NOVEMBER 1996

CED

COMMUNICATIONS ENGINEERING & DESIGN
THE PREMIER MAGAZINE FOR BROADCAST & BROADBAND COMMUNICATIONS

Telco video: Developing new strategies

Telco/cable co-ops ◆ Going digital ◆ Network availability

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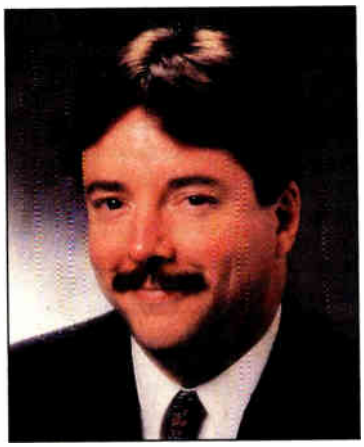

Is data simply today's CB craze?

Depending on who you talk to, and perhaps even on what day you talk to them, industry observers are characterizing Internet access and the World Wide Web as either the greatest new revenue opportunity, or the '90s version of the CB radio fad.

For example, at last month's Convergence: Digital Television and Internet conference in San Jose, Stephen Weiswasser, president and CEO of the Americast consortium, was decidedly bearish. "The number of people on-line and the growth rate of on-line is decreasing significantly," he was quoted as saying. "Right now, it appears that the average customer knows that the Web is not all it's cracked up to be."

After a bit of analysis, I've determined that Weiswasser is right–and wrong at the same time. Without numbers to back up his claim that the on-line world is shrinking, I won't argue that point. I will acknowledge that the Web isn't everything it's cracked up to be, but that's a temporary situation, and already, there's plenty of work underway that will change the face of the Web.

We hear all the time that technology doesn't create good business models. Consumers don't buy new technology or spend money on services unless there's a compelling reason to do so. But technology companies don't typically build technology unless there's at least a perceived marketplace need, either.

While there's a lot of money being spent on hardware, there's real market pull, too. Millions of people are on-line chatting, exchanging e-mail, downloading files, looking up information or simply surfing the Web. Corporations have invested heavily in developing Web sites and Intranets to keep their employees tied together electronically.

Yes, the CB radio was cool for awhile, too, because it gave strangers a new way to meet and communicate. But the problem with the CB radio was that the content never changed, so people became bored.

To avoid becoming the latest passe fad, data providers have to do more than provide a new pipeline for information exchange. The keys are to develop localism, avoid creating hardware that has only one application and to keep the medium fresh.

We've already witnessed the top three cable operators, with a combined subscriber count of more than 30 million homes, launch their own services, each of which can be customized to appeal to local markets. That's powerful. With the additional speed and bandwidth a cable network offers, the content can be upgraded beyond today's static, often uninspired Web postings to captivating, video-intensive "programs" that will keep people coming back time and again.

Access to such networks will get easier, too. Soon, you won't need a computer to access the Internet–you can use a cable set-top box or the TV receiver itself. But just like no one wants to watch nothing but old TV re-runs, few will be turned on by "Frequently-Asked Questions," or a list of someone's most recent press releases. It's time to unleash the game developers and Silicon Valley artists on the Web. Otherwise, maybe we'll say, "10-4 good buddy," to the whole thing.

Roger J. Brown

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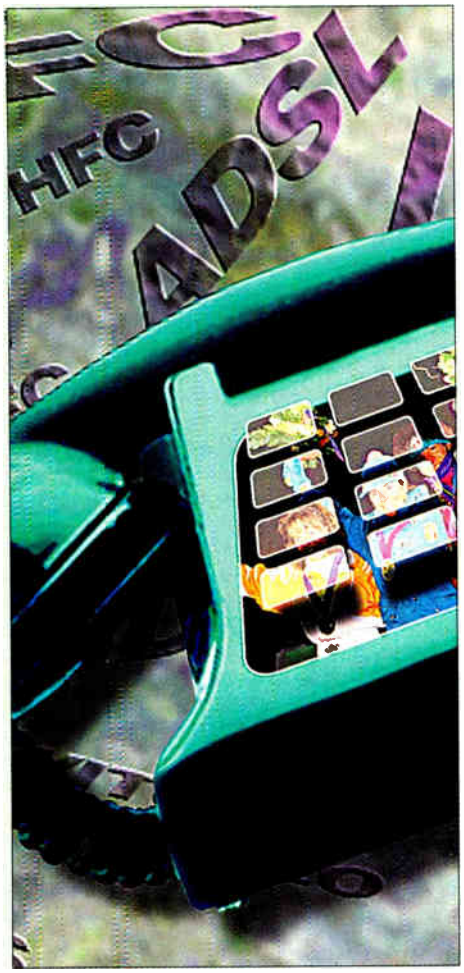

Illustration by Bob Stewart

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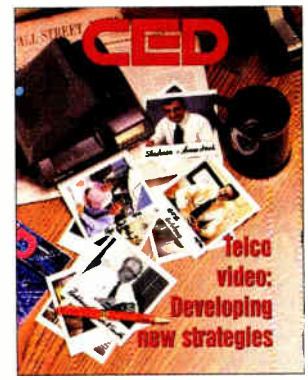

42 Telcos revamp video plans, forge ahead

By CED *staff*

If cable operators are finding it harder to deliver telephony services than they had thought, telephone companies are finding it harder to deliver video than they had thought. Nevertheless, nine of the nation's biggest telcos are continuing to mold their video strategies for success, as they look at everything from HFC to SDV.

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

About the Cover

This month's cover features some of the telco strategists who are responsible for implementing their companies' video plans in the real world. Pictured (clockwise from top): Ali Shadman, vice president of operations and business development, Ameritech New Media; William D. Wilson, president of GTE Media Ventures Inc.; William F. Reddersen, group president–long distance and video services, BellSouth; and Jim Baumann (left), executive director–engineering, Pacific Bell Video Services-South, and Jeffrey Carlson, vice president and general manager, Pacific Bell Video Services-South. Concept photo by Don Riley. Personnel shots courtesy of each company. BellSouth photo by Alex Jones.

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An analyst from Philips Broadband examines line cards at Citizens Telecom's central office (See page 12).

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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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GI and S-A agree on key points of set-top interoperability specs

A potentially historic agreement between two long-time rivals over digital set-top interoperability was reached last month as the result of cable industry clamoring for in-home terminals that can be purchased from multiple sources. Specifically, General Instrument and Scientific-Atlanta have agreed to work toward an agreement that includes a royalty-free cross-licensing arrangement for core encryption, modulation and forward error correction.

CableLabs and its members have agreed upon the major elements of an interoperable digital cable system specification for North America that creates the basic platform on which digital video and data services can ride and to which equipment manufacturers can build hardware.

Under terms of the specification, digital gear will conform to MPEG-2 main profile/main level parameters; the MPEG-2 transport multiplex; Dolby AC-3 audio; and ATSC service information tables. Downstream digital modulation will be based on ITU's Annex B, which calls for 64- and 256-QAM with concatenated trellis coded modulation, plus enhancements like variable interleaving depth to reduce latency for delay-sensitive applications.

Multiple conditional access and control data streams, such as General Instrument's DigiCipher and Scientific-Atlanta's PowerKEY will be supported, but they will have to be ported to the core encryption system, which will be GI's DES-based Digicipher system.

Furthermore, the benefits of interoperability will be made available to cable operators immediately. DigiCable terminals that have already been shipped to and deployed by TCI, Comcast, Cox and others will adhere to the specification, using the GI conditional access system. In addition, the Pegasus set-top boxes, which will likely be supplied by S-A, Toshiba and Pioneer to Time Warner Cable and perhaps other cable operators, will also adhere to the specification.

CableLabs President and CEO Richard Green was quick to praise the equipment suppliers for hammering out the agreement. "This is a tremendous precedent and we would like to see it expand into other areas," he said in a prepared statement.

"This is a clear win for the cable industry," said Bob Van Orden, business director for S-A's Digital Video Systems unit. He adds that under the agreement, the manufacturers can now compete for business based on features and value, as opposed to proprietary encryption methods or other gating items.

Leading cable engineers were also quick to point out the benefits of such an agreement. "This specification will advance the industry's ability to deploy digital set-top boxes and cable modems in a cost-effective manner," said Jim Chiddix, Time Warner Cable's chief technical officer. "That will (result in) lower price points and more choice."

TCI Senior Vice President Tom Elliot echoed those thoughts: "This . . . specification will allow the simultaneous coexistence of set-tops and data modems from a variety of manufacturers."

C-Cor allies with Bay; adds suite of services

Refusing to be left behind as cable operators hasten to capitalize on the popularity of data services, C-Cor Electronics last month announced it had signed a non-exclusive cooperative marketing agreement with Bay Networks and formed a set of equipment and services to support the delivery of data over cable networks.

During a press conference at the Atlantic Cable Show in Baltimore, C-Cor President and CEO Scott Chandler said his company and Bay's LANcity Cable Modem Division had agreed to work together to insure equipment interoperability as well as a high quality of service.

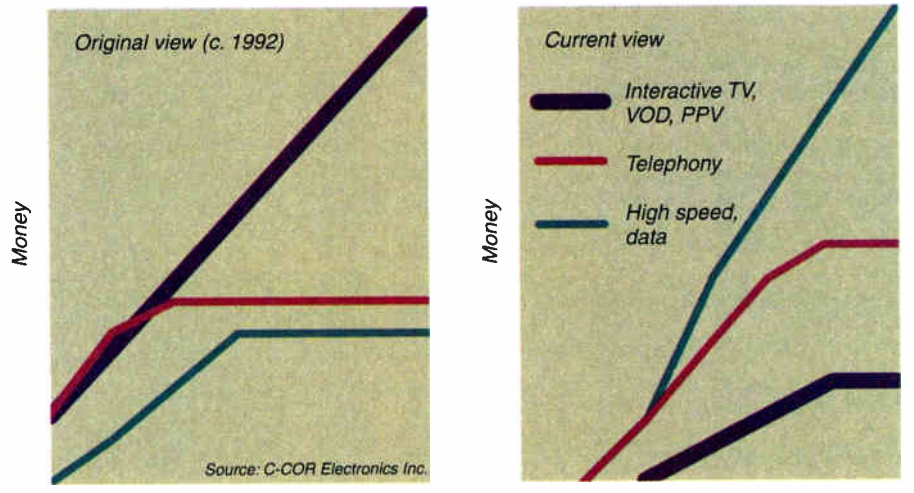
Specifically, the agreement calls for the development of a seamless, end-to-end network management system, joint marketing by both companies' sales and customer support personnel, training integration, interoperability testing of equipment from both companies and a jointly-developed white paper on high-speed data delivery over HFC networks.

Both companies revealed that they are in discussions with "a number of leading cable operators," both domestically and internationally, to provide both products and expertise.

In a related announcement, C-Cor announced "C-Cor Data Select," a suite of equipment and services designed to support the delivery of high-speed data over HFC networks. In essence, the initiative is aimed at helping cable operators shore up their weak link–the return path. During the press conference, Chandler noted that while more than half of all cable plant is "two-way capable," only about 10 percent has actually been activated.

A key part of the plan is to develop strategic relationships, such as the one with Bay Networks, to gain access to high-quality modems, routers, network management software and other equipment. C-Cor will add to it: market assessment/trunk-node prioritization services; network design; two-way HFC equipment, including fiber optic transmitters, AM fiber nodes and RF amplifiers; return path activation, balancing and sweeping; and distribution equipment network management, Chandler said.

Drivers/timing of new revenue streams for HFC have changed over time



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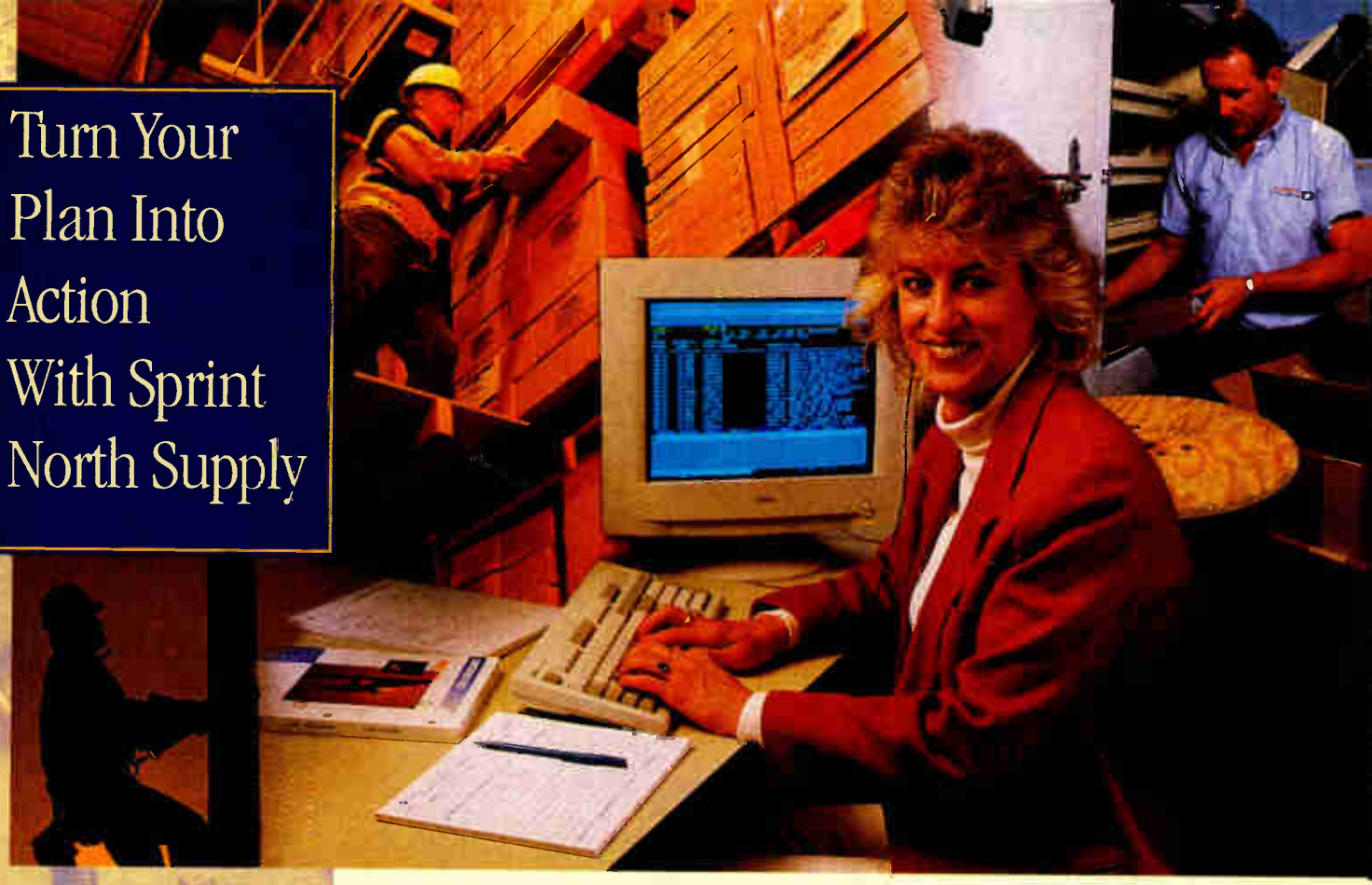

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Data services gear up; modem std. a year away

Over the past 60 days or so, each of the top three cable TV MSOs have debuted their own high-speed data services; now comes word that the industry is "likely" to see interoperable cable modems by the end of next year.

With Time Warner's "RoadRunner," Continental's "Highway 1" and TCI/Comcast/Cox's "@Home" services promising to offer consumers blazingly quick Internet access, file transfer and a host of other new services and information, the nation's largest cable companies formally announced that they've become high-speed Internet access providers. But one key piece of the puzzle is missing–modems that conform to a standard so they can work in virtually any cable system. But relief may soon be at hand.

@Home kicked off its service to residents of TCI's system in Fremont, Calif. and recently expanded to portions of the operator's Sunnyvale, Calif. system. Just a few days later, Time Warner made a glitzy splash in Akron, Ohio as it rolled out its RoadRunner service. Then, in late September, Continental said it would be offering its Highway 1 service to residents in New England and Jacksonville, Fla. within the coming weeks, and rolling the service out on a national scale over the next 12 months.

Particularly, service will soon be offered to Boston-area communities Needham, Wellesley and Newton; to 1,400 residents who live in portions of the metropolitan Detroit system; and Jacksonville. By the end of the year, Continental's New England network will be capable of delivering the service to about 225,000 homes, and double that amount by the end of 1997.

On the hardware side, CableLabs announced in late September that five cable modem manufacturers–Com21, General Instrument, Hewlett-Packard, LANcity and Motorola–are all contributing to the industry's data interface specification process. MSOs Rogers Cablesystems and Continental Cablevision, as well as MCNS members TCI, Time Warner, Comcast and Cox, plan to use key intellectual property offered by some of the manufacturers in the specification, which is scheduled to be published by the end of 1996 and tested sometime in 1997.

Once the spec is published and tested, modem manufacturers are expected to alter their products to comply with the new specification by the end of 1997. It is also expected that modems from multiple manufacturers could become available through retail outlets as well as through the MSOs themselves.

CableLabs was careful to point out that no one product or equipment vendor is being selected in the interface specification process. There is also no currently-available product that meets the requirements of the proposed specs.

Cable/telco co-op on new telephony gear

Who says cable companies and telcos have to go to war to offer their customers communications solutions? Not Century Communications and Citizens Telecom, who jointly deployed an HFC-based system from Philips Broadband Networks that will allow residents of Norwich, N.Y. to receive a package of telephony and on-line services, high-speed Internet access, video conferencing, work-at-home, long-distance learning, broadcast video and a host of multimedia services.

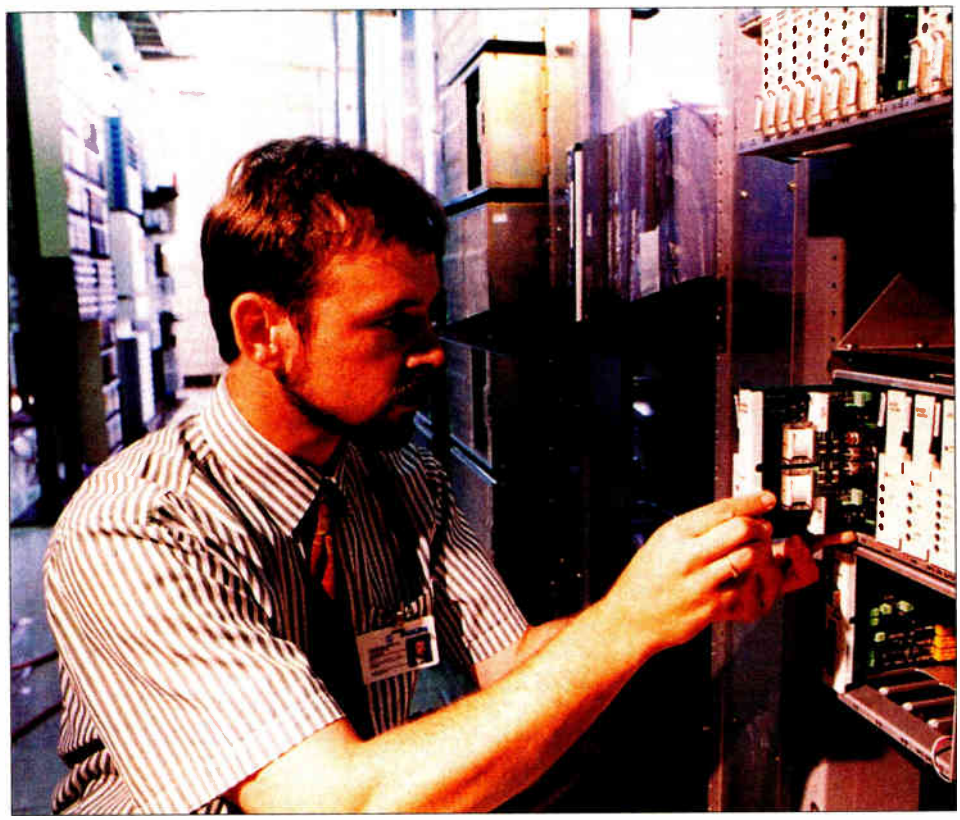
The product trial of the Broadband Communications Gateway allows Philips to place its equipment in a real-world environment while both service providers test the waters for new service provision, notes Rick Haube, Philips' manager of business development.

The system consists of a headend modem, single-home subscriber interface units and multiple dwelling business unit for businesses and apartment complexes. In Norwich, several SIUs were deployed, each of which offered two lines of service. A multiple dwelling unit was installed at Citizens' local central office to allow employees to test and use P-Phone, fax, coin and POTS services.

With the system up and running since July, the initial field results are promising, according to Dennis Jones, general manager of Century's Norwich network. In fact, he says only minimal drop filtering and return path amp modifications were necessary to make the technology work as specified.

