who have requested more information.

Continental first introduced its high-speed Internet access service in September 1996 in metro Boston and Jacksonville. The company is now providing it to a total of about 2,500 customers in the three markets, combined.

GI unit to supply DirecTv Japan

SAN DIEGO–Magnitude Compression Systems Inc., a subsidiary of General Instrument Corp., has signed a $13.7 million contract with Matsushita Electric Industrial Co. Ltd. to supply Magnitude MPEG-2/DVB Encoding Systems to DirecTv Japan Inc. (DTVJ).

The systems are currently being shipped to DTVJ, which is scheduled to launch its direct-to-home service in the third quarter of 1997. DTVJ will be one of the largest DTH satellite systems in the Asia Pacific region.

The Magnitude system is compliant with both the Moving Picture Experts Group (MPEG-2) standards, which govern the digital processing and transmission of audio and video information, and the Digital Video Broadcast (DVB) standards, which define the broadcasting of digital and audio signals.

C-Cor named as Shingo Prize finalist

STATE COLLEGE, Pa.–C-Cor Electronics Inc. has been selected as one of the finalists for the 5th Annual Shingo Prize for Excellence in American Manufacturing. CED

Hiding data: Compatible digital upgrades

By Walter S. Ciciora, Ph.D.

When I talk about "compatibility," it's usually about cable and consumer electronics compatibility. But the concept of compatibility has broad application to a wide variety of cable subjects.

Practical digital

We've been in the digital age for more than a decade. Along the way, we've sometimes gotten carried away. We've fallen prey to what I used to call "digital mania." Digital mania is a mental and an emotional disease whose victims believe that everything can and should be done digitally, and that in three years' time, it will all be free.

Most importantly, digital is not free; it can be very expensive. While digital technology has a relatively fast downward cost curve, the starting point of the curve is rather high.

The cable industry needs a practical approach to rolling out digital technology, especially in smaller systems. A practical approach would employ digital technology in applications that pay dividends, and avoid it where it simply raises costs. Of course, an important application which may not raise revenues is customer retention. Given the high cost of customer acquisition in a highly-penetrated business, and the extreme unlikelihood of subscriber recapture when the customer has invested several hundred dollars in a home satellite dish, customer retention is a critical goal.

Too many digital enthusiasts believe that the digital wave will sweep away analog television in just a few years. That is very unlikely. There are around 300 million television sets in almost 100 million television households, along with at least 150 million VCRs. About 25 million new color TVs and 14 million new VCRs are sold every year. The ones sold this year will last even longer than the ones sold last year. They last more than a decade, on average. This means some last 15 to 20 years!

This is just too big a market of NTSC signal capability to ignore. Many of these viewers cannot afford the cost of a new digital television or set-top adapter. Still others can afford it but have other priorities for their disposable income. Yet others have been trained to wait until the price comes down and will delay their move to digital.

So how can we serve both the early adopters who will want advanced digital services and not lose or offend the loyal customers who are quite pleased with their analog service? How can we serve the new computer market's desires for high-speed data? In particular, how can we do this cost-effectively, without expensive upgrades that have questionable returns?

All of the current approaches to adding digital without expanding channel capacity require sacrificing some of the analog channels. In a system with limited capacity, this will only aggravate the analog customers. A way of adding digital capacity without cannibalizing the analog capacity is needed. Fortunately there are ways. Of interest, the WavePhore and Digideck corporations have broadcast proposals which have won FCC approval.

WavePhore has two approaches. One method, like Teletext, uses lines 10 through 20 in each field for a data speed of up to 150 Kbps. WavePhore added substantial error detection and protection bits to its structure to protect against multipath and other transmission problems.

On June 28, 1996, the FCC approved digital data transmission in NTSC in its Report & Order (R&O), "Digital Data Transmission Within the Video Portion of Television Broadcast Station Transmissions." This R&O amends FCC rules to allow ancillary data within the video portion of the NTSC signal. Two systems, Digideck and the second WavePhore system, embed the digital data in the video signal.

It is important to keep in mind that Teletext, WavePhore and Digideck were designed for broadcast television. The broadcast television environment is more difficult for data than the cable environment. As an important example of this, the Digital Advanced Television standards approved by the FCC include two different data rates for broadcast and for cable. The cable rate allows two HDTV signals to be carried in the same 6 MHz that can only convey one HDTV in broadcast. This is accomplished in two ways. First, the more well-behaved cable spectrum allows twice as many levels to be discriminated. But doubling the number of discriminated levels does not double the data capacity. Going the rest of the way involves taking advantage of the fact that the error rate in cable will be much less than must be accommodated in broadcast. As a result, less error protection is required.

These are important lessons to be applied to cable. A cable data signal should be able to have more fundamental levels than broadcast signals. This means more basic bits per Hertz of bandwidth. And more of those bits could be allocated to payload because fewer are needed for error detection and correction.

The compatible digital upgrade

The Compatible Digital Upgrade concept hides digital data in the analog 6 MHz channels. No analog channels are lost. Current analog subscribers see no loss of capacity, nor any degradation of service. In fact, they have no way of knowing that anything has changed, except by the advertising of the availability of new services.

The cost of advanced tuners intended to give access to data is quite modest. If two or more tuners were included in the set-top, their outputs could be combined to provide sufficient capacity for compressed digital video or a data stream for computers and Internet access via television.

Quite acceptable compressed digital video has been shown at 1.5 Mbps, and very good video at 3.0 Mbps. These are target values for the provision of data pipes in analog systems.

What if it were possible to compatibly hide 3 Mbps in 6 MHz of analog video? It is possible! CED

Have a comment?
Contact Walt via e-mail at: wciciora@aol.com

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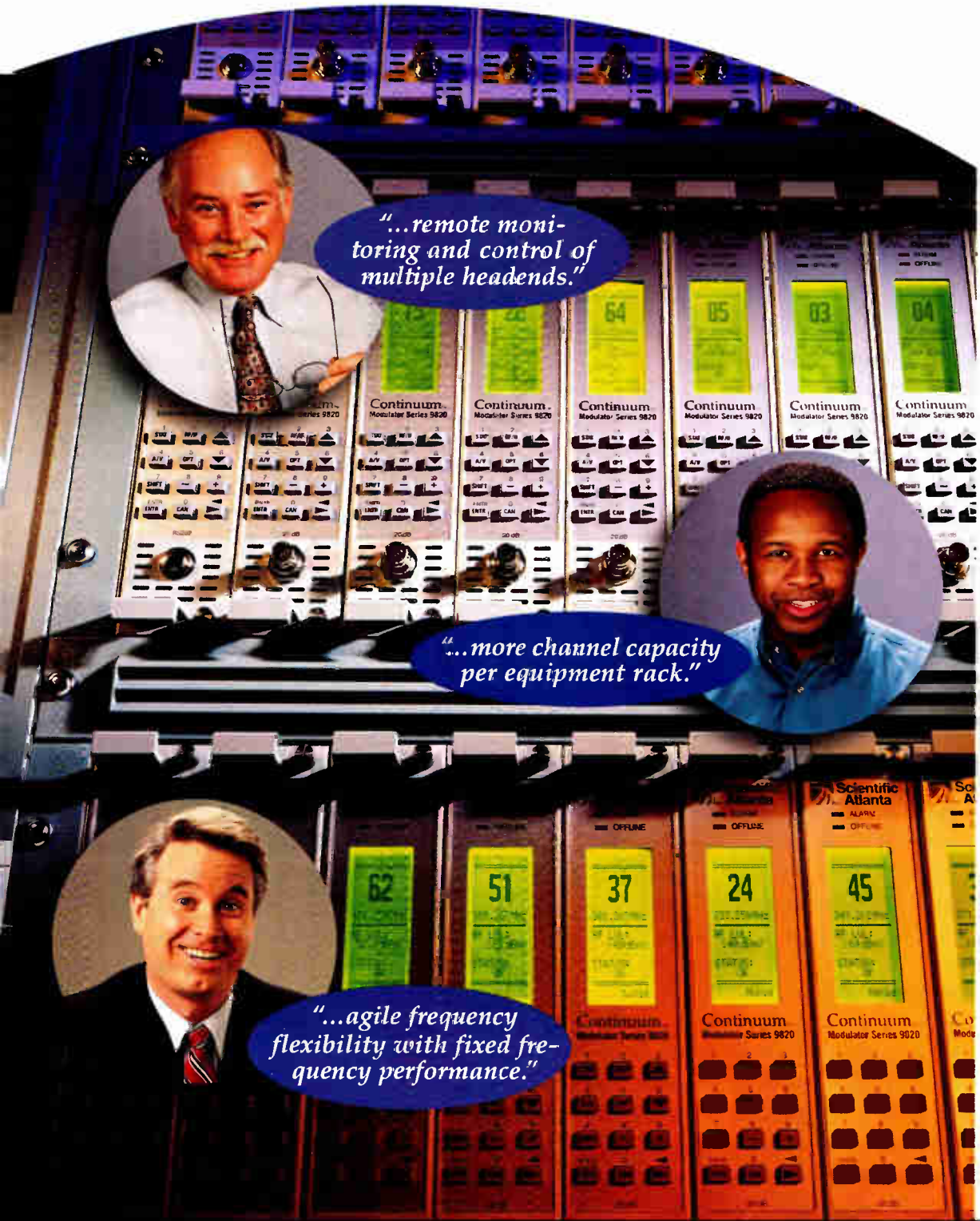

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