NEC and HP chosen as Telstra main suppliers

Telstra, the Australian telephone company that is building an integrated voice/data/video network using the hybrid fiber/coax architecture, has chosen NEC Australia and Hewlett-Packard Australia to be its equipment and information technology suppliers for its next round of broadband service deployment. NEC will provide CyberSURFR cable modems from Motorola and cable routers for the company's Access Network Subsystem, while HP will provide the broadband server complex equipment.



An analyst from Philips Broadband examines line cards at Citizens Telecom's central office prior to deploying the BCG system for product trials.

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The four companies will be working closely together in integrating the systems with Telstra's cable network.

Eighteen companies were invited by Telstra to formally bid for the technology contracts, and the successful tenderers had proven their capabilities in that regard, as well having the necessary flexibility to respond to market demands, according to Telstra officials.

The next expansion of Telstra's cable data services will be in parts of Melbourne and Sydney.

Vendors launch new ADSL equipment

Aware Inc. has announced "ADSL-Link," an ADSL Internet access modem with full rate adaptation functionality. The product was specifically designed for high-speed data services, such as access to the Internet, telecommuting and video conferencing over one standard twisted copper pair telephone line–without any disruption to normal telephone service on that line.

The rate adaptation feature is important because it dynamically adjusts data transmission speeds for the length and quality of the line, which allows the phone companies to reach customers who are more than 12,000 feet from a central office. The introduction of rate adaptation lets Aware's modems take full advantage of the capabilities of discrete multitone (DMT) technology.

The new, $2,000 modem will deliver data at rates from 32 kbps to over 7 Mbps to the office or home, and from 32 kbps to 768 kbps from the home to the central office. The transmission rate is automatically set to the maximum possible rate and can be adjusted in 32 kbps increments.

ADSL-Link is based upon the AD6444, the first generation ADSL chipset from Analog Devices, a cooperative development between the two companies. The modem's rate adaptive capability is implemented as a software extension to the core chipset functionality.

ADSL-Link can purportedly reach distances of up to 18,000 feet with data rates of 1.5 Mbps downstream and 160 kbps upstream. Data rates of over 7 Mbps downstream and 768 kbps upstream are available over shorter distances.

The modem is available with an Ethernet or serial interface and includes an integrated POTS splitter. The serial interface is ideal for lab evaluations and for connecting to routers, while the Ethernet interface is ideal for connecting directly to PCs, hubs and LANs.

Motorola also announced a new addition to its ADSL product line. The CopperGold ADSL Line Driver, designed to optimize the performance of the company's DMT-based transceiver, provides a single-chip interface and reduces the footprint on the board. The design is said to result in lower power needs, lower cost and optimized performance.

The Driver is available in two configurations, with two different power levels–one for central office locations and the other optimized for the remote terminal.

The products are scheduled for availability in the first quarter of 1997, at costs of under $10 each in volume quantities.

Not to be left out, Amati Communications Corp. and XEL Communications are working toward a memorandum of understanding to jointly offer a line of products based on Amati's ADSL/DMT technology at rates up to 8 Mbps.

Amati products are being used in tests of 2-, 4- and 8-Mbps video-on-demand services offered by PTTs in Europe and Asia/Pacific; and a 6 Mbps trial of broadcast-quality video in Australia. The company also provides equipment to GTE for Internet access trials in Dallas and Redmond, Wash.

Meanwhile, GlobeSpan Technologies says it has shipped 35,000 CAP-based DSL transceivers, which have been at the core of 90 percent of all ADSL modems used in worldwide trials to date, including Westell's FlexCap ADSL modems by UUNET Canada, Nynex, Ameritech, GTE and Pacific Bell.

In June, Westell announced that UUNET Canada would become the first commercial Internet Service Provider (ISP) to conduct ADSL field trials. In August, GTE and Microsoft announced that the first phase of their ADSL trials in Redmond, Wash. will provide 40 of their employees with Internet access using Microsoft NT-based servers; and Pacific Bell began initial CAP-based ADSL trials in the San Francisco Bay area, with plans to expand trial deployments over the next few months.

Later in August, Nynex, Lotus and Westell announced that they began a trial that enables Lotus personnel to gain high-speed access from their homes to Lotus corporate networks and the Internet. Then, in September, Ameritech and IBM said they would provide several hundred Chicago consumers with ADSL Internet access.

Jottings

Want to be a speaker at next year's **SCTE Cable-Tec Expo?** You have until Dec. 1 to submit your proposal for either the annual Engineering Conference or a workshop. The Expo is set for June 4-7, 1997, in Orlando, Fla. Submissions must include a brief abstract and should be faxed to Bill Riker at 610/363-5898 . . . The **Antec** acquisition juggernaut just keeps on rolling: The company announced last month that it's in discussions to acquire **TSX Corp.** (formerly known as Texscan), pending the execution of a definitive agreement. The acquisition would finally give Antec its own line of fiber optic transmission gear . . . The **National Cable Television Center** and Museum is now on-line with its own World Wide Web site. The site's five sections feature historical overviews, information resources, educational diagrams and photos and biographies. Look it up at www.cablecenter.org . . . The SCTE has gotten into the act as well, with a Web site that features SCTE info, a publications list and calendar. Check it out at www.scte.org . . . **General Instrument** formally announced it will work with **WorldGate Communications** to support the "TV On-Line" service that allows TV viewers to browse the Internet via cable TV set-top boxes. Set-tops from Scientific-Atlanta already support the service, and GI will alter the way its equipment processes information in the vertical blanking interval to accommodate TVOL . . . GI also has a deal with **Superior Electronics Group** to interface GI distribution gear with Superior's Cheetah status monitoring software . . . Speaking of set-tops, Sony has selected VLSI Technology chipsets for inclusion in its set-tops that support Japan's PerfecTV! and France's Canal+ satellite services. Specifically, VLSI's QPSK demod, FEC decoder and MPEG-2 transport demux will be integrated into the DVB-compliant boxes . . . **Comcast** and **TCI** joined a group of other investors who collectively poured $20 million into The Lightspan Partnership, a provider of interactive educational media and Internet access. Using CD-ROMs and Internet, Lightspan creates and offers curriculum-based video programming for kids for both in-school and at-home use. Comcast and TCI, through its education subsidiary ETC w/tci, also said they would support Lightspan's content as part of their Internet service offerings . . . **Nortel** has delivered its Cornerstone Voice telephony-over-cable product to Japan cable operator TV Chigasaki for a governmental emergency information exchange system . . . **CAI Wireless Systems** will trial high-speed wireless Internet access services in Rochester, N.Y. The test will utilize General Instrument's SURFboard 27 Mbps modem in the downstream and a standard telephone modem in the upstream direction . . . . CED

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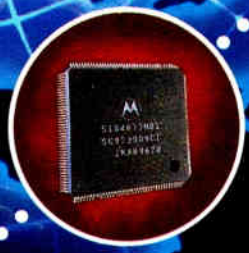

Motorola's Panama Chip

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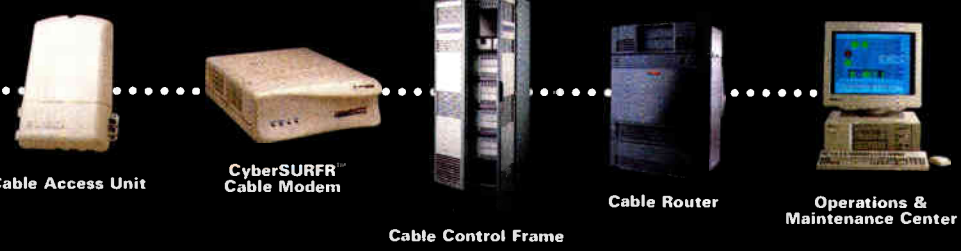

Clear Sailing. Now is the time for system operators to set a course for Panama. Motorola's new Panama™ Chip Set has been created exclusively for the cable industry to provide a reliable, efficient link from broadband networks to the world of telephony and beyond. An integral part of CableComm technology, the Panama Chip Set clears the communication passage to system operators and establishes a new route filled with oceans of untapped revenues.

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Reader Service 8

Kuska and the theory of relativity

Michelle Kuska

She was programming in BASIC on a home-built computer in the fourth grade; by the eighth grade, she had mastered Pascal. And much later, with the final stroke of a pencil on her graduate school entrance exams, she won a National Science Foundation Graduate Fellowship.

For one so young, Michelle Kuska has managed to cram a lot of experience in technology into her life. A systems engineer who also has an intricate grasp of how technology works at the micro level, Kuska is currently eating and breathing cable modems as she heads up the Multimedia Cable Network System (MCNS) working group, and evaluates modems for TCI Technology Ventures Inc., as director of network technology.

Since joining TCI in 1994, Kuska has written the Data Over Cable System RFP, as well as the Data Over Cable Service Interface Specification RFP, which meant consolidating information from five other MSOs, as well as Cable Television Laboratories. The ultimate goal of the MCNS group is ensuring that there will be affordable, interoperable cable modems available to the public–perhaps by the end of 1998.

Drafting a modem specification is a continual balancing act between making "technically correct" choices, says Kuska, and making tradeoffs in scheduling and cost. "You don't always want to choose the technically correct direction," she adds. "But because we're working with technical professionals, that makes it very easy. We discuss all of these issues, and we pretty much come to the same conclusions." The next step for Kuska and the working group will be to contribute suggested technical directions to the SCTE's Data Standards Subcommittee, which was due to occur in mid-October.

Kuska's background makes her ideal for this modem mission: because she has designed circuits, she intuitively knows whether a particular product design will work, and how easy or difficult it will be to implement; because she is a programmer, she can evaluate modem designs from a software perspective.

Kuska is well-versed in the issues that affect the engineering of services over hybrid fiber/coax networks. Shortly before joining TCI, she was working with Pacific Bell's consumer broadband unit, where she was the principal technical analyst and systems architect for the interactive digital services network offering on the company's HFC network, with responsibility for level 1 gateway design and development. Some of her contributions included evaluating set-tops, level 1 gateway configurations and the backbone ATM network. Before that, she worked as senior engineer in customer broadband applications for PacBell, where she authored the company's Broadband Asynchronous Transfer Mode Access Strategy, covering FTTH, FTTC, ADSL, HDSL and HFC. Actually, Kuska worked for PacBell for nearly five years, beginning with a college internship in 1990 when she began collaborating with vendors on solving interface problems between new and existing equipment.

Her electronics background, however, spans much more than broadband communications. In 1989, while working for Sandia National Laboratories in its Ultrafast Phenomena Laboratory, Kuska designed and built an interferometric second harmonic generation autocorrelator for characterizing femtosecond pulses generated by a colliding-pulse, mode-locked ring dye laser–essentially, a device which splits a beam of light, sends it down two separate paths, and recombines it so that the user can see certain characteristics of the light wave.

Prior to that, as a mere summer intern, she completed a variety of sophisticated projects for AT&T Bell Laboratories, including:

✔Performing measurements to characterize jitter in the DACS IV (digital access cross-connect system).
✔Designing a prototype trunk line work station support processor for a new feature in a 5ESS switch.
✔And designing a 1.25 µm 16x16 bit CMOS multiplier as an experiment in standard cell design methodology.

Though she has spent much of her professional life thus far in problem-solving for electronics and communications, Kuska's first love is physics: "But they don't give you jobs in physics." Specializing in quantum mechanics while earning a B.S. in electrical engineering from Cornell University and an M.S.E.E. from Stanford, Kuska amassed a number of academic honors, including a Ford Foundation Graduate Fellowship, a GEM Graduate Fellowship, a Bell Laboratories Engineering Scholarship and Cornell's John McMullen Dean's Prize.

A parrot named Rover

When TCI beckoned, Kuska jumped at the chance to leave California for Colorado: "For me, California was always too expensive, too crowded, too much crime." Plus, her new home allows her access to abundant adventures. Her list of mountain activities includes hiking, skiing, whitewater rafting and experiencing a dude ranch. She also enjoys tennis, ice skating and collecting antique furniture (the latter because she abhors particle board).

And there's still plenty of time left over to spend with Tweepy, Baby, Rover and Fluffy, Kuska's pet parrots. "I got my first one (a cockatiel) when I was an undergraduate," notes Kuska. But four birds? "You can't keep a bird alone because they are flock animals, so I got a second one to keep him company. And when I started working at Pacific Bell, I wanted a parrot that played more like a dog, so I researched the types of parrots, and bought a Lory." (All this, and time to devote to pet research, too.)

While she has accomplished enough–both personally and professionally–to be an individual twice her age, Kuska's secret may be that, while some of the rest of us are moving at a normal speed, she's moving a little closer to the speed of light. No wonder she looks so young.

–Dana Cervenka

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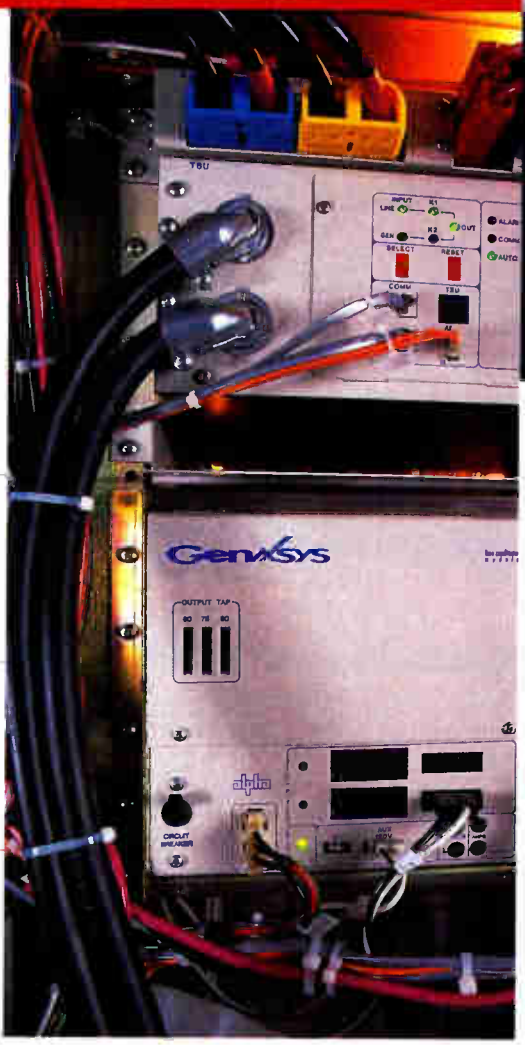

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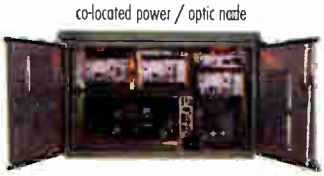

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How to build a stainless steel house

By Wendell Bailey, VP of Science and Technology, NCTA

In 1981, the cable television industry was beginning to look into expanding its involvement in upstream activities. In fact, at that time, the NCTA maintained a publication known as the *Enhanced Services Guide* that listed systems which offered such things as teletext, security and two-way services. The best known of these early efforts was the QUBE system by Warner Cable. This service was used in several communities, and was the subject of literally thousands of articles about future two-way offerings.

One of the issues that began to surface in late 1981 was directly related to the QUBE service. Certain segments of the communities where QUBE was offered were concerned about the use to which cable operators would put subscriber information that was collected. It seems that people were concerned that some of the features of the interactive service could reveal who watched what, and when. It is true that the system could determine the details of what channel was turned on and which movie service was authorized. The issue of privacy and concern about "Big Brother" had arrived in cable land.

The NCTA and its board of directors decided to do something about this concern, and the result was a set of guidelines that spoke to what information could be collected, and under what circumstances it could be used. Specifically, these guidelines gave the subscriber the right to demand that no information collected by the operator could be used for any purpose except the actual operation of the cable system without the written permission of the subscriber.

Giving our privacy away

Today, one would have to say that, in terms of danger to our privacy, the cable issue in the world of QUBE was light years away. Today, privacy is uppermost in our minds. The Internet and its capabilities have made it possible to find out just about anything, about just about anyone, in only a minute. There are dozens of databases, web sites and computer programs that can identify you through a wide variety of details. Anyone who knows your telephone number has an absolute lock on your address. Anyone who knows your address has an excellent chance of finding out where you work, and anyone who knows your name and address is just an eyelash away from finding out your social security number. Sometimes you give this information freely to someone who asks for it in connection with a service or a purchase. It may seem incredible, but virtually any detail that a commercial merchant gets from you can end up on a list that is available through the previously-mentioned venues.

Perhaps a few examples are in order. If you are a ham operator and are active on the air, anyone (either another ham or just a short-wave radio listener) can get your call sign, go on the World Wide Web and access a license database from the U.S. government that has your name, address and birthday! If the government database is off-line, not to worry–there are at least three other web sites that have the same data.

If you were paying attention to the press a few weeks ago, you would have heard about a major online database, widely used by professionals, that, for a period of 11 days, made available to anyone who knew what to ask for details about you that included your social security number. A loud, negative public reaction to this offering caused the company to change its service so that the social security number is no longer available. I don't know about you, but I still wonder how this company got my personal details in the first place.

That, of course, is the crux of the issue. How exactly do the people who offer to "give me up" get the data? The answer is, I gave it to them, just as you have given your data to them. We do it in a hundred ways, and we have been doing it for years. It is done thoughtlessly and innocently and inadvertently, but nonetheless, *we* do it. What does it mean? What is the extent of the danger to ourselves and our friends and families? After all, we live in a country that is governed with our consent, what harm could there be? (That last sentence was heavy with irony, in case you missed it.)

The first floor is in place

Many years ago, I read a book that I have never forgotten. In a roundabout way, it was about this very issue. The book was titled, *The Stainless Steel Rat*, by Harry Harrison. It was about a world that was just about to finish the monumental task of putting all of the details about all of the people on the face of the earth into one gigantic database.

The scenario was that physical money would no longer be needed, because everywhere you went, there would be a terminal that would know all about you, if you just passed close enough to be scanned. The hero of the piece was the fellow who was hired to complete the programming of the massive system with the details of the last un-entered people. At this point, the protagonist realizes that he has the ability to be the only person on the planet who is NOT entered into the system, and this state of affairs might have a benefit. He poses a question to himself: What kind of varmint could survive in a house made entirely out of stainless steel? The answer, of course, is a stainless steel rat.

We are rapidly approaching a time when it will be hard to quibble with those who believe that the Internet and the government have together, perhaps inadvertently, built the first floor of a stainless steel house. CED

Have a comment?
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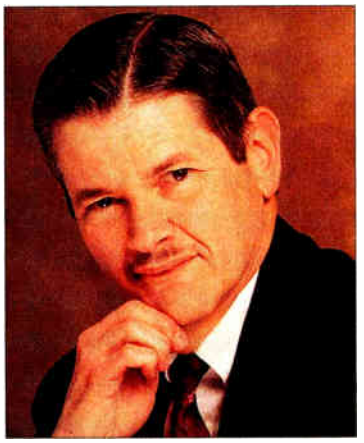
Reader Service 10

Resolution and bandwidth: The twins



By Jim Farmer, Chief Technical Officer, Antec

Last month, I discussed some of the parameters of the NTSC television system and how we got to where we are today. I also looked at some of the bandwidth reduction tradeoffs used in the PAL and NTSC systems. The point was made that, as good as the work of the MPEG committee has been, there was an awful lot of very impressive work that came before.

In NTSC television, there are 480 or so lines of active video on the screen, out of a total of 525 lines transmitted. I talked last month about interlaced scanning, a bandwidth reduction technique in which alternate halves of the picture are painted, with the two halves interlaced.

Unfortunately, interlace scanning is not a perfect answer. One problem, seen when we are reproducing still pictures, is that the interlace is not perfect. That is, the two halves of the picture don't fit together quite correctly. This is because of imperfections in the scanning process, and manifests itself as too much space between the two interlaced halves on one side of a line pair, and too little on the other. Another problem is that, because each half of the picture (field) is updated only 30 times a second, the field does exhibit flicker. Each field is flickering out of phase with the other, producing what some call "interlace flicker." For these reasons, we lose vertical resolution from the interlace.

Painting twice as many pictures

Some people want to eliminate interlace scanning from high definition television because it is harder to generate in a computer, and it doesn't compress as well. The former reason is why most computer monitors don't use interlaced scanning (they also run at a much higher frame rate, which costs money and takes bandwidth). On the other hand, interlace does a pretty good job on entertainment video. The highest resolution mode of MPEG cannot be transmitted in six megahertz, if interlace scanning is not used.

If interlace were to be eliminated, one would have to paint twice as many pictures on the screen each second, in order to maintain about the same flicker reduction. This means that the vertical and horizontal deflection rates would be doubled. Because the deflection circuits use a lot of power, the amount being proportional to the square of the scan rate, then power consumption would increase. Further, costs for the appropriate hardware would be higher. However, one could obtain better picture quality this way.

Some programmers have announced their intention to transmit HDTV in progressive scan format. The nature of the beast is that the TV can decide whether or not to display that picture using progressive or interlaced scanning, just by the way in which it reads the decompressed picture out of memory.

Last month, I said there is a way to talk about lines of resolution horizontally, even though the picture is not broken into lines vertically. Today, there are about 480 active lines on the screen. I'll put in a fudge factor (which, by the way, happens to make the numbers come out right) and say that we have effectively about 70 percent of 480 lines, after allowing for the limitations of interlaced scanning. Seventy percent of 480 lines gives us 336 effective lines of vertical resolution. If we want the same resolution horizontally as vertically, we will need 4/3 as many lines, because the screen is four units wide for every three units high. This gets us from 336 lines up to 448 lines.

Lines of HORIZONTAL resolution, when the screen is broken up VERTICALLY with lines? Yep, we can talk about lines of horizontal resolution. Look at it this way: Suppose the camera is photographing a bunch of vertical lines, alternating between white and black. How many such lines could be displayed on the screen? If we are to have the same resolution horizontally as vertically, we need to be able to display 448 separate black and white lines, and we need adequate baseband bandwidth to make that happen. For every time that the camera picks up one black line and one white one, the electrical signal goes through one complete cycle. It wants to go through 448 changes, or half this number of cycles, 224, in one horizontal line.

Now one line lasts for roughly 63.5 microseconds. But this includes sync and the front and back porches, not just active picture time. The actual active picture time is about 53 µS, so it is in 53 µS that the electrical signal must complete 224 cycles. Now 224 cycles divided by 53 µS yields a frequency of about 4.2 MHz, which just so happens to be the maximum baseband frequency allowed in the NTSC television system! (Now, how did I know that would work out?)

The alert reader will note that the NCTA uses 4 MHz, not 4.2 MHz, as the maximum frequency, for example, in computation of carrier-to-noise ratio. This is pretty close, though, and in real systems, we are lucky to get the extra 200 KHz. In fact, when color was added, the maximum luminance (black-and-white) frequency dropped from 4.2 MHz to around 3 MHz. That made the pictures less sharp horizontally, but people preferred color to horizontal resolution. (In the modern vernacular, one could say that pixels, or picture elements, are rectangular, not square, because there is less resolution horizontally than there is vertically.) Later, when comb filters were developed, we got some of the lost resolution back, but that's a story for some other time.

How about that: We started with the vertical resolution in lines, and wound up computing the maximum baseband frequency in the NTSC system. Amazing what modern science can do. CED

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Reader Service 11

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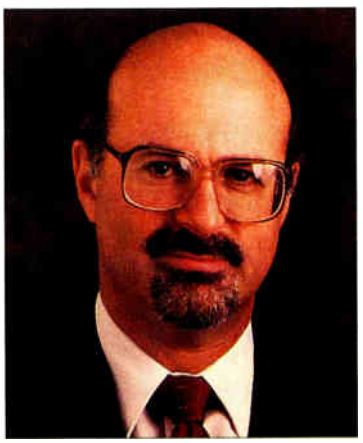
Evolution of the local phone market



By Jeffrey Krauss, waiting for local phone competition and President of Telecommunications and Technology Policy

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

The 1996 Telecommunications Act established a national policy of competition in the local telephone business. Today, there are many potential competitors on the horizon, each associated with a particular technology–cellular, PCS, LMDS, DEMS, 38 GHz, optical fiber, and of course, cable TV. But I believe that in the long run, there will be consolidation, and there will be a small number of competitors, each utilizing a mix of technologies. This will be driven by customer demand for "one-stop shopping," the recognition that no single technology can meet all user needs and the need to foster a healthier business climate. FCC policies need to be adjusted to encourage this consolidation, or at least, to eliminate the current notion of "the more competitors, the better."

The players today

Today, the potential local telephone competitors are generally associated with a single technology. The existing local exchange telephone company, for example, serves most customers using twisted pairs of low bandwidth wires, each wire pair dedicated to a single phone line. Companies like Metropolitan Fiber and Teleport serve most of their customers by running digital optical fiber to the customer's location. Cable TV companies employ coaxial cable to the home.

And then there are numerous wireless technologies that will be used for local phone service. Most of these require licenses from the FCC. There are two cellular phone companies in each area. (In most cases, the local telephone company owns one of the two cellular companies, but operates it as a separate business. Pacific Telesis has actually gone so far as to divest its cellular operations into a totally separate company, called Airtouch.)

There will be several PCS operators in each area, such as the Sprint Spectrum service operating in the Washington D.C. area. While there are some business affiliations developing in this sector, so far, they are between a PCS operator and a long distance carrier (AT&T, MCI or Sprint) rather than between PCS and a different local loop technology.

Fixed wireless technologies that can support local telephone service include Digital Electronic Message Service (DEMS) at 18 GHz, Local Multipoint Distribution Service (LMDS) at 28 GHz and the frequencies at 38 GHz (which don't yet have their own name). The major players in these technologies are Associated Communications, headed by former AT&T President Alex Mandl, in the DEMS service; CellularVision in the LMDS service; and Winstar at 38 GHz. But the FCC plans to hold auctions for additional licenses in these services, so additional players will emerge.

Finally, there are unlicensed wireless services that could be used for local loop service. Frequency bands for these include 915 MHz, 2450 MHz and 5800 MHz using spread spectrum technology, and 1900 MHz and 2400 MHz under the new "unlicensed PCS" rules.

What these new competitors will find is that no single technology meets all customer needs. Each technology has both advantages and disadvantages.

Twisted pairs, optical fiber and coaxial cable all require long intervals between placing an order for service and installing the fiber or cable. The phone company has a huge advantage here–it has wire in place already to serve customers almost everywhere. But new competitors have to go through the pain and delay of cutting through streets and sidewalks to serve new customers. Once in place, it's easy to hook up additional customers.

Cellular service is available almost everywhere. Once the local phone companies lower the interconnection fees they impose on cellular calls, which they are required to do under the 1996 Telecommunications Act, cellular service will become much less expensive. But cellular technology is mostly analog and will be for many years, channel bandwidths are narrow, and thus high-speed data is difficult to support. Perhaps PCS will overcome this limitation, but even so, it will take many years for PCS coverage to match cellular or phone company coverage.

The fixed wireless technologies all have the advantage that they can employ highly directional antennas in order to reuse frequencies from one cell to the next. But they require direct lines of sight between transmitter and receiver, which may be difficult to accomplish for some locations. The unlicensed wireless technologies are far from perfect, because if these frequencies become congested, there is a risk of interference. But service to new customers can be provided almost instantaneously—no delay caused by FCC licensing.

A combination of technologies, not a single technology, is the best way to go, because of customer requirements, time factors and physical limitations. Companies that want to compete against the phone company need a broad portfolio of technologies. But so far, the only ones who have learned this lesson are the phone companies themselves. US West and Bell Atlantic are experimenting with unlicensed wireless equipment from Tadiran as a way to quickly install service to new customers when twisted pair capacity is exhausted, and new cables would take months to install.

Current FCC policies fail to encourage joint ventures among technologies that can compete with the phone company. To the contrary, there are FCC policies that limit the number of channels or amount of spectrum that one licensee may control. These policies actually discourage joint ventures.

Current FCC regulatory policies are based on the notion that "the more competitors, the better." But in the real world, a few healthy competitors, with broad portfolios of technologies, will be more effective against the existing phone companies than a multitude of small, weak companies each using a single technology. CED

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Reader Service 12

'BTSC now, or forever have no peace'

The following is a conversation that may soon occur (and indeed is occurring) in many households as digital video technology is disseminated. Digital transmission and reception equipment manufacturers, system operators, programmers, broadcasters and other involved parties would be well advised to seriously heed the warning within. Witnesses at weddings are advised to raise concerns through the admonition to "speak now, or forever hold your peace." As the marriage of digital transportation and analog TVs begins, this "piece" will discuss why we must "BTSC now, or forever have no peace!"

Prologue: The press has recently been inundated with reports of digital video technology for broadcast, cable, MMDS and other industries near at hand. Multi-hundred million, and even billion dollar contracts have been entered into for next-generation digital set-tops. While the author has certainly not been privy to the design specifications of these set-tops, prototypes and architectural renderings indicate that none of the current designs include the ability to generate a BTSC carrier with its requisite subcarriers, matrixing, and companding, despite having up to five channels available for stereo/surround sound (AC-3) under MPEG-2. My research has revealed that a significant percentage of stereo televisions, both currently in the home and in the marketplace, do not have discrete baseband audio jacks, and can only reproduce stereo signals by decoding a BTSC carrier. Read on, and delve into the world of the "F" connector input customer, or shall we say, "potential" customer?

Technician: Hello, Mr. Lansing.

Customer: Call me Altec.

Technician: Pardon me, but I can't help noticing your name matches that of a famous designer and manufacturer of audio equipment. Any relation?

Customer: Oh no, no, no. Just a coincidence, but albeit an appropriate one, 'cause I LOVVVVVEEE my audio! In fact, I wasn't able to sleep last night just thinking about getting your new digital service with crystal clear pictures and stereo that will knock my socks off. Come on in, and tell me more about your service.

Technician: Well, Mr. Lansing, our new advanced service delivers hundreds of digital channels directly to your TV. We use state-of-the art digital compression using the MPEG-2 transportation protocol. I could go into a lot of detail, but suffice it to say, there is absolutely no degradation in the signal as it goes through our network. What we send is what you get.

Customer: I'd like to hear more about how it gets here, but right now, I'm ready to see, and more importantly, hear what you've got. In fact, I've got a brand new 25-inch TV just for this new service. Hook me up!

"The right of aural separation ought to be one of the amendments in the Bill of Rights!"

Technician: OK! It will take me a few minutes to do some testing and setup of your equipment. Could you please sign this work order and fill out this survey while you wait?

Customer: Sure. I'll be at the kitchen table if you need me.

A few minutes later:

Technician (rather sheepishly): Mr. Lansing, could you please come here?

Customer: OK, I just completed the survey. Is there some kind of problem?

Technician: Well, I'm afraid there is.

Customer: Is it a problem with your network? I know new technology sometimes hiccups, but I can handle that. What's the deal?

Technician: No, the network is fine. In fact, I did not detect any errors at all.

Customer: Then what's wrong?

Technician: Mr. Lansing, I'm afraid your new TV doesn't have the right input connectors, and you will only be able to receive a mono audio signal.

Customer: What!!!! I paid hundreds of dollars for this set!! And what's more, it gets all your current stereo channels just fine! I saw the indicator light and could hear the stereo separation. Look, let me show you!

Technician: Well, it's a little complicated. If you had a stereo receiver or preamp, I could feed you stereo; heck, I could even give you five-channel audio. But you see, Mr. Lansing, your TV only has one jack on the back where your cable connects.

Customer (more agitated): Now why will the darn thing work in stereo on your old system, but it won't on your new and improved digital system? All your advertisements said this thing was better than candy to a baby. Now it looks like you are taking candy from the baby!

Technician (conciliatory): Well sir, to be honest with you, I don't think that the folks that designed or purchased these set-tops thought about TVs like yours. Our set-tops have left and right audio jacks, but your TV doesn't. I'm afraid there is not much I can do. But on the other hand, look at this picture!

Customer (controlled but highly agitated): Doggone it! I know it's not your fault, but somebody ought to be hoisted (up) for either being too cheap or too dumb to realize that there are lots of TVs like this. In fact, there are at least five of this exact model in my neighborhood. It's got a great picture, was very affordable, and USED to have dynamite stereo until somebody improved the system. Is the da#n government involved here!?

Technician (diving for cover): Tell you what, Mr. Lansing. I would like to leave you this new set-top with no charges for a month, while we research this situation further. In fact, I'll install a special connection so you can still receive your old stereo channels like you used to. What about that?

Customer: Well, I'll try it for free, but I guarantee you I will be on the phone with those satellite folks to see if their system is any better. If it is, you can kiss me goodbye!

Technician: I would encourage you to do that, Mr. Lansing, but I'm afraid they will give you the same answer that I did.

Customer: They better not! I won't put up with folks discriminating against me! I've got rights! It ain't in the Constitution, but the right of aural separation ought to be one of the amendments in the Bill of Rights! If what you say is true, I'm gonna write my representative. Heck, I'll even send the President an e-mail! What do you think of that!

Technician: Sir, you absolutely have the right to do that, but, again, let us research the issue while you view for free. Maybe we can find an answer.

Customer (calming down): OK, OK, OK. I know it's not your fault. Just tell your folks to find me an answer, quick! And the answer better not be NO!

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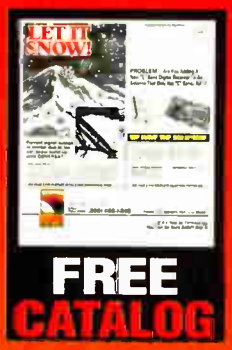

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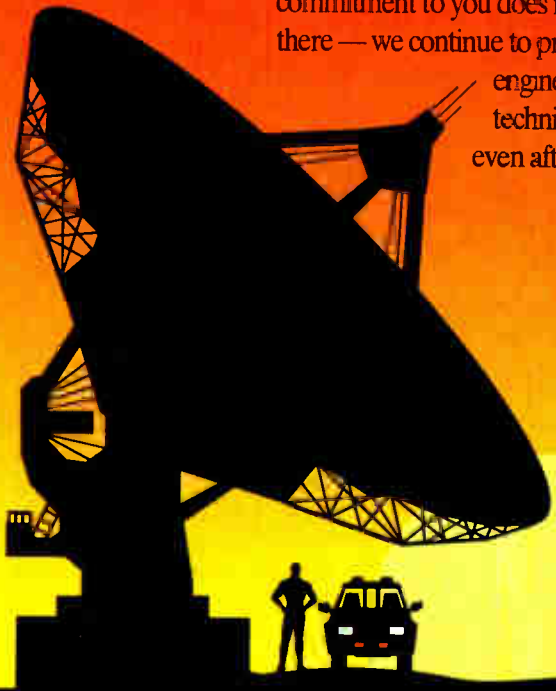

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Hybrid WDM systems for video trunking

High-capacity applications

By Chinlon Lin, Keang-Po Ho, Hongxing Dai and Jinyi Pan, Bellcore; and Hermann Gysel and Mani Ramachandran, Synchronous Communications

High-density wavelength-division-multiplexing (HD-WDM) and optical amplifier technologies are becoming important in high-capacity long-haul and metropolitan area fiber networks. Both technologies are of interest for high-capacity video trunking serving both telecom and cable TV networks. This article will discuss hybrid WDM systems in which the optical channels have different bit rates and/or different signal formats (e.g., mixture of four optical channels of baseband digital signals at 2.5 Gbps and one optical channel of passband subcarrier-multiplexed AM or M-QAM signals) for high-capacity video trunking applications. Based on HD-WDM systems in the 1550 nm region with erbium-doped fiber amplifiers (EDFAs), the performance of such hybrid systems is studied. Simulation results indicate that high-performance trunking of both digital and analog video channels can be achieved with proper design of a hybrid WDM system which takes into consideration the optical amplifier gain nonuniformity, different amplifier input power requirements and different receiver performance characteristics, WDM crosstalks, etc.

Video trunking–AM, FM and digital

Because of the expected increased demand for video and multimedia-based Internet and other broadband services, in the near future, the total transmission capacity on the fiber backbone networks will have to be increased substantially. The use of optical fiber transmission systems for video supertrunking applications in cable TV networks is well-known, and the signal format used in the trunking could be analog (AM or FM) or digital, each having its merits and disadvantages [1]. AM-VSB video trunking has the advantage that it does not require video signal format conversion at the distribution node as it is directly compatible with current AM-VSB TV receivers. The trunking distance and the overall signal quality, however, are more limited. In contrast, FM or digital supertrunking can achieve high signal quality but require format conversion or set-top boxes with conversion capability. FM supertrunking was quite popular, but baseband digital trunking systems offer better signal quality and very-long-haul trunking capability. Today, high-quality trunking of multichannel video signals over the regional backbone networks is often based on baseband digital optical fiber transport of digitized uncompressed video signals. This requires video signal conversion (digital to AM) at the hub before delivery to the HFC or FTTC distribution networks.

✔Digital video trunking for regional backbone networks. Multichannel baseband digital video trunking systems are typically designed to operate

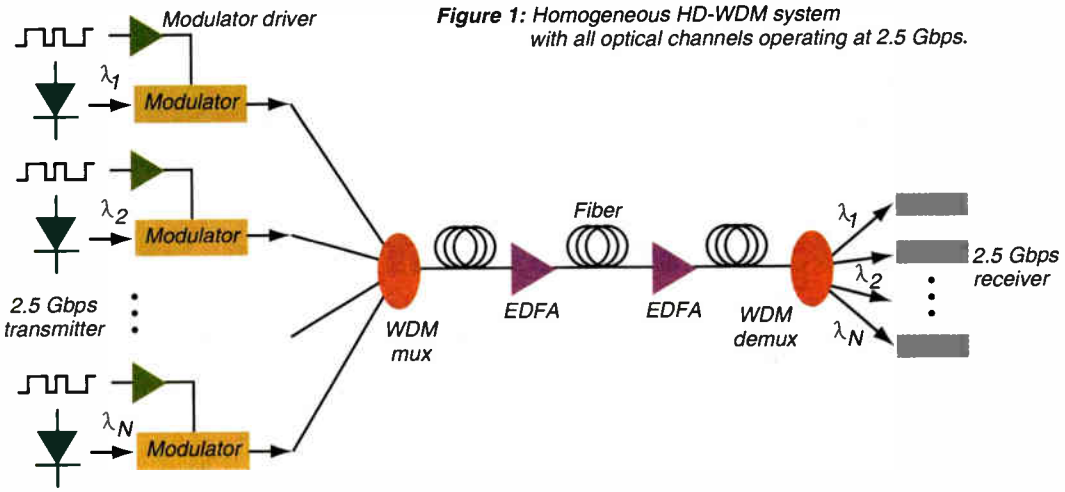

Figure 1: *Homogeneous HD-WDM system with all optical channels operating at 2.5 Gbps.*

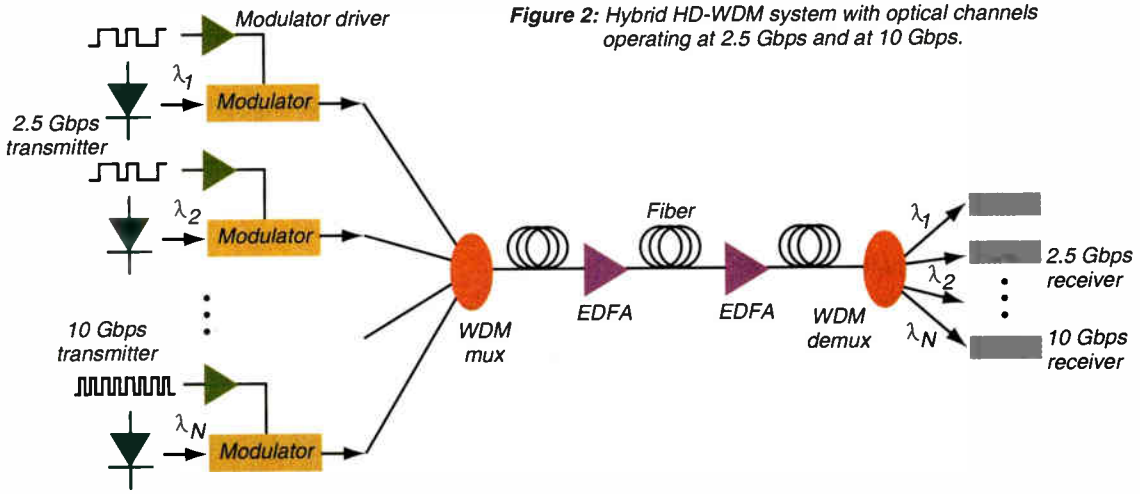

Figure 2: *Hybrid HD-WDM system with optical channels operating at 2.5 Gbps and at 10 Gbps.*

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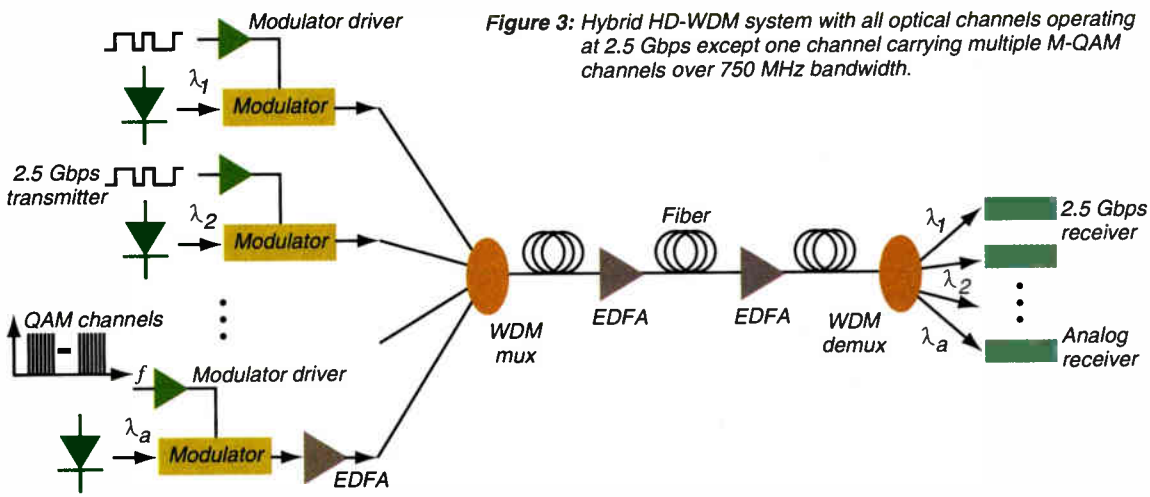

Figure 3: *Hybrid HD-WDM system with all optical channels operating at 2.5 Gbps except one channel carrying multiple M-QAM channels over 750 MHz bandwidth.*

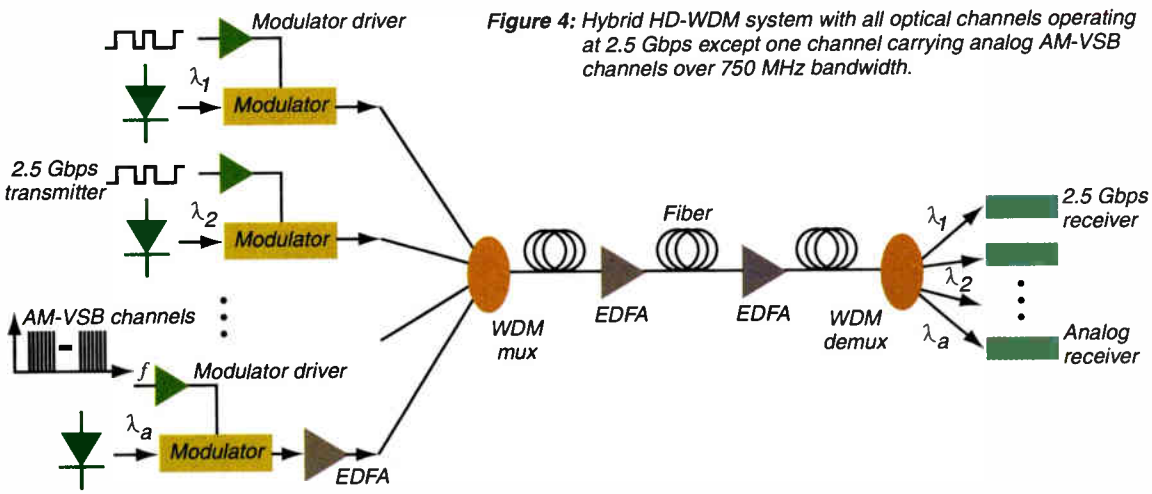

Figure 4: *Hybrid HD-WDM system with all optical channels operating at 2.5 Gbps except one channel carrying analog AM-VSB channels over 750 MHz bandwidth.*

close to 1.2 and 2.4 Gbps, for transporting up to eight or 16 uncompressed digitized PCM (pulse-code-modulated) video channels (assuming ~ 140 Mbps for each digitized PCM video channel). Such baseband digital trunking systems could be designed to conform with Sonet standards (e.g., OC-48 for ~ 2.5 Gbps operation), or alternatively, proprietary baseband digital PCM systems can be designed which are not compatible with Sonet standards [2]. The relative merits of Sonet vs. non-Sonet-based digital video trunking systems have been widely discussed [2,3] in terms of cost, performance and network reliability and flexibility, as well as compatibility with other traffic types over the telecom networks.

✔High-capacity video trunking: TDM, SDM and WDM. For trunking of more than 16 digital video channels, one can use higher bit-rate electronics and optics (higher speed TDM, e.g., at ~ 5 or 10 Gbps to double and quadruple the video channel trunking capacity). Or, one can simply use more fibers and more video trunking systems at a 2.4 Gbps rate (sometimes called SDM for space-division-multiplexing). Alternatively, one can use wavelength-division-multiplexing (WDM) of multiple optical channels over the same fiber. Such WDM techniques are now well-known for increasing the overall transmission capacity of optical fiber communications systems without installing new fiber links. Using multiple

(Continued on page 35)

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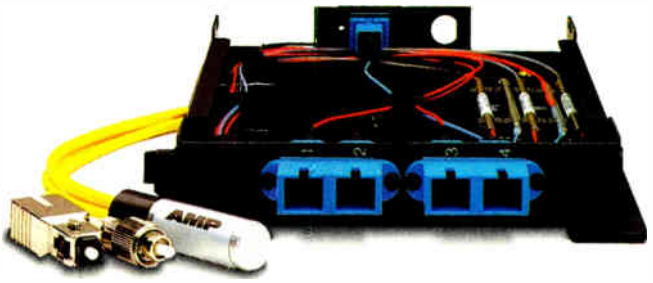

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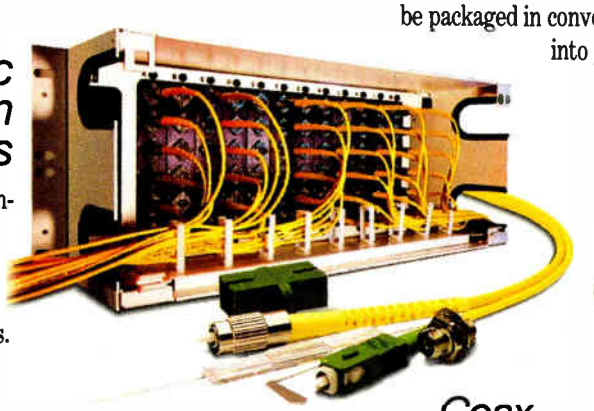

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Reader Service 17

WDM hot at NFOEC

If there was one major theme of the 12th annual National Fiber Optic Engineers Conference in Denver this year, it had to be wavelength division multiplexing. While it may be a bit soon to think about WDM for video services, it has become a huge issue in the telecom world as network providers are beating the bushes looking for additional capacity

With at least three panel sessions on the subject, presenters touched on WDM economics, system choices, case studies and control and management of such networks. And vendors appeared on the scene, telling all that they're rushing to develop electronics that offer ever-greater capacity. To date, several vendors have already introduced 4-, 8-, and 16-channel systems, and promise equipment that will feature ever-greater levels of multiplexing.

Of course, the other way to expand capacity is to transport signals at ever-greater speeds. Fujitsu and Alcatel were on hand in Denver to talk about their new OC-192 and 160 Gbps products, respectively.

The other newsworthy event was a historic Sonet interoperability demonstration between Bellcore, Fujitsu and Lucent. The three companies demonstrated a full, seven-layer OSI communications link between their equipment (see Figure below). The upshot is that telcos and cable companies can finally confirm that all OAM&P (operations, administration, maintenance and provisioning) info is being fully communicated from one network element to another.

The other newsworthy event was a historic Sonet interoperability demonstration

In the past, vendors chose to use proprietary equipment and protocols to provide the functionality their customers demanded, instead of using the complex OSI protocols. However, this never allowed the full suite of information to be passed between different vendors' equipment. But now that there is agreement on an interoperability specification, vendors will be incorporating it into future hardware, finally making it possible for multiple vendors to peacefully co-exist in the same network. The next step? To get more vendors to agree to build their equipment to the spec.

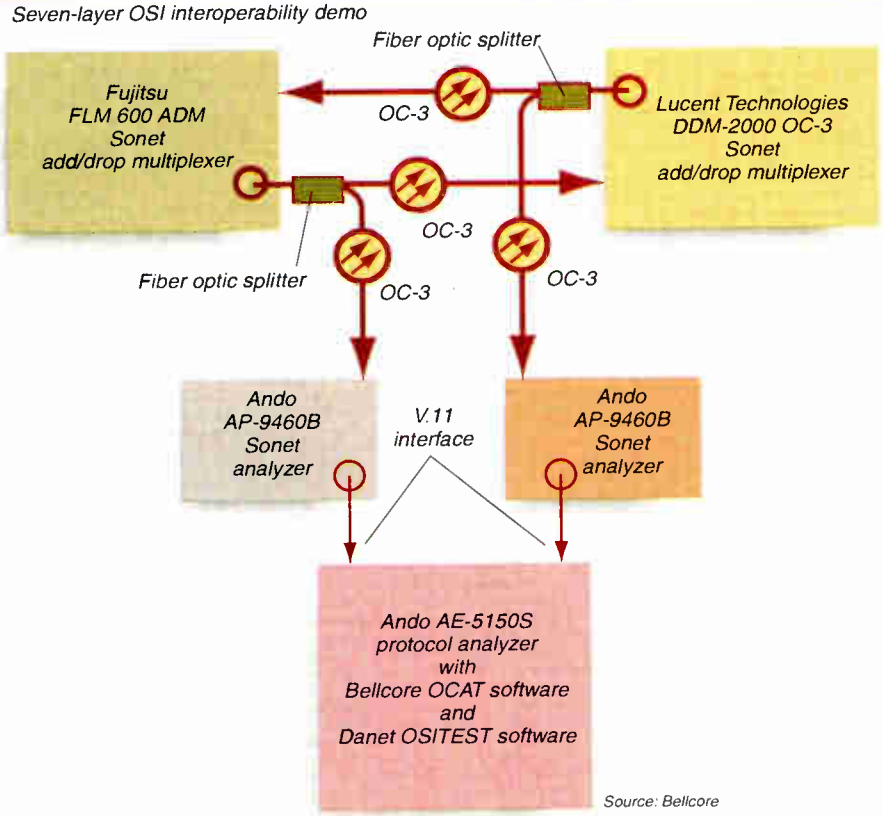
During the NFOEC demo, Fujitsu connected its FLM 600 ADM Sonet add/drop multiplexer to Lucent's DDM-2000 OC-3 Sonet multiplexer. Bellcore added its OCAT protocol analysis software to view the upper layer protocols on an Ando AE-5150S protocol analyzer.

Meanwhile, a separate demonstration in the Tellabs booth showed multi-vendor internetworking of Sonet network elements among Tellabs, Fujitsu, Lucent and Nortel equipment. Tellabs is the first digital cross-connect vendor to demonstrate interoperability with a Fujitsu add/drop multiplexer.

Finally, Tellabs' Titan 5500 digital cross-connect was tied to Nortel's S/DMS TransportNode OC-3 Express to show "reach-through connectivity" between the two products. This means that a network provider can bring a device such as Nortel's OC-3 Express under direct supervision of the central office via the digital cross-connect. Nortel's OC-12 and OC-48 products have also shown the same interoperability properties.

–Roger Brown

Seven-layer OSI interoperability demo



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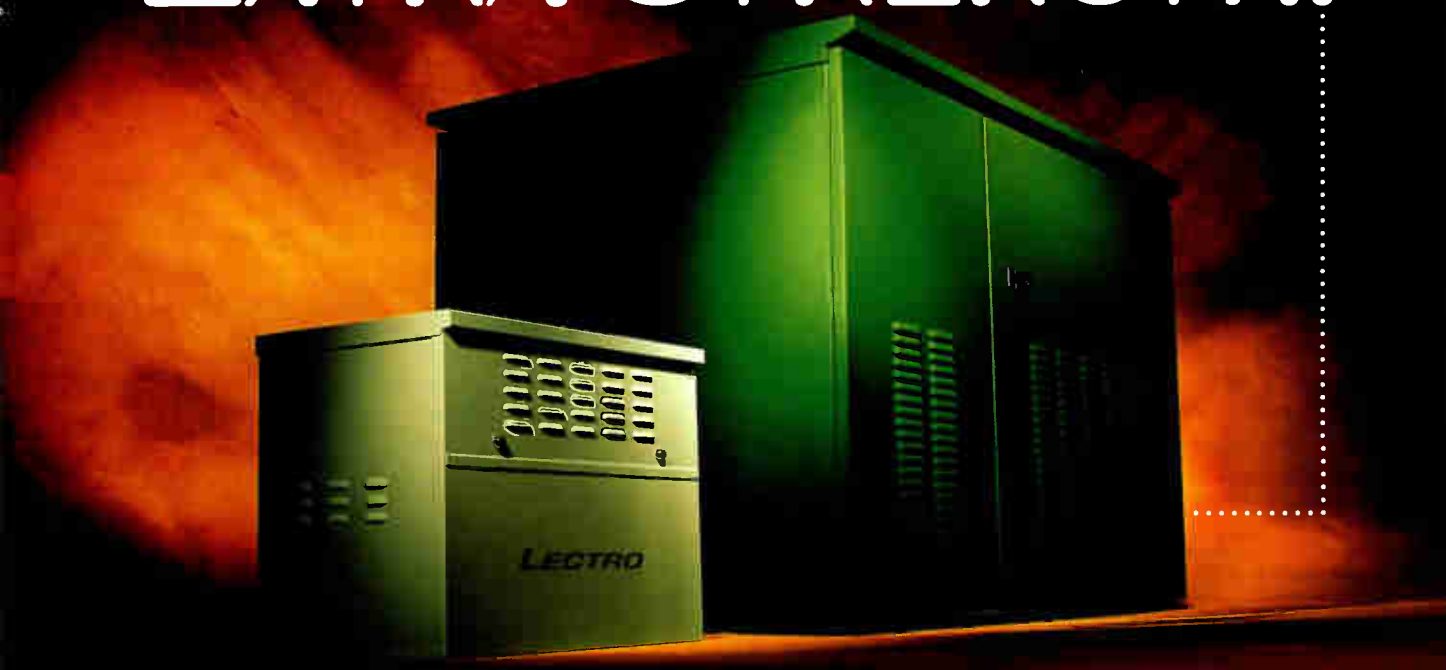

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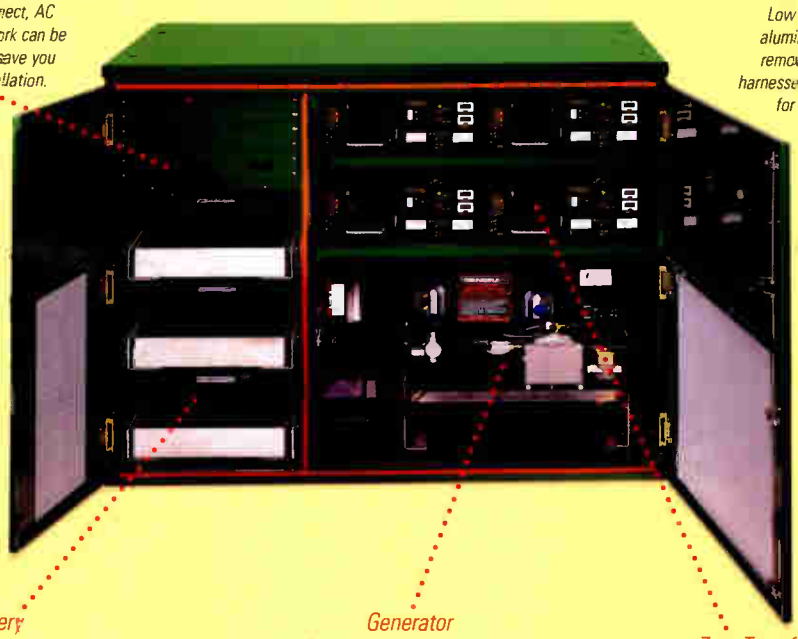

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(Continued from page 32)

optical channels, high-density (HD-) WDM systems show great promise for video trunking applications.

✔HD-WDM for high-capacity digital video trunking. For high-capacity video transport, e.g., trunking of 64-128 uncompressed digital video channels, HD-WDM systems with four to eight optical channels operating at 2.5 Gbps each can be used to achieve the goal. In HD-WDM systems, the optical channels typically may have an optical channel separation of, e.g., 0.8-4 nm, allowing, for example, four to 32 optical channels in a given fiber low-loss transparency window. Because of the lower loss of the 1550 nm region and availability of very efficient erbium-doped fiber amplifiers (EDFAs) for 1530-1560 nm signals, most of the HD-WDM system experiments were at 1550 nm (using 1550 nm DFB lasers with optical power increases provided by EDFAs). The use of HD-WDM is especially relevant for very-high-capacity digital video trunking. With 32 optical channels, one can deliver 512 uncompressed digital video channels over the same fiber link.

The need for ultra-high-capacity optical transport systems could be reduced by digital video compression (MPEG-2), allowing, for example, ~ 4 Mbps for each NTSC video channel, as compared with ~140 Mbps for uncompressed digital video. In principle, if the same HD-WDM trunking capacity for transporting 512 uncompressed digital video channels is used to transport compressed MPEG-2 video channels with ~ 4 Mbps per channel, more than 18,000 digital video channels could be transported over long distances even at a system electronic bit rate of 2.4 Gbps per laser transmitter wavelength. This would allow digital video broadcast of, for example, the entire catalog of video titles in a large video chain store or video library, making the video channels available for the subscriber to select by optoelectronic selection (wavelength tuning plus electronic tuning), without switching in the CO or headend. While such a system may be high-cost today, there is a long-term potential for such a broadcast system as costs fall in the future.

Recent experimental demonstrations reported at OFC'96 indicated as many as 55 optical channels (0.6 nm channel spacing), each operating at 20 Gbps, could be multiplexed and amplified within the EDFA bandwidth (~ 35 nm) to achieve a total transmission capacity of 1.1 Terabits/sec (1,100 Gbps) [4]. This is near the limit of the optical channel capacity for EDFA gain spectra; the result indeed highlighted the capability of HD-WDM with EDFAs. If such an HD-WDM system is developed for video transport, the 1.1 Tbps capacity would allow trunking and distribution of more than 7,000 (or 110 x 64) uncompressed digital NTSC video channels.

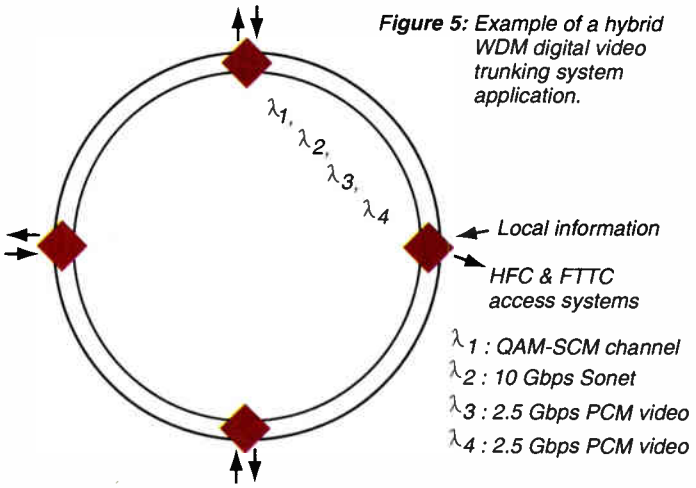


Figure 5: *Example of a hybrid WDM digital video trunking system application.*

✔Homogeneous and hybrid WDM systems for video trunking applications. Most of the WDM system demonstrations reported or real-life deployments so far are based on homogeneous WDM systems in which all optical channels are carrying digital signals operating at the same bit rate, e.g., 2.5 Gbps, 5 Gbps or 10 Gbps for each and every optical channel. One of the key attributes of WDM is a high degree of signal bit-rate transparency as well as signal format transparency. To

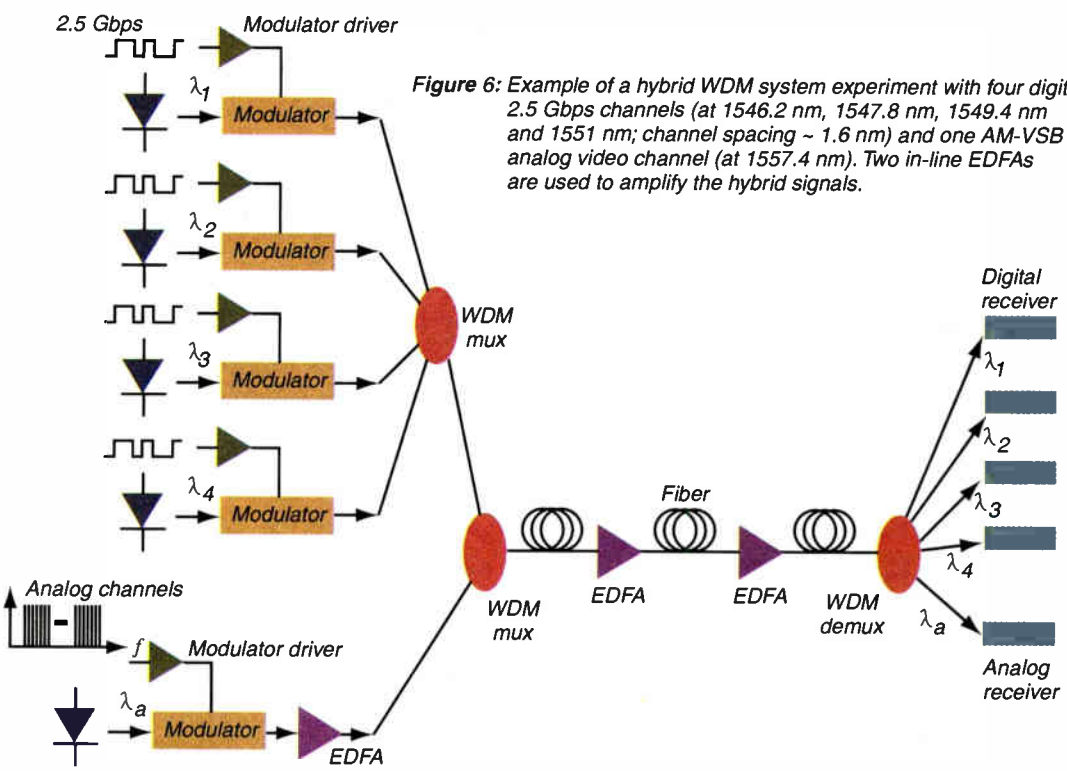


Figure 6: *Example of a hybrid WDM system experiment with four digital 2.5 Gbps channels (at 1546.2 nm, 1547.8 nm, 1549.4 nm and 1551 nm; channel spacing ~ 1.6 nm) and one AM-VSB analog video channel (at 1557.4 nm). Two in-line EDFAs are used to amplify the hybrid signals.*

Figure 7a: Spectral output after the first EDFA for the five-channel hybrid WDM system of Figure 6.

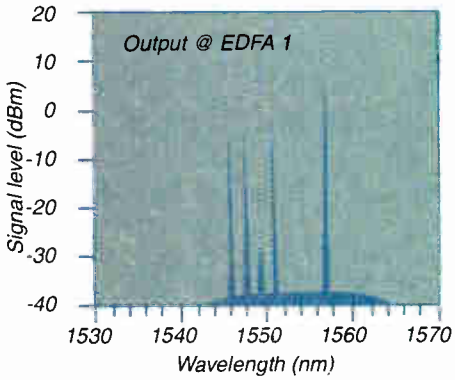
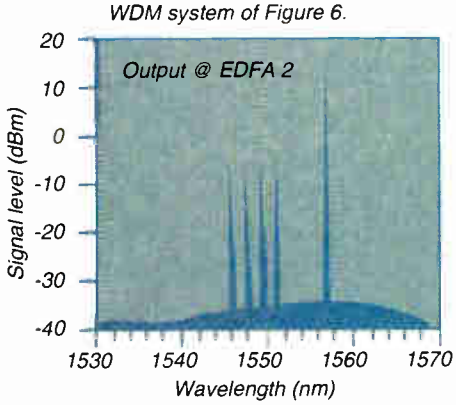


Figure 7b: Spectral output after the second EDFA for the five-channel hybrid WDM system of Figure 6.



take full advantage of this characteristic of WDM, both hybrid and homogeneous WDM systems should be considered for their potential applications. Here we consider four types of HD-WDM systems: (1) with all optical channels carrying digital signals at 2.5 Gbps; (2) with a mixture of baseband digital channels at 2.5 Gbps and 10 Gbps; (3) with a mixture of baseband digital channels at 2.5 Gbps and one optical channel carrying passband 64-QAM signals; and (4) with a mixture of baseband digital channels at 2.5 Gbps and one optical channel carrying AM video channels.

Figures 1-4 illustrate four such different WDM systems. The first one is the commonly-demonstrated homogeneous WDM system, where all channels carry the same digital signals at the same bit rate; the other three are the hybrid WDM systems in which a mixture of signal bit rates and/or signal formats are carried over different optical channels. A variety of signal format combinations is possible with hybrid WDM systems, making them ideal for flexible upgrades in the evolution of broadband networks.

Applications of such hybrid WDM systems for high-capacity video trunking are of great interest in the "full-service networks" envisioned by both cable TV and telecom network providers. In fact, both HFC (hybrid fiber/coax) and FTTC/FTTH-based access networks can be served with such a trunking network. Figure 5 shows the schematic of such a digital video trunking application based on hybrid WDM systems [5].

In the WDM systems illustrated in Figures 1-4 with each optical channel operating at high speeds (2.5 Gbps or 10 Gbps per channel), the dispersion of the embedded 1310 nm optimized conventional singlemode fibers may cause significant dispersion penalties when the optical-channels operate in the 1550 nm region for lower fiber loss and efficient erbium-doped fiber amplifiers (EDFAs); therefore, practical dispersion-reducing or dispersion-compensating fibers (DCF) [6-9] over the entire wavelength region of interest may be needed. Use of the EDFAs and DCF may become an important system design consideration in such 1550 nm-based hybrid HD-WDM systems.

The disparity between the power budgets of lower- and higher-speed digital systems, as well as the greatly different required received optical powers for digital vs. analog optical channels, are critical system design issues for such hybrid WDM systems. The following section describes the simulation results of a hybrid WDM system.

✔An example of a hybrid AM/digital WDM video trunking system with EDFAs. In a hybrid WDM video trunking system corresponding to Figure 4, with several optical channels operating at 2.5 Gbps and one optical channel carrying AM-VSB video signals, the analog and digital channels are carried as separate wavelength channels. Cascaded EDFAs are used to increase the link power budget and the transmission distance.

The major challenge in such a hybrid system is to meet the stringent carrier-to-noise ratio (CNR) requirements for the analog channels while maintaining adequate transmission performance for the digital channels. Recently, we have demonstrated hybrid AM-VSB/M-QAM video trunking with cascaded EDFAs [10]. It has been found that high-quality analog video transmission can be achieved if each in-line EDFA is operated in the deep-saturation regime. This typically requires an input optical signal level greater than 3 dBm.

In a hybrid AM/digital WDM system, however, the desired operating point for the analog channel leads to a dramatic difference in optical signal levels between analog and digital channels at the input of in-line

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Reader Service 19

The digital channels "see" only the saturated gain, rather than the small-signal gain. . .

EDFAs because of the relatively low output power in digital lightwave transmitters. Consequently, the operating point of each in-line EDFA is dominated by the analog channel and the digital channels "see" only the saturated gain, rather than the much higher small-signal gain in a purely digital system with cascaded in-line amplifiers.

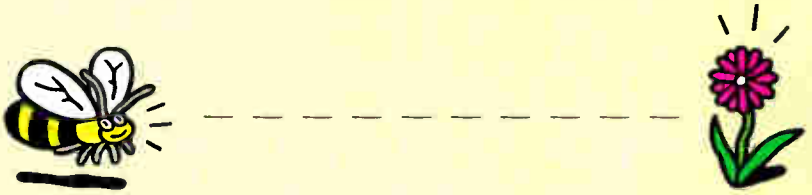
From a system-design point-of-view, it is important to balance the optical signal level requirements for both analog and digital channels by appropriately choosing a target link power budget to ensure adequate AM channel CNR and digital channel signal-to-noise ratio (SNR) at the optical receivers. Moreover, because of the intrinsically non-flat spectral gain profile in EDFAs, gain equalization may be necessary between digital channels such that signals from all digital channels are received within the receiver's dynamic range.

To understand these issues further, we performed computer simulations of the transmission of a five-channel hybrid AM/digital WDM system with two in-line EDFAs. The schematic of the hybrid WDM system transmission experiment is shown in Figure 6.

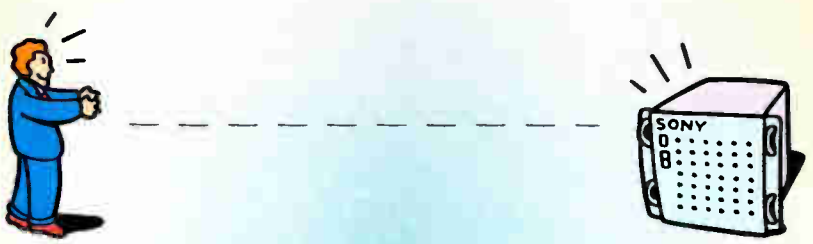
There are five optical channels in the hybrid WDM system depicted in the example of Figure 6. The four 2.5 Gbps digital channels are placed at 1546.2 nm, 1547.8 nm, 1549.4 nm and 1551 nm, with channel spacings of about 1.6 nm (optical frequency spacing equals 200 GHz), respectively. The one analog, AM-VSB optical channel is placed at 1557.4 nm, well-separated from the digital optical channels. The output power of the AM laser transmitter is assumed to be 16 dBm, and that of the digital transmitter is 0 dBm. The five optical channels are combined by an interference-filter based wavelength-multiplexer [11] with the low-loss side at the AM wavelength.

The insertion loss from the mux for the AM and each of the digital channels varies between 2.5 dB and 4.5 dB for the concerned wavelength span. An additional 1 dB loss margin is included to account for the various connector losses, etc. Based on our previous AM video trunking studies [10], the optical power of the AM channel is set at 3 dBm at the first in-line EDFA, corresponding to a 9.5 dB power budget for the first leg of the fiber link.

A spectrally resolved numerical model is used to perform a computer simulation of the performance of the EDFA [12].The pump to the EDFA is assumed to be 70 mw at 980 nm. The results are shown in Figures 7a and 7b.



(bee) (flower)



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Reader Service 21

SONY

XPM may impose practical limitations on the actual system performance

Figure 7a shows the spectral output after the first EDFA. As expected, the amplifier is saturated by the analog channel with a saturation output power of 16.2 dBm. The digital channel outputs are between -0.9 to -2.2 dBm. With the AM channel level set at 3 dBm at the input of the second in-line EDFA, the output signal levels and noise spectrum are computed and given in Figure 7b.

Once again, the AM channel dominates with a saturated output power of 16.2 dBm, while the digital channel levels dropped to between -2 to -4.1 dBm. Indeed, pronounced signal level difference (>2 dB) is seen between digital channels due to the accumulated gain tilt in the EDFA cascades. A symmetric interference-filter-based WDM demultiplexer is used to separate each optical channel.

If the AM channel is received at 0 dBm optical power, the link power budget after the second in-line EDFA is approximately 10.5 dB, and the total link budget is 33 dB. For digital channels, on the other hand, the received optical power levels are between -18.1 dBm and -17.3 dBm, which are well within the normal operation range of the 2.5 Gbps optical receivers.

The computer simulation results indicated satisfactory performance for both the analog and digital optical channels for the five-channel hybrid AM/digital WDM video trunking system shown in Figure 6; with a total link power budget of 33 dB, transmission over 100 km of single-mode fiber is possible. Based on our previous single-optical-channel analog transmission results [10], the AM channel should offer a CNR better than 49 dB with negligible distortion degradation. The digital channels should also offer error-free transmission based on the above numerical simulation.

Finally, note that the penalty from fiber nonlinearities such as SBS or XPM has not been included in the model. Although SBS effect can be minimized by the specially-designed laser transmitters, XPM may impose practical limitations on the actual system performance of such a multi-wavelength system.

Experimental results of fiber transmission measurements of such five-channel hybrid WDM systems in the 1550 nm region show that transmission over 100 km of embedded conventional singlemode fiber can be achieved with error-free performance of the four digital optical channels (at 2.4 Gbps each, with a total capacity ~ 10 Gbps for uncompressed digital video channels), and a CNR of 50 dB for the analog optical channel carrying 80 channels of AM-VSB video sig-

nals, with CTB and CSO less than - 65 dBc. Such a hybrid WDM system demonstrated the feasibility of hybrid digital and analog video trunking and the advantage of the transparency of WDM techniques.

Summary

Hybrid WDM offers the potential of high-capacity mixed signal-format video transport to serve different network and service needs. Simulation results indicate that high-performance trunking of both digital and analog video channels can be achieved with proper design of a hybrid WDM system which takes into consideration the optical amplifier gain nonuniformity, different amplifier input power requirements, and different receiver performance characteristics, WDM crosstalks, etc.

The challenge is to design and implement such hybrid WDM systems in a cost-effective manner so network providers can deploy such systems to achieve the network flexibility for providing current and future services over the same fiber network. CED

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Hybrid WDM offers the potential of high-capacity mixed signal-format video transport

Telco video plans becoming clearer all the time

But pending mergers could cloud the image

By Roger Brown, Michael Lafferty and Dana Cervenka

What a difference two years can make. Back in 1994, the buzz around the telecom industry was how every major telephone company was going to aggressively upgrade its network with fiber optics and would be offering a suite of broadband services (e.g., cable TV, interactive entertainment and information, home shopping) to American consumers–all within a tight timespan.

Then reality sunk in and displaced the hyperbolic promises, and suddenly no one was doing anything. Bell Atlantic backed off its plan to deploy hybrid fiber/coax-based networks, opting instead to wait until switched digital video equipment was mature enough and cost-effective enough to deploy. US West and others followed that lead.

Meanwhile, Pacific Telesis, Ameritech and Southern New England Telecommunications forged ahead, convinced that HFC was an architecture that provided them not only broadband capacity, but operational savings over their traditional, copper-based networks as well. But there were sticking points: network powering required some innovation, and integrating multiple services on the platform took a lot more engineering than many would have guessed.

But now, several of the nation's largest telcos are poised and ready to enter the video and high-speed data market. Some are still testing the waters, while others are jumping in with both feet. *CED* editors recently contacted each of the nine major telcos to uncover their latest video strategies. What we found was a wide range of approaches and, in some cases, strategies that are still emerging.

The collection of articles that follows is the result of our behind-the-scenes look into the telecommunications world.

PACIFIC BELL®

A Pacific Telesis Company

Firm believers in HFC, with a dash of MMDS added in

Along with Ameritech and US West, this San Francisco-based regional Bell operating company is considered to be a leader in the development of a broadband networking strategy that covers voice, data and video as it attempts to protect its core business by fortifying the state of California.

Through its Pacific Bell Video Services division, the company is taking a two-pronged attack: embracing hybrid fiber/coax design as the platform for all wireline services in San Jose and San Diego; and deploying digital MMDS technology in the Los Angeles/Orange County areas as a means to attack the market quickly and cost-effectively.

Unlike many other telcos, PacBell is convinced that switching to the HFC architecture for all services, including voice, will save the company millions of dollars in operational and maintenance costs over the life of the network. So the company's engineers took the architecture and built it to telephone company specs for reliability and route redundancy.

"I have a Bell-shaped head," admits Keith Cambron, executive director of network systems engineering for the company. "We built it using telephony standards, so this is an extremely high-quality signaling network."

ILLUSTRATION BY BOB STEWART

As such, it's been designed for voice services, which remains the company's primary priority. But video and Internet access services are close followers, according to Cambron, because they are additional revenue generators.

By virtue of its cable TV franchise in San Jose, PacBell has been busily constructing a network to serve that community and now passes nearly 20,000 homes, according to Cambron, but plans to pass about 35,000 homes by the end of 1996. Crews have passed about that many homes in San Diego as well (the goal is to pass about 160,000 homes in the two areas combined by the end of 1997), but without a franchise to offer cable TV, that network is being built for telephony.

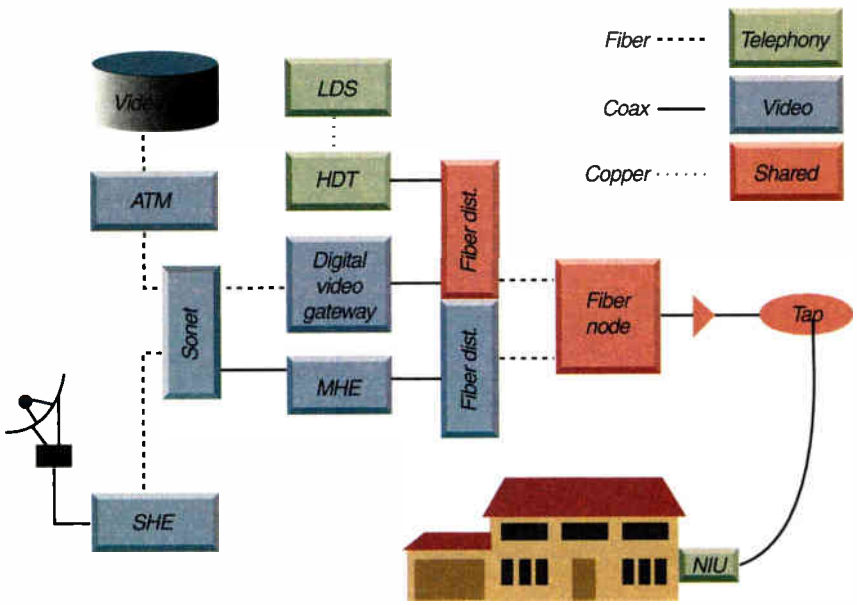
While PacBell has been aggressively pursuing the video business, its strategy could certainly change after the company is merged into SBC Communications, which is likely to happen sometime later in the first quarter of 1997, by all indications. "We definitely will complete the construction in San Jose, but they're (SBC) going to have to make construction decisions for 1998 and beyond," Cambron notes. "Our goal is to continue to build the network, prove that the technology works and that it's a good economic decision, but in the end, the construction program and commitments will be made by SBC. In San Jose, we're absolutely committed to that construction, and it will continue beyond 1997 regardless."

Cambron said he had met with SBC senior management to share his views on HFC and characterized SBC as being in "much more of a study mode than we are." Although SBC owns the former Hauser cable properties and is funding an HFC build in Chile, Cambron said SBC officials also seem to be interested in switched digital video technology as well. "They're familiar with both technologies but really don't have a full service network up and running commercially."

But make no mistake: Cambron is clearly an HFC proponent, whether the company pursues the video business or not. "In places like San Diego, it's more economic to put in (an HFC network) than to put in copper," he notes. "It's a good investment whether you're going to get into video right away or not. People tend to think video is the sole focus for what we're doing, but for telcos, we have to figure out how to replace the copper network."

Cambron is an HFC proponent, whether the company pursues the video business or not

Figure 1: *Pacific Bell's HFC architecture*



Source: Pacific Bell

In his role, Cambron regularly monitors other technological developments, but says HFC continues to be the most economical method to get the bandwidth he needs. "The only alternative (for video) we've embraced is MMDS because it takes so long to replace your copper network, and MMDS gives you tremendous access to the customer in a short period of time," says Cambron. "The other alternatives are SDV and fiber-to-the-home. We have a fundamental belief that analog video will be around for another 10 years-plus, and we need to offer that in addition to digital video. SDV doesn't serve additional outlets well, and we can't get past that. Also, we continue to see a 30 percent differential between HFC and SDV, and every quarter or 50 cents per home, we take a careful look at. So an additional 30 percent is very hard for us to justify."

As of September 1, PacBell has been offering analog video service over its San Jose HFC network commercially. Prior to that, the company had been testing cable service provision to about 1,300 residents for free. Since then, Pacific Bell has been quite successful at

converting those residents to paying customers. "The conversion rates of the trial customers wasn't 100 percent, but it was close," he notes.

PacBell has been concentrating its voice service in the Pacific Beach area of San Diego, but service rollout has been hampered by software and hardware issues associated with the Lucent hardware.

"We've been waiting for about 10 months and are working with just about 100 customers." But with gear now ready to go, Cambron says crews in San Diego and San Jose will soon be replacing copper drops and installing side-of-home network interface units on every home.

And finally, interdiction gear from Blonder-Tongue is being tested and should be installed sometime in the first quarter of 1997, Cambron says. The goal is to replace the Scientific-Atlanta 8600x analog set-tops that are currently being used after production quantities of interdiction are received.

Overall, Cambron says he feels comfortable with the engineering and network design decisions he's made. "We feel pretty good that the recommendations the industry is coming around to are things that were incorporated into our architecture early on."

While there are reports that some telcos are having problems with digital MMDS, such is not the case in Los Angeles, where PacBell will debut that service sometime early next year. The company has been deeply involved with MMDS since the middle of 1995, when it purchased Cross Country Wireless for $175 million, which gave PacBell transmitting rights for Los Angeles, Orange County and San Diego. A second acquisition, of V*TV, gave the company transmitting rights in the San Francisco Bay Area as well.

Then, in March 1996, PacBell bid $21 million in the FCC's MMDS auction to acquire more channels in L.A. and San Diego, as well as authorizations in San Francisco; Seattle; Spokane; Tampa, Fla.; and Greenville, S. C.

Since then, PacBell has sunk some $200 million into upgrading the MMDS system in L.A. and Orange County to digital. Transmission towers atop Mt. Wilson and Mt. Modjeska give an unimpeded view into roughly 4 million homes located in the L.A. Basin.

PacBell is now entering a beta test phase where it will deploy 500 Thomson digital set-tops in about 350 homes, notes Jeffrey Carlson, VP and GM of Pacific Bell Video Services in southern California. Today, PacBell is offering 60 channels of video and 38 NVOD channels.

As for the technology, it's working flawlessly, reports Jim Baumann, executive director of engineering. "It's offering everything and more," he notes. "We've been pleasantly surprised at what our coverage area is and the robustness of the (64-QAM) modulation. The transport system is rock-solid–during the power outage we had out here, we only lost one off-air broadcaster who had a generator fail."

Pricing and packaging plans haven't been announced yet, but PacBell expects to launch its service late in the first quarter of 1997 with 136 video channels (including 40 near video-on-demand) and several digital music channels as well. This will occur after a call center is completed and field support has been organized.

US WEST

Lengthy video history equals lessons learned

To summarize US West's video strategy, you must first make a distinction between the company's plans in and out of its 14-state telephony region.

Poised to become the country's third-largest cable operator when the company closes on its planned $16 billion acquisition of Continental Cablevision (scheduled for November sometime), the company will be both one of HFC's biggest fans while it simultaneously looks for a way to leverage its existing copper network with technologies such as ADSL.

The RBOC has always been aggressively pursuing video, but to many observers, never seemed to settle on just how it wanted to build its networks. The company jumped into the fray with an expensive network build in Omaha, Neb., then redesigned the network and announced it would deploy to millions of homes in Denver; Portland, Ore.; Minneapolis/St. Paul; Salt Lake City; and Boise, Idaho. But after months of inaction from the FCC on its Section 214 waiver filings, the company last year announced it was suspending construction in those cities while it explored its technology options.

Within its telephony region, the company is interested in wireless (satellite and/or MMDS) technology, but hasn't decided on whether it would invest in or simply resell such services. "But over the long-term, they like switched digital video," notes Joe Wetzel, vice president of technology for US West Multimedia Group. "But I don't think they've committed to build anything." Why not? Because with the Telecom Reform Act and requirements to unbundle the network, there's doubt within US West as to whether it makes economic sense to build such a network.

And why the interest in SDV, when many argue that HFC is less costly? "There are two reasons," notes Wetzel. "One is where you start from (is the incumbent network coax or copper-based?) and the other is that an RBOC will always have a different service set in the range of services as well as penetration rates. Those things make a difference" in the conclusion.

Wetzel argues that SDV may not be much more expensive than HFC for a telco with lots of copper in the ground. "I think it's much closer (than a 30 percent cost premium). HFC has a bit more variable cost than SDV, so for us we opt for higher variable cost, but the RBOC has to serve 100 percent of the homes passed and we (cable service) don't.

Outside of the telephony region, it's much simpler. "First of all, we believe in convergence," says Wetzel. "So we want to offer voice, data and video . . . and the only current broadband network out there is cable, and we believe it's a strong cost competitor. Therefore, investing in cable makes sense, and it makes sense to do HFC." So, after it acquires Continental, the company will upgrade to HFC and add voice and data services, Wetzel says.

But does US West plan to expand its reach and overbuild another cable operator? "Probably not," says Wetzel. "We will go where we currently have franchises." And in cases where they serve only portions of a market–like Boston–they'd work with the other operator. "We would work with Cablevision Systems in Boston, not overbuild them" much like several operators today work together on advertising interconnects.

US West has already learned plenty about building broadband networks in both Omaha, and the Atlanta areas, even though the two systems are radically different. In Omaha, the company built a complex, dual-cable network to separate voice and video traffic that also utilized interdiction for the video so that set-tops weren't needed. Because of technology shortcomings that existed at the time, the company designed a double-star FTTC telephone network and added an HFC network on top of it.

While the architecture may have been necessary at the time, it's safe to say Omaha is truly unique. "The Omaha architecture will never be done again," said A.D. "Doug" Simpson of US West during the recent National Fiber Optics Engineers Conference. Simpson said that because technology has improved and because market demands differ, there is no one architecture the company has embraced. "Perhaps the best architecture is a wide variety of architectures," he notes.

Meanwhile, in Atlanta, the company is spending upwards of $350 million to completely overhaul the old Wometco properties as it continues to serve cable TV customers while readying to compete with BellSouth for voice customers. The company has been rechristened as "MediaOne"–a brand that the old Continental properties will be known as after the deal is completed.

To date, 12 separate headends have been collapsed into two regional "superheadends" that are completely redundant and house video signal origination gear as well as the AT&T Class 5 telephony switches. The system, which had been run as eight separate systems previously, was collapsed into a single network, with just one P&L statement. The 12,000-mile plant was upgraded with 6,000 miles of optical cable; a call center was started; a sophisticated network operations center was constructed; a new billing system and operational support system was implemented; SeaChange digital ad insertion equipment was purchased to serve seven different zones; and a new, 24-hour local news channel was started, mandating the construction of a new studio.

The 750 MHz network uses traditional HFC architecture, with 1550 nm signals transported over fiber emanating from both headends to 42 hubs, where the signals are converted to 1310 nm and sent to 2,175 nodes, each averaging about 500 homes passed. Six fibers serve each node and 90-volt powering was selected. Each of the 110 power nodes has a minimum of 30 minutes battery backup and unlimited backup time from natural gas generators. The system is about 70 miles square, covers portions of nine counties and covers 54 franchise areas.

As a result, the company is offering subscribers 95 (including 13 near-video-on-demand) analog channels and plans to roll out high-speed data modems by the end of the year. Presently, there are no plans to offer a tier of digital channels, although the network will support it, according to Greg Worthman, director of network upgrades at MediaOne.

As for high-speed data modems, MediaOne is primarily following the lead of Time Warner, says Barbara Warren, product manager of high-speed data services. As such, the company will be offering the RoadRunner service over Motorola's modems and Hewlett-Packard servers.

Does US West have any plans for ADSL or LMDS? Wetzel says US West Interprise–the data networking side of the house–has tremendous interest in the emerging technology, but not for video. "They've been real bullish on ADSL," he notes. As for LMDS, "it's one of those things that's being watched," he says. Depending on costs, it could be a complement to an existing cable system as a way to serve new, high-growth areas.

In the meantime, data and telephony are growing in importance as well. Wetzel says US West will continue to support the rollout of data services that is now underway and will also continue to fund the deployment of telephony services, such as what Time Warner is doing in Rochester, N.Y. "I think you'll see more rollout by the end of the year," predicts Wetzel.

SNET
We go beyond the call

Statewide franchise in hand, SNET forges ahead

Southern New England Telecommunications may not be one of the Bell "seven sisters," but it thinks big. Counting as its customers some of the country's most affluent people, it would be business suicide not to offer broadband services to its subscribers before competitors swoop in and skim the cream off the top.

SNET, which recently was granted the country's first statewide cable TV franchise by Connecticut, originally announced a comprehensive and costly plan (15 years and $4.5 billion) to upgrade its network to hybrid fiber/coax architecture. Known as the "I-SNET," the new network "is an integrated, interactive multimedia network that will ultimately serve every home and business in Connecticut," according to marketing information found on the company's Web site.

SNET forged a strategic relationship with AT&T Network Systems (now Lucent) to build the I-SNET. As such, SNET will deploy the HFC-2000 system, which consists of a host digital terminal at the headend, a series of fiber nodes and network interface units designed for installation near the home. The HFC network will bring fiber deep into the network–serving on average about 200 homes per node.

SNET originally expected to deploy 80,000 lines of the HFC network by the end of 1996 and 500,000 lines sometime in 1998. Now that

Figure 2: SNET Personal Vision deployment schedule
(By end of year 1998)
Approximate percentage of homes and businesses in parentheses following town

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

it has a cable franchise in hand, the plan is to offer cable TV service to 20 percent of Connecticut's population by the end of 1997; 36 percent by 1998; 48 percent by 1999; 60 percent by 2000; 88 percent by 1995; and the entire state by 1997.

Those areas to be wired first include: Norwalk, Westport, Fairfield, Stratford, Milford, East Haven, Branford, Wallingford, Meriden, Bloomfield, West Hartford, New Britain, Farmington, Bristol, Bethel and Old Greenwich; the majority of Darien, Weston, West Haven and Danbury; and portions of Stamford, Bridgeport, Trumbull, New Haven, North Haven, Waterbury, Plymouth and Hartford. (See Figure 2, page 47).

As part of the build, SNET engineers have come up with a unique network powering scheme. Intended as a method to protect the company's investment in large, complex back-up power generators, the approach sends 480-volt power down the same cable that's used to send communication signals (see "HFC centralized powering: A unique approach," *CED*, April 1996, p.72).

The 76-channel analog video network is already under construction and will be turned up with voice and video services beginning in 1997, according to Patrice Listfield, president of SNET Personal Vision, a SNET subsidiary that was developed after the company abandoned its video dialtone approach to video deployment. The VDT approach was abandoned because of slow approval at the FCC. However, the 350 West Hartford residents who took part in the original VDT trial are still receiving service.

GTE: Bullish on HFC and a whole lot more

For the man on the street, when discussions center around the converging telecommunications marketplace, the long distance giants and the competing Baby Bells, the largest local-exchange carrier (LEC) in the country often gets overlooked. But those in the know, realize that GTE Corporation is a force to be reckoned with. And, its aggressive entry into video services is a perfect case in point.

With revenues and sales of $20 billion in 1995, GTE is one of the world's largest publicly held telecommunications companies. In the United States alone, it serves markets that include more than one-third of the U.S. population. This includes wireline operations in 28 states, of which 45 percent are in California, Florida and Texas, while one-third are in five key metropolitan markets: Dallas, Honolulu, Los Angeles, Riverside/San Bernadino, Calif., and Tampa/St. Petersburg, Fla.

The company also has wireless operations in 15 of those states and Tennessee. That makes GTE wireless services available in 74 metropolitan statistical areas (MSAs) with 52 million potential customers.

What's all this telephony got to do with video? Everything.

"Our strategy is to bring video services to the consumer as a part of our overall bundled package," says William D. (Rick) Wilson, president of GTE Media Ventures Inc. "We're offering long distance now. We're offering local. We're offering Internet applications, so we see the video part as being another important part of that package.

"Our plan is 7 million homes passed by about the year 2005. And we hope to see about 2 million customers out of that in 66 top tier markets we've targeted. We have a very detailed list, by year. We've done a lot of market research and have gone through virtually every one of our markets."

Wilson reports GTE's primary focus right now, is to get its "feet on the ground" in Florida and California. "We've picked what we believe are two fairly tough markets," says Wilson. "One being Time Warner in Florida, the other one TCI in California (Ventura County)." After all, says Wilson, if it can crack these two cable nuts successfully, it's got a real good start on breaking into all kinds of markets, no matter who the incumbent cable provider is.

Of the two, GTE's hybrid fiber/coax deployment in the Tampa Bay/St. Petersburg, Fla. area is nearest to completion. When it's all said and done, GTE anticipates passing 170,000 homes, offering full digital video service, as well as such services as near-video-on-demand and a variety of interactive services.

Engineered by systems integrator Lucent Technologies, the GTE video network incorporates a fiber-optic supertrunking design from Bell Labs (See Figure 3). "I'd say it's probably the highest quality system you could put in," says Wilson. "Of course, you could say I'm biased, but I've looked at both the pictures, and you can tell the difference. Upstream and downstream, it has a lot of excess bandwidth capacity available, even when we go to a digital format. We want to use as much of that bandwidth as we can."

Wilson says that while GTE is learning a great deal about the cable business, it's also bringing its considerable telephony experience to bear as well. "We're taking everything we've learned in the telephone side about monitoring, preventive maintenance, how to do things right the first time. And we're putting that in motion in all of these (deployments)," states Wilson.

"We're monitoring our network all the way through the (500-home) node level, even down into the network. And eventually to the set-top box through our national network monitoring center in Dallas."

The Florida deployment, reports Wilson, will be the first to offer between 80 and 100 channels of digital video, as early as the end of the year. "We've got the technology in hand right now," explains Wilson. "We're in the process of actually installing it in Florida and we'll be testing it, I'm hoping, by the beginning of November. If that all works the way we think, we will begin to deploy the (General Instrument) boxes that we have already in hand to certain parts of that market."

GTE's new video customers will also be the first to turn on the latest version of GTE's mainStreet interactive TV service. Besides carrying customized local content (e.g., local news, weather, shopping and public service offerings), the system features more than 80 multimedia and full-motion, two-way services including home finance, shopping and education, as well as play-along games and original productions from the nation's first interactive virtual TV studio.

Programming for GTE's systems in Florida and California is being packaged by americast, the joint venture between GTE, Ameritech Corp., BellSouth Corp., SBC Communications Inc., Southern New England Telecommunications and The Walt Disney Company (owners of this magazine). GTE's americast offers a variety of programming packages, beginning with a basic package called "localcast" which is broadcast "in the clear." And, those who choose GTE's enhanced basic, called "premiercast," for example, get their analog set-top and their electronic program guide (StarSight) at no extra charge.

While the telco has plenty of offerings and trials in high-speed data communications on its telephony side of the business (e.g., ISDN, ADSL), it isn't letting its high bandwidth HFC systems bypass this lucrative revenue stream either. Wilson reports the Florida system will be a launching a cable data modem trial (vendor undisclosed) by the end of October, with "a limited service" in Clearwater, Fla. in the

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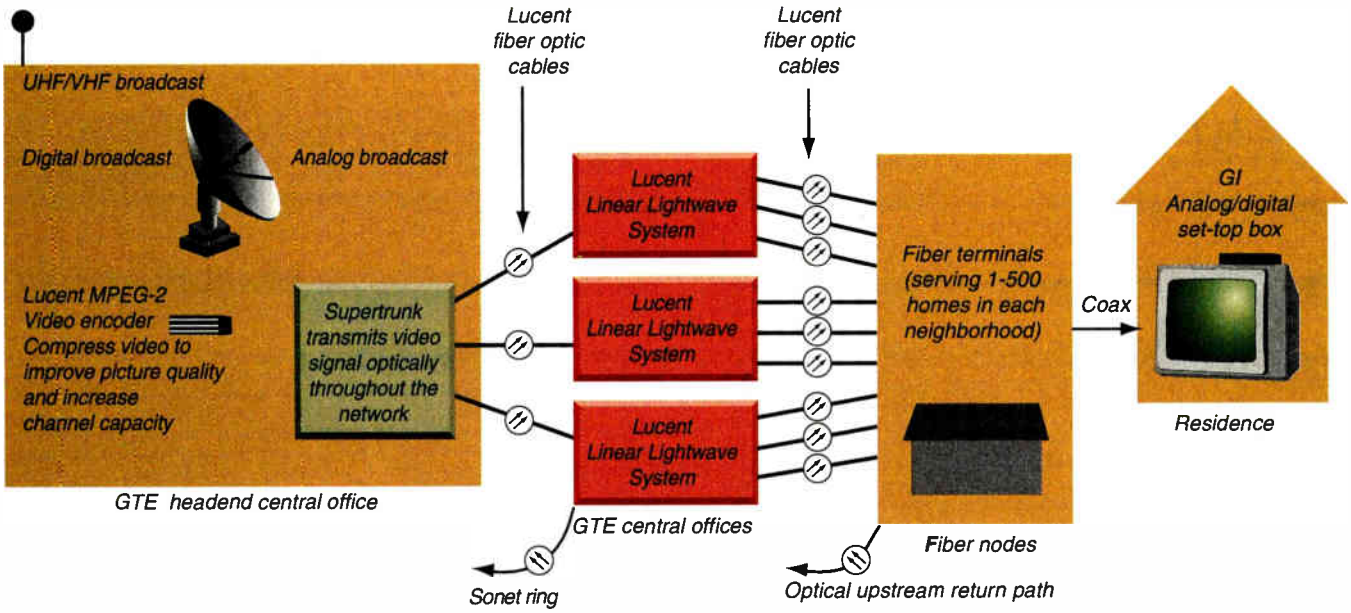
Figure 3: GTE's consumer video network



Source: Lucent Technologies

November time frame.

To some, GTE's aggressive support of HFC in its Florida and California deployments would seem to put all of its video cards in one stack. According to Wilson, though, nothing could be further from the truth. With the rapid change of technology, GTE is the last one to permanently slam the door on any potential video delivery technology.

Wilson admits GTE has talked to a number of MMDS (multichannel multipoint distribution system) or wireless cable license holders. But, he says no agreements have been reached mainly because "we find MMDS to be a very difficult business case to work with."

"First of all," explains Wilson, "the problem of aggregating licenses is a big deal. And, there is the problem of aggregating agreements for those licenses under a digital scenario, which, by the way, hasn't really been proven yet. And then coupled with that is the fact that in those top markets we believe we want to enter, a wired solution has a lot more power to it because it has a lot more channel capacity and a lot more ability to do interactive applications.

"Putting all that together, we tend to look at the MMDS kind of applications as possible interim solutions. The longer we can't find something that works, the narrower that window becomes to use it."

Wilson has similar misgivings about LMDS (local multipoint distribution systems). While the auction dates, let alone the auction rules, have yet to be set for the high frequency LMDS licenses, Wilson acknowledges GTE personnel have been tracking developments and the technology produced by such vendors as Texas Instruments. At best, he believes LMDS may offer his company a solution to "some niche applications." Yet, he says "there's still a problem of trying to make a business case work in a niche application."

He notes, as well, that digital subscriber line technologies (e.g., VDSL) and switched digital video (SDV) are still "on the radar" as far as GTE is concerned. Wilson says his company has experimented with SDV in its Cerritos, Calif. cable system but "we're struggling with the cost of that."

"But, I think with the VDSL kind of application," explains Wilson, "what you get, in my layman's opinion, is a combination of SDV kinds of solutions and a semi fiber-to-the-curb, although it's not down to the curb level, and some better economics. So right now, I'd look more at a VDSL solution than I would necessarily at an SDV solution. But, this stuff moves around and we continue to monitor it."

Wilson also believes broadband nirvana, aka, fiber-to-the-home (FTTH), is inevitable. How one gets there, he says, may be a combination of deliberate design and the expanding demand for new services and applications, and hence more bandwidth.

As far as deliberate design, Wilson cites GTE's involvement with the design and construction of the Playa Vista development in Los Angeles. The 1,000+ acre development will be home to Steven Spielberg's new DreamWorks SKG movie studio (the first to be built in L.A. in nearly 60 years). The project also includes two major office campuses, more than 13,000 homes to serve a "broad blend of people," a variety of smaller-scale office and retail spaces, an elementary school, an eight-acre lake and even a 260-acre wetland preserve.

To support the state-of-the-art, 3.5 million square foot movie studio and other corporate residents like IBM and Silicon Graphics, GTE has committed itself to "build a world class network" that includes an all-fiber network featuring the latest ATM switches and Sonet technology. The company expects bandwidth for the project to be in the 10 Gbps range, enough to transmit a million pages of text or to give DreamWorks' professionals the ability to edit digital video streams live, as well as providing them real-time digital links to studios worldwide.

A more "natural" progression to FTTH in GTE's less star-struck markets has also been given a lot of thought. "We're looking at it from what the bandwidth requirements would be," says Wilson. "We've looked at the HFC system in the markets that we're building in, and said, 'Okay, if I use the HFC system to provide data through cable modems to the residential market, what do I think my capacity is? How long is that capacity good for based on bandwidth demand we see coming out of those residential markets?' And we're looking at it and saying, 'Gee, it's 10 years, based on the market studies.'

"Then you say, 'Okay, that's good enough. I don't need anymore than that right now and I've designed the network to a level that if it

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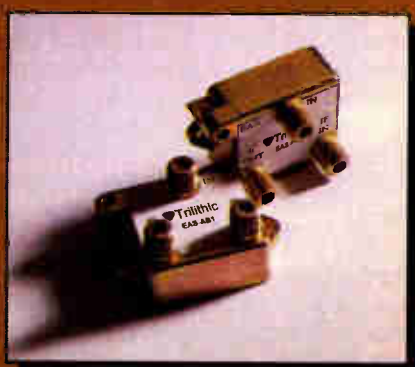

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passed earlier this year.) A type of common carriage agreement, an OVS designation would allow different video providers to use Bell Atlantic's video network, and Bell Atlantic Video Services will be one of those providers.

In the interim while the company's full service network is being built–and it could be a long pause–Bell Atlantic will launch wireless video service, in the form of digital MMDS, to quickly enter the video provision marketplace. The first launch will be in Hampton Roads, Va. in the spring of '97 via networks constructed by CAI Wireless Systems Inc. (see related story, "Nynex," page 61).

In MMDS, "You have a robust product that can compete head-to-head with cable," says Plumb, referring to the fact that cable services are still being delivered via an analog platform. Through its investment in CAI Wireless, Bell Atlantic will gain access to MMDS distribution systems with the capacity to deliver about 100 channels in digital quality.

Any discussion of the company's wireless plans has to include an update on the Tele-TV joint venture between Bell Atlantic, Nynex and Pacific Telesis Group, which was set up to provide programming, as well as technology including set-tops, to the three companies. The video systems integration unit of the company, Tele-TV Systems, has contracted with Thomson Consumer Electronics for up to 3 million set-tops to be used in the trios' MMDS systems.

But because all three members of Tele-TV are involved in mergers (Bell Atlantic wants to acquire Nynex; SBC is after PacTel, and SBC is a member of the americast consortium), the dynamic of the joint venture may change, with uncertain results.

For the time being, however, plans are still on track–in one example of that, Bell Atlantic will roll out its service in Hampton Roads in the spring of '97 with the Tele-Tv brand name.

Different technologies, same goal

While Bell Atlantic's transmission medium of choice may have changed several times over the past five years, the mission is the same, says Plumb. "Consumers don't buy networks," he notes. "Our goal is to provide the best of cable, coupled with the best of a videotape rental store."

Each technology evaluated by the company had to meet both of those criteria, in order to be accepted. While Bell Atlantic has flirted with hybrid fiber/coax in the past, it was not convinced that the technology could deliver full, two-way interactivity, and thus announced in May of 1995 that it would pull its "214" video dialtone applications that were before the FCC, stating that "this clears the way for the company to use newer switched digital video (SDV) technology, which will bring fiber very close to the home."

And while the company is trialing ADSL for the delivery of data, there are a couple of technological constraints that made it less than ideal for video transmission. For one, as was demonstrated in a technical trial that took place in 1993, ADSL did not interface well with the company's digital loop carrier and fiber systems; for another, Bell Atlantic soon discovered that old party line systems that had lain dormant for many years were unpleasantly awakened by the technology, resulting in some less than desirable interactions. Though initial thoughts were that ADSL would allow the operator to reach 95 percent of a metropolitan market, in reality, those technical glitches meant that only 25-30 percent could be served with ease.

In the data realm, Bell Atlantic has launched a trial of ADSL for high-speed access at 1.5 Mbps (64 Kbps for consumer data transmission) in a limited area of northern Virginia. The trial, which could be extended beyond its scheduled December 31 close date, will include a maximum of 500 customers.

As for LMDS, it remains an open question, says Plumb, noting that his company still

Figure 5: Ameritech New Media cable TV franchises
The company has franchises with 25 communities having a total population of more than 1.4 million people. (as of Oct. 1996)

Franchise	Date	Population	Competitor
Illinois			
Glendale Heights*	August 1995	30,000	Time Warner
Naperville*	February 1996	105,000	Jones Intercable
Vernon Hills	September 1996	18,000	Jones Intercable
Illinois total:		***153,000***	
Michigan			
Canton Township*	June 1995	62,000	Continental Cablevision
Plymouth*	June 1995	10,000	Continental Cablevision
Plymouth Township*	June 1995	28,000	Continental Cablevision
Northville*	June 1995	6,300	Continental Cablevision
Fraser*	November 1995	14,000	Comcast Cable
Northville Twp*	November 1995	19,000	Continental Cablevision
Southgate*	December 1995	30,000	Comcast Cable
Garden City*	April 1996	32,000	Comcast Cable
Troy	April 1996	80,000	TCI
Wayne	May 1996	20,000	Time Warner
Lincoln Park	July 1996	42,000	TCI
Sterling Heights	September 1996	121,000	Comcast Cable
Clinton Township	October 1996	95,000	Comcast Cable
Michigan total:		***559,300***	
Ohio			
Hilliard	March 1996	18,000	Time Warner
Upper Arlington*	March 1996	36,000	Time Warner
North Olmsted*	April 1996	35,000	Cablevision Systems
Columbus*	April 1996	600,000	Time Warner, Coaxial
Berea*	June 1996	20,000	Cablevision Systems
Perry Township	July 1996	6,500	Time Warner
Worthington	September 1996	19,000	Time Warner
Clinton Township	October 1996	4,500	Time Warner
Ohio total:		***739,000***	
Wisconsin			
Greendale	December 1995	15,000	Time Warner
Total population:		***1,466,300***	

*Ameritech is offering service in portions of these towns.

retains its interest in LMDS provider CellularVision of New York: "We want to keep the rights to bid on that spectrum." That opportunity is slated to happen later this year.

Ameritech

Going for the cable gusto

Ameritech New Media Enterprises Inc. continues to pursue cable franchises with great gusto. At last count, the operator had cable TV franchise agreements with 25 communities in the Midwest, covering in excess of 1.4 million people (as of mid-October). Of those 25 communities, Ameritech is already offering cable service to portions of 14 of them: eight suburbs in Detroit, Mich.; two communities in the Chicago area; and four communities in Ohio (see Figure 5 for a complete franchise listing). In the Midwest, as it brings its cable systems on-line, the operator will go head-to-head with the likes of Time Warner, Jones Intercable, Tele-Communications Inc., Continental Cablevision, Comcast Cable, Cablevision Systems and Coaxial Communications.

And, the company reports that it is conducting franchise discussions with an additional 30 communities in its region, which falls in nicely with its plans to expand its franchise clusters in order to capitalize on economies of scale.

"We have to walk a fine line between rolling out very aggressively," says Ameritech New Media spokesperson Dave Onak, "and making sure that we can do it at a pace that allows us to maintain quality control. There are communities calling us, wanting franchises. And we are saying that we'd love to, but we are a start-up, and can't be everywhere at once."

In one of the latest announcements of that batch, Ameritech has been granted the franchise for Sterling Heights, Mich., a Detroit suburb, where it will construct a two-way HFC video network later this year, with the delivery of "americast" services to begin early next year. In another recently signed agreement, the board of Clinton Township, Ohio granted Ameritech a 15-year franchise for the area, which is an unincorporated region surrounded by the city of Columbus.

Initially, those subscribers who sign up for the operator's full service, billed as "Ameritech presents americast," will purchase an 80-90 channel package composed of about 60 channels of expanded, basic cable; 10 premium movie channels; 10 pay-per-view channels and The Sega Channel (The expanded basic package will offer The Disney Channel and The Golf Channel at no extra charge.). The programming package is the offspring of the Americast joint venture between Ameritech, The Walt Disney Company, BellSouth, GTE, SBC Communications and SNET.

All of this entertainment will be riding on hybrid fiber/coax networks to reach the operator's customers. Unlike several of its telco brethren which have backed off of plans to build HFC networks for video, Ameritech still seems to be committed to the architecture, which it is deploying in a 750 MHz version, down to nodes of 400-500 homes. In addition, the company is hanging its franchises off redundant fiber rings.

"To us, it (HFC) looks to be the best solution when you look both short-term and long-term," says Onak. "Maybe some companies which aren't going to be offering video for a few years are waiting for something better, but as of right now, it's a cost-effective way to deliver the channels that we are offering. And yet, it 's easily upgradable to handle the several hundred channels that will be available once we get into the digital world."

But a commitment to HFC doesn't mean that Ameritech has closed the door on other technologies. Engineering executives continue to watch the progress of digital MMDS, possibly as a complement to their HFC networks. "MMDS seems very promising, but there are still some concerns, such as, is it really just an interim step because of its bandwidth constraints?" elaborates Onak.

Like Bell Atlantic and Nynex, the company is evaluating the merits of ADSL for the delivery of access to high-speed data services and the Internet. Last month, Ameritech and IBM were scheduled to begin a trial of ADSL technology to deliver access to the Internet and other data services to about 200 customers of both companies located in Wheaton, Ill., a suburb of Chicago.

In a footnote to the company's plans, Ameritech chairman, president and CEO Richard Notebaert has been quoted in the press recently as saying that the company has not completely dismissed the possibility of delivering video over ADSL.

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options open. From the beginning, the company's video strategy has been shifting to accommodate new information. In one example of that, back in 1994, Ameritech's video arm first announced plans to enter the market as a provider of video dialtone; however, not wanting to lose precious time waiting for the rules for VDT to be defined, Ameritech soon decided that becoming a cable operator was the fastest way to get into the video business. "And now, with open video systems (OVS), everything is still not clearly defined," says Onak. "We made the right decision."

In another example of its bet-hedging, Ameritech, as part of the Americast venture, has signed a non-exclusive contract for the purchase of at least 3 million digital set-tops from Zenith Electronics Corp. which will allow consortium members to deploy MMDS, HFC, SDV and direct broadcast satellite video networks. The set-tops, which are slated to be produced starting in the first half of 1997, use interchangeable network interface modules to provide flexibility in adapting to various business and content delivery models. "We wanted to make sure that, moving forward, we had the capability of delivering our services via a multitude of technologies," adds Onak.

In addition to the subscriber equipment purchased from Zenith, Ameritech New Media is working with suppliers including Scientific-Atlanta, Digital Equipment Corp. and ADC Telecommunications Inc. to construct its HFC networks.

Beyond its video forays, Ameritech, through its various subsidiaries, is involved in a range of services including local and long distance service, cellular, paging, data and even inhome security monitoring. "The goal is to become a full service provider," says Onak.

NYNEX®

"One size doesn't fit all"

While Nynex is throwing its energies into the deployment of digital wireless cable (MMDS) as a short-term video strategy, for the long haul, the operator has decided that "one size doesn't fit all," as it evaluates a number of technologies, including switched digital video, according to a corporate spokesman.

"The near-term effort is to get into the marketplace as quickly as possible," he notes, "and establish the brand with wireless cable, then watch the development of these other technologies."

In the context of its MMDS plans, Nynex will begin testing digital wireless cable in the Boston area sometime this quarter, made possible by its investment–with Bell Atlantic–in CAI Wireless, which will provide the delivery networks for Nynex programming in Boston, and for Bell Atlantic's programming in Hampton Roads, Va. Set-tops purchased by the Tele-Tv consortium from Thomson will deliver the programming to the homes of Nynex "friendlys" in Boston, and sometime during the first quarter of 1997, Nynex will move the service from a trial into a limited deployment.

"We will be evaluating the results in the Boston area to determine where we go next," says the spokesman, "and future rollout plans."

According to the terms of the relationship with Nynex and Bell Atlantic as it was originally announced, CAI will design, construct and maintain digital MMDS networks in 13 markets served by the two telcos. The wireless operator is expected to build systems for Nynex in Providence, Rhode Island; as well as in Albany, Syracuse, Buffalo, Long Island and New York City, N.Y. Both telcos will lease their systems from CAI on a per-subscriber, per line-of-sight basis.

However, as was recently reported in *CED's* sister publication, *Multichannel News*, CAI Wireless has informed the SEC that it, Bell Atlantic and Nynex are renegotiating their agreement (see MCN, Oct. 17, 1996, page 8). Some of the items under discussion include "extending the time the Bells have to exercise an option to become the wireless cable provider and marketer in a given system using CAI's systems and sharing revenue with CAI."

Longterm, though, Nynex believes that interactivity will be key to the deployment of video, and because MMDS does not currently support interactive services, the company will have to pursue another strategy to launch itself into the video realm.

Like Bell Atlantic, Nynex also cooled on HFC technology, this after concluding a trial of analog video dialtone services in Manhattan in the summer of 1995. The Manhattan trial utilized an HFC network to deliver cable programming for Liberty Cable Television and Time Warner to 2,500 apartment dwellers in three East Side buildings.

Further, after completing some preparatory construction work, Nynex suspended construction of the full service HFC networks it was due to build in Warwick, Rhode Island and in Somerville, Mass. (in Warwick, the network had been slated to pass all 60,000 homes; in Somerville, the company's 214 application was for 360,000 homes in the area). "Prior to the actual buildout of the network, the decision was made to look at (new) developments in technology," says the spokesman.

So what will take the place of HFC as the company's interactive video strategy? Perhaps switched digital video. In fact, just before *CED* went to press, Nynex chose GI subsidiary Next Level Communications to provide FTTC technology as part of its future video plans. The multi-year agreement includes about one million lines of transport electronics.

"The prices continue to drop for robust technologies like SDV," notes the spokesman.

Regardless of the type of technology used, Nynex plans to begin offering interactive video services by early 1998.

Like its proposed merger partner, Bell Atlantic, Nynex is looking at ADSL, but only for data, not video. To evaluate the copper-based technology, Nynex, Lotus Development Corp. and Westell are conducting a trial that gives Lotus software designers and developers the ability to access both the Internet and Lotus corporate networks at high data rates, utilizing Westell's FlexCAP ADSL modems. The test includes a 1.5 megabit link from Nynex's CO facilities to the residences of 60 Lotus employees based in the Boston area.

Plans to enter the Internet access market later this year, though, revolve around ISDN, dial-up phone lines and dedicated lines.

Rather than weighting video, voice, or high-speed data services more heavily, Nynex is instead searching for ways to attractively package different combinations of services for customers. CED

Local telcos, cable companies partner for profit

Former foes dance to the same beat

By Ken Pyle, Product Manager, E/O Networks

The paradigm for manufacturing companies has shifted from the vertically integrated manufacturer of the postwar era to one working in concert with partner companies to create end-products. Companies may be partners at one level, such as manufacturing, while they compete at another level, such as marketing the product to the consumer. This is possible because "soft" assets, such as brand name, packaging, service and distribution channels, are often more valuable than the manufactured product.

This shift away from vertical integration is occurring in service industries as well. For example, some airlines are shifting from owning airplanes (i.e. production method) to owning only the knowledge or information resources (i.e. the reservation systems and frequent flyer awards). Examples can also be found in the telecommunications field where brand name and other soft attributes are a company's key asset.

Similarly, opportunities exist for local cable TV and telephony operators to share facilities in a cooperative fashion, providing benefits to both parties. This is counter to the current paradigm where cable TV and telephony operators engage in cutthroat competition. The benefit of cooperating instead of competing includes addition of system capacity that otherwise might not have been economically viable, at rates that are competitive with new entrants. This article details the drivers that make local cable TV/telco operator partnerships viable, applications where network sharing is feasible and possible business relationships to ensure successful partnerships.

Background

Prior to a partnership between local telephony and cable TV, each must have an overriding need that justifies joining with a potential competitor. This need results from fear or

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inertia. The fear comes from either real or potential competition, and the inertia is what must be overcome to offer a new service. For a telco, the competition could come from wireless providers–PCS or cellular–or landline providers, such as cable TV or competitive access providers. The cable TV operator faces immediate competition from direct broadcast satellite and potential competition from MMDS and local telcos. Either way, competition often drives the requirement for an expedient service solution.

The inertia factor is organization-dependent and results from a company's method of doing business. The infrastructure requirements of providing telephony service are different from those required for providing cable television programming. In this context, infrastructure is much more than the physical plant connecting the central office or headend to the end subscriber and includes all of the elements required to conduct business. In other words, the cable TV and telco operator are experts in their respective service offerings and face a learning curve when serving a new market.

Some of the unique attributes of telco and cable TV operators are generalized in Figure 1.

The cable company is familiar with the sourcing, processing and delivery of broadband, broadcast services, in contrast to the local telco, which is expert at providing narrowband, switched services via the public switched network. Cable craftsmen are trained for installation and maintenance of coaxial networks. The telcos' craftsmen, on the other hand, are adroit at working with twisted pair. The time required for training craftsmen on a new media is significant and cannot be overlooked when deciding the best way to implement new services.

Finally, the challenge of dealing with local franchise authorities, in the case of cable TV, and the state public utility commissions, in the case of a local telco, is another new skill-set that must be mastered for each respective operator.

Strengths that both the telco and cable TV provider offer include an in-region infrastructure, an existing subscriber base and brand name recognition.

The extent to which the brand name is of value depends on how well an operator's service has been marketed. By definition, neither operator provides service outside of its exchange or franchised service area, so system expansion beyond its existing boundaries is an issue.

***Table 1:** Example of a service extension to a rural community.*

Fiber cost distance & cost (6 fiber cable)	$100K (10 miles @ $10K per mile)
Fiber trunking cost (cable TV)	$10K
*Fiber trunking cost (telephone)	$36K
Small town/village	66 homes passed (100 homes per mile)
Coax plant	.66 miles of coaxial plant @ $12K/mile
Copper plant	.66 miles of twisted pair @ $8K/mile

**Assumes fiber optic ring-based system operating in a universal mode.*

Applications

The reasons for local cable TV and telcos to share infrastructure include network cost-reduction, minimizing time-to-market for providing new service and expansion of service area. Infrastructure sharing provides a cost-effective and timely way for the local operators to defend against new competition. Some of the specific applications of infrastructure sharing are headend and/or exchange consolidation, service extensions and service region expansion.

✔Headend and/or exchange consolidation. The cost of a cable TV headend or central office ranges from $100,000 to more than $1 million. The consolidation of these facilities has thus been occurring for some time as a way to decrease capital and maintenance costs. These consolidations have typically been accomplished using fiber optic trunking techniques. With the cost of installed fiber ranging from $7,000 per mile in rural areas to more than $20,000 per mile in urban areas, the economics of infrastructure sharing are compelling.

With headend or exchange consolidation, shown in Figure 2, the service areas of the telco and cable TV operator overlap, and it's possible that they might even compete in some service areas.

There are several ways of sharing the cost of the infrastructure, including one operator owning the facility and leasing dark fiber to the second operator. Another method of cost

***Figure 1:** Unique attributes of cable TV operators and telcos.*

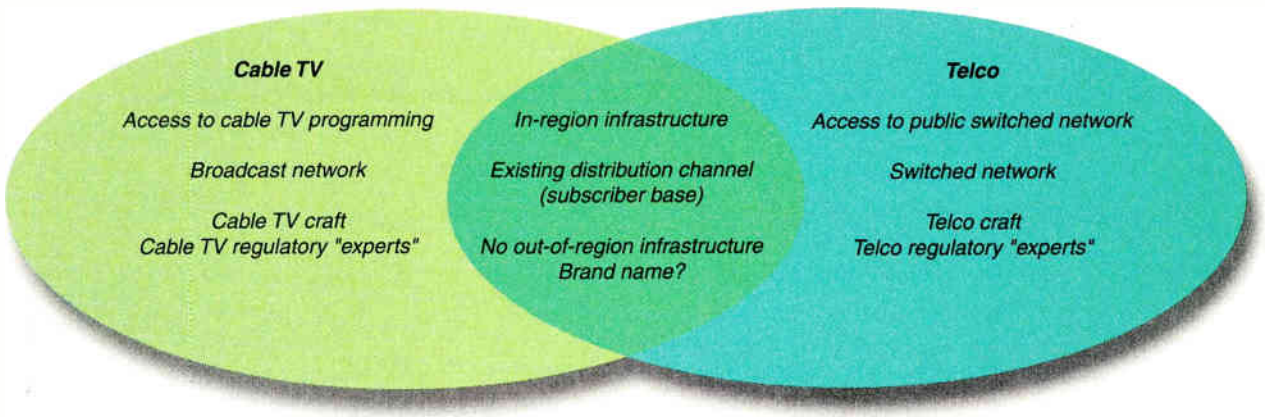
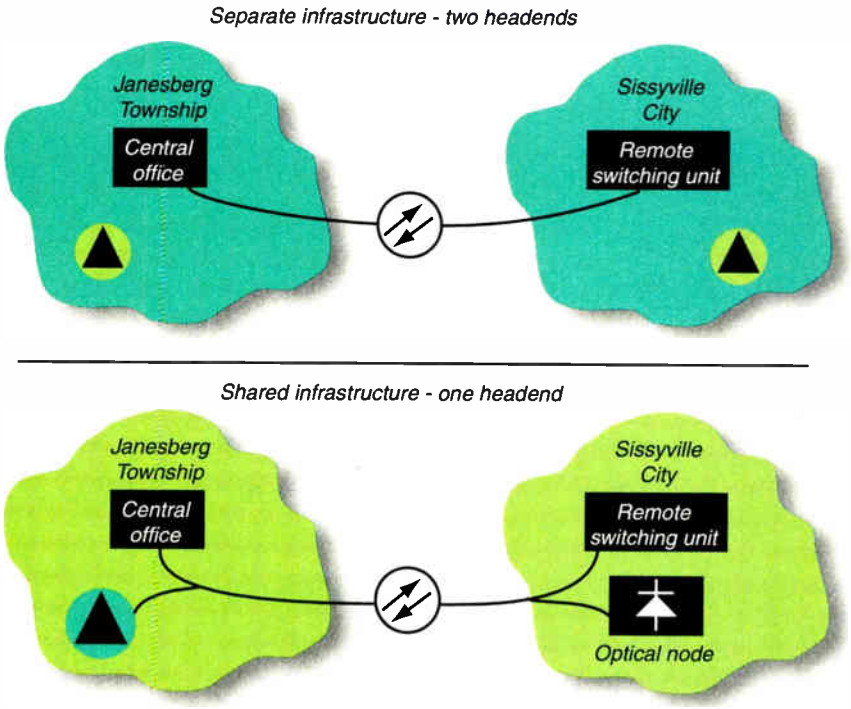


Figure 2: *Example of headend consolidation.*



sharing is to form a jointly-owned entity, similar to regional advertising interconnects, which would be responsible for facility maintenance.

✔Service extensions. Extension of service to areas either not served or poorly served by cable TV or telco interests are applications where infrastructure sharing can make sense. Again, in these applications (depicted in Figure 3), the cable TV and local telco's service areas most likely overlap.

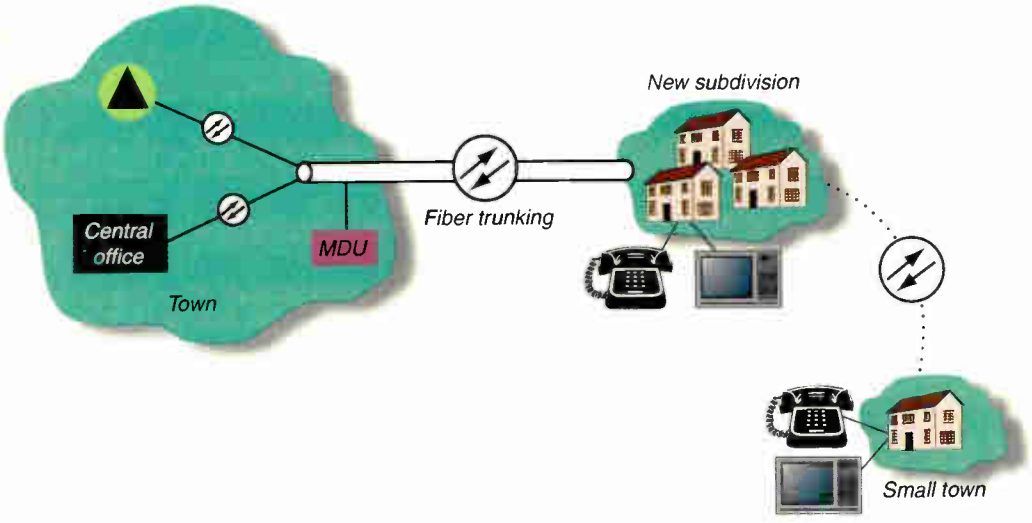
Large, multi-tenant dwellings are ripe for service improvements via a direct fiber optic feed to the building. New subdivisions at the edge of a city are another opportunity for cable TV and telco fiber extensions.

Lastly, installation of fiber optic links as replacements for analog and digital telephone carrier often justifies the extension of cable television service to rural communities that were previously too small to justify cable television.

As an example, assume a service extension to a rural community with the specified characteristics (see Table 1, page 64).

As can be seen from the Table, the domi-

Figure 3: Examples of service extensions.



nant cost factor is the cost of fiber from the headend to the rural community, while other costs, such as optoelectronics for signal trunking, coaxial and twisted copper pair plant, are secondary.

The extent to which the fiber cost is shared among telephony and cable services is a factor in determining the feasibility of extending cable service to a given community.

Utilization of fiber optics in providing rural telephone service reduces the amount of electronics required in the outside plant facility, as well as eliminates the capacity limitations of copper alternatives. A major advantage is the sharing of the transport bandwidth. In other words, telephony service often provides the sole justification for the placement of outside plant fiber.

Additionally, the telephony system provides a means of returning alarm information from the cable TV optical receiver to the central office or headend. Cable TV optical receivers are added only at those locations along the fiber route where the subscriber density is high enough to support cable television service.

Service region expansion

A third type of application is expansion of service into out-of-region areas. These regions are locations beyond the operators' existing franchise or exchange boundary. In

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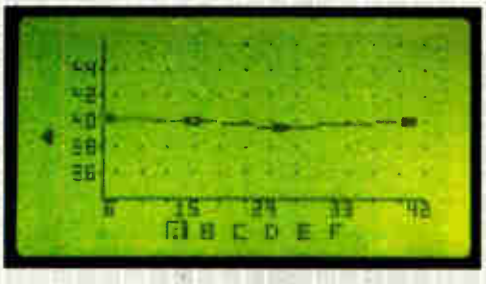

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this scenario, a telco in one location unites with a cable TV provider in another area to compete against other local telco and cable TV providers. By selectively sharing infrastructure, both entities are able to quickly and cost-effectively increase the size of their serving areas. This concept is illustrated in Figure 4, where a telco and a cable TV provider with adjacent exchanges share facilities to expand their reach.

In the above scenario, the local telephone company provides the switching infrastructure, while the cable TV company provides the headend expertise. Key to extending these services into the adjacent regions is the use of fiber interconnects.

In the illustration below, inter-office fiber optic rings are assumed. Cable TV transport is via an "AM" fiber system, because it minimizes the amount of remote signal processing. A fiber optic-based digital loop carrier system with distributed optical network units (ONUs) provides the transport of telephony signals from the central office, because it cost-effectively allows low penetration service to easily be distributed over multiple sites.

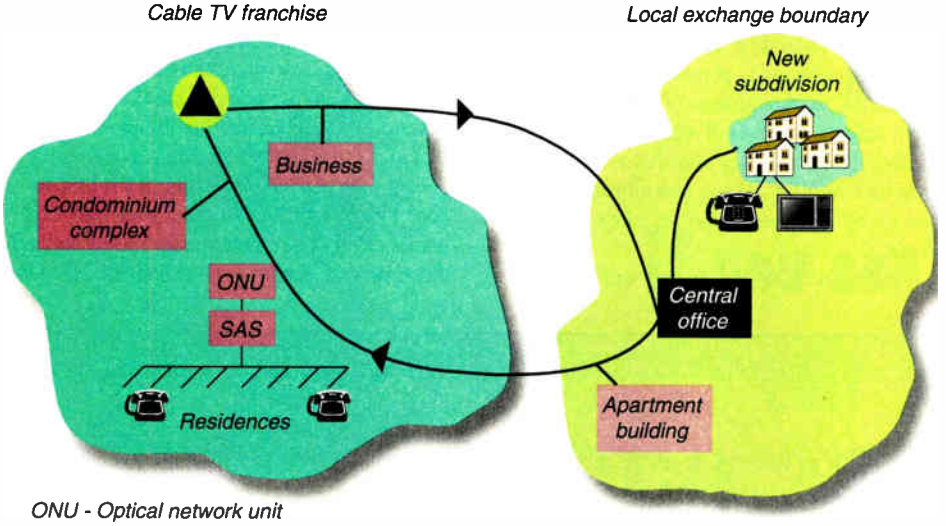
Penetration of service will be low initially, as both the cable TV and telco entity are new players outside of their initial service area. Thus, it is important to target service offerings at areas where success is likely, and infrastructure is in place. Examples include service to apartment buildings, small business and new subdivisions.

Another possibility, courtesy of the Telecommunications Act of 1996, is to use the incumbent telco's copper network. To exploit this, an ONU would be placed near a service access interface (SAI), and distribution and drop pairs would be leased from the competing telco.[1]

The marketing and administration of service outside of region can be performed in several ways. As an example, the telco and cable TV company might provide joint promotional campaigns for their services.

Additionally, billing for each service could still be independent, but might be coordinated such that they appear in the same envelope. Revenue for right-of-way use could be in the form of a per-subscriber fee.

Figure 4: *Service region expansions.*



ONU - Optical network unit
SAI - Service access interface

Summary

A number of opportunities exist at the local level for cable TV and telco partnerships, including out-of-region service extensions, system expansion and headend consolidation. The synergies between the cable TV and telco worlds can offer a compelling reason for them to partner to provide increased system capacity and service offerings and to compete against other, out-of-region entities.

This ability to share facilities in a cooperative fashion is contrary to the common belief that local cable TV and telephony operators must and will engage in cutthroat competition. CED

Reference

[1]*MultiChannel News*, August 12, 1996, F. Dawson, page 4.

the features of the system that are of interest to the service provider. The right selection of MTTR is key in making the results plausible. The MTTR chosen for various parts of the system must reflect the average performance of a maintenance organization for the various parts of the system. Bellcore TR909 [3] suggests the following MTTR values (see Table 1).

3. Architecture analysis and decomposition: To predict the appropriate reliability, availability and maintainability measures for a complex system such as the HSIU, for which there are a large number of subsystem modular components, a tremendous number of states may be required to appropriately model the system.

4. Architecture modeling: Architecture modeling involves creating reliability model(s) that describe the behavior of a system. Features such as interactions between the hardware and software components, maintenance and operational characteristics, and fault detection and isolation characteristics must all be taken into account. It turns out that the end-to-end system or network can be modeled as a chain of complex system components. Each complex network component in this chain can be analyzed rigorously and individually. The results can then be used to compute the end-to-end availability with much simpler methods. This can be done as long as the components are statistically independent.

5. System component parameter determination: One of the most important (and often time-consuming) tasks in system reliability modeling and analysis is the determination of the parameters of the reliability model such as circuit pack failure rate, maintenance and repair times, and detection and coverage probabilities. There are three methods to calculate availability parameters as described by Bellcore TR-332 [1]. These will be discussed in a later section.

6. Model solution and computation of RAM measures: Once the reliability model(s) are created and the parameters have been determined, the model(s) can be solved for the appropriate RAM measures

7. Model parameter sensitivity analysis: One of the usages of reliability analysis is the optimization of system architecture. Often, this task takes the form of determining the effect of changes in a parameter on the desired availability measure, then subsequently finding the value that optimizes the measure. In these cases also, the effect of the choice of parameter value on the resulting availability measure is of major importance. A parameter sensitivity analysis is the procedure that assesses the effects of changes in the parameter on the desired availability (RAM) measures.

This procedure is especially appropriate for finding the weak link in an architecture. Also, through this process, a development organization can determine whether it is over-engineering or under-engineering redundancy in a system.

Figure 3: State transition diagram

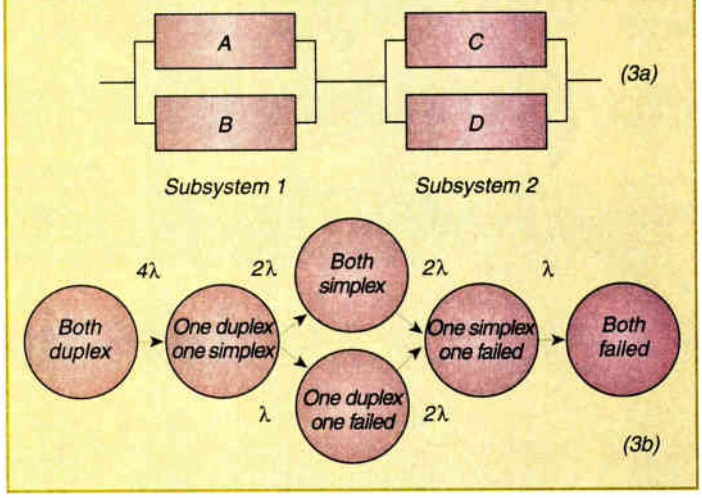


Table 1: Mean time to repair (MTTR) values for fiber-in-the-loop

Location or type of equipment	MTTR (hours)
For central office or manned headends	2
For host digital terminal (HSIU)	4
For outside plant equipment	6

Table 2: Environmental factor

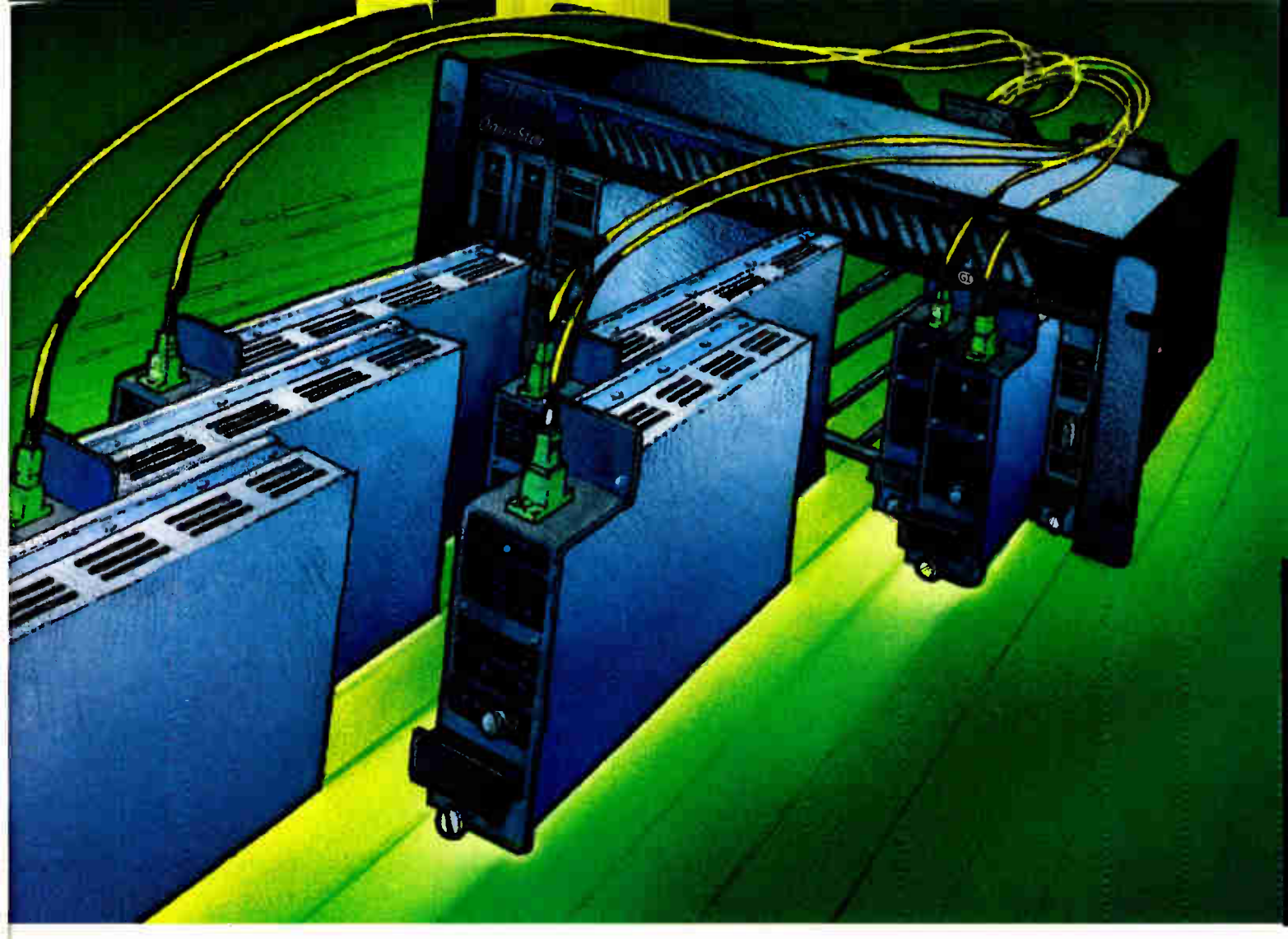
Environment	π_E	Nominal environmental conditions
Ground, benign	1.0	Nearly zero environmental stress, e.g. central office, CEV
Ground, fixed	1.5	Conditions less than ideal, some environmental stress, e.g. manholes, remote terminal, customer premises subject to shock, vibration, or temperature variation
Ground, mobile	5.0	Conditions more severe than previous row. Mobile telephones, test equipment

Reliability block diagram (combinatorial method)

Reliability Block Diagrams (RBDs) are commonly used to represent the reliability architecture of a system. RBDs consist of a simple pictorial method to represent the effects of all possible configurations of functioning and failed components on the functioning of the system. RBDs are most useful when analyzing the end-to-end availability of a transmission system such as the hybrid fiber/coax (HFC) architecture. This is because of the functional independence of the components of the end-to-end system. It will become clear that in a complex, stand-alone system such as the HSIU, the state space method would be more appropriate. In the HFC architecture as shown in Figure 1, there is no functional inter-dependence say, between the function of the customer interface unit and the fiber optics, except for signal transmission processing. The optics have to pass the broadband signal through, with some level of integrity. To demonstrate the point we assume that the optics either process signals with no through degradation, or pass no signal at all, and that is only upon unit failure. The CIU does not rely on the optics to function properly. Because of the functional independence property, the failure analysis of the HFC architecture would most appropriately be analyzed using RBDs or using the academic terminology, the combinatorial method. To understand the availability of the HFC architecture, we must establish some simple combinatorial rules. It can be proven that the availability of a serial chain, as shown in Figure 2a, when the members are statistically independent, is the product of the availability of each chain member. Therefore, the availability of the chain, when the availability of each component is known, and when they are statistically independent, is given by $A_{eq} = A_M * A_N$ (4).

For the parallel blocks of Figure 2b, the equivalent availability of the chain is given by: $A_{eq} = A_M + A_N - A_M * A_N$ (5).

The relations of (2),



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(4) and (5) are sufficient to analyze any RBD availability. In a later section, we will apply these equations to the reference model of Figure 1 to derive the availability of a typical HFC architecture, for the delivery of telephony services.

State transition diagram

(State space method: Markov modeling)

For most complex systems, there are more modes of operation than simply just working or failed. There are a variety of different working modes where certain components have failed but are being covered because of redundancy, a variety of different failed modes where different components have failed and brought down the system, and other modes of degraded operation which cannot be conveniently labeled as working or failed. Each possible mode of operation for a system, and the set of states of the system, is called the "state space." It is customary to assign the list of possible states of the system the numbers 1,2,....,n and refer to the model as an n-state model. A "state transition diagram" is a pictorial view of all of the possible operational states of the system, with arrows representing possible transfers (called state transitions) in the mode of operation of the system. In Figure 3, the two reliability modeling methods for the same system are illustrated (see page 72).

The numbers shown on the lines are failure rates (commonly expressed in FITs). It is also assumed that the times between the occurrence of events are exponentially distributed. Exponential distributions have many useful properties. It turns out that an exponentially distributed process, call it X, of (failure) rate λ, is defined as $P(X>t) = e^{-\lambda t}$ for $t >= 0$.

An exponential distribution is fully defined once the rate λ is known.

In Figure (3a) a system is shown using RBDs. The system consists of two identical subsystems in series, with each subsystem having two identical components in parallel, labeled A, B, C and D. It is assumed that all components have exponential distributions with a common failure rate λ. The same system is shown in Figure (3b) using the state transition diagrams. Some of the properties of exponential distributions have been used to go from the RBDs to the state transition diagram. For example, $P(X_A \cup X_B > t) = e^{-2\lambda t}$, where $P(X_A > t)$, represents the "time before failure" distribution for the component A. The 4λ rate shown on the line moving from "both duplex" to "one duplex, one simplex" state represents the equivalent rate for the union of the four processes A, B, C and D, because any singular failure in a both duplex state will result in a transition.

Once the repair statistics are incorporated into the model, then many availability calculations can be done. For the sake of time, we will not get into this method any further; however, we will state the only proper way to understand a certain availability measure of a system or a subsystem with inter-dependencies is via the state space method or the Markov modeling method. Care must be taken that the behavior of the system has been properly modeled. It is very easy to overlook the fault detection and diagnostic portion of a system. Most fault tolerant complex systems utilize rather sophisticated fault detection, diagnostic and recovery schemes. The more complex these schemes are, the higher will be the probability of fault recovery malfunction. This fault recovery scheme is handled through some hand-shaking between hardware and software. This complex interaction between software and hardware can only be modeled through Markov models. To apply combinatorial methods (RBDs) to these complex schemes will result in over-simplification and illusive conclusions.

Table 3: *Typical device failure rates*

Device type	Failure rate (in 10^9 hours)	Temperature stress curve	Electric stress curve, or multiplier
Digital integrated circuits	CMOS		
101-500 Gates	52	8	1.0
1001-2000 Gates	70	8	1.0
10001-15000 Gates	110	8	1.0
Microprocessors	CMOS		
1001-2000 Gates	50	8	1.0
10001-15000 Gates	71	8	1.0
Random access memory	CMOS, static		
64Kbits	170	8	1.0
256Kbits	300	8	1.0
Random access memory	NMOS, dynamic		
64Kbits	120	8	1.0
256Kbits	180	8	1.0
1024Kbits	270	8	1.0
ROMS, PROMS, EPROMS	CMOS		
64Kbits	55	10	1.0
256Kbits	81	10	1.0
1024Kbits	120	10	1.0
850 nm laser diode	15000	10	1.0
1550 nm laser diode	5000	10	1.0
Discrete resistor fixed, film	2	3	C
Discrete capacitor fixed, Al, axial lead < 400 µf	30	7	E
Relays, contactor	560	3	C

Component failures

The majority of the failures in the field are because of a hardware component failure. Therefore, there is a need to predict or assess the field reliability performance of replaceable hardware assemblies.

The three methods in Bellcore TR-332 for calculating the MTBF of a system's replaceable components (plug-in, power convertor module, etc.) are given in the following subsection. Method I is basically a parts count method. Method II combines results of lab testing with Method I. Method III allows for incorporating field return data into the long-term predictions. In this article, we will only look at Method I in some detail.

Method I

This method provides a starting point when no lab test results or field failure information are available. Bellcore defines the steady-state failure prediction of a replaceable system com-

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Table 4: Quality level multiplier

	Integrated circuits		Discrete semiconductor devices		All other devices
Quality level	Hermetic	Non-hermetic	Hermetic	Plastic	
I, Some device quality control	1.5	1.8	1.5	1.8	1.5
II, Average device quality control	1.0	1.0	1.0	1.0	1.0
III, Tight quality control	0.5	0.5	0.5	0.5	0.5

ponent, circuit pack, or assembly, as λ_{SS}, where, $\lambda_{SS} = \pi_E \sum N_i \lambda_{SSi}$, with the summation done over i=1,..,n, and (6)

where

n = the number of devices in the assembly

N_i = quantity of the i^{th} device type

π_E = unit environmental factor as explained in Table 2

$\lambda_{SSi} = \lambda_{Gi}\ \pi_{Qi}\ \pi_{Si}\ \pi_{Ti}$, steady-state failure prediction rate for the i^{th} device (7)

λ_{Gi} = Generic failure rate for the i^{th} device, given in Table 3

π_{Qi} = Quality factor for the i^{th} device, given in Table 4

π_{Si} = Stress factor for the i^{th} device, given in Table 5

π_{Ti} = Temperature factor for the i^{th} device, given in Table 7. (See Tables 2-7.)

Observations

As it can be inferred from the above formulas and tables, there are many factors that affect the reliability or potential lifetime of a device. Some devices are more sensitive to electrical stress, such as capacitors, resistors and diodes (not given). Laser diodes, ROMS and PROMS are sensitive to high temperature operating environments.

For example, for these devices at 65°C, the expected lifetime will be almost four times worse than that operating at 40°C. Quality control of incoming devices also has significant implications over their long-term reliability. Activities such as burn-in or screening through temperature cycling, lot-to-lot control of components and periodic requalification are characteristic of Quality Level III (as given in Table 4), representing the tightest level of quality control. A product designed for high reliability performance would have all of these factors incorporated. The designer should be cognizant of the steady-state operating temperature of the devices used in his design and should take measures to ensure that temperature-sensitive devices are not heat stressed, and discretes such as diodes, capacitors or resistors are not electrically stressed. Furthermore, an attempt should be made to minimize the number of high failure rate devices, and in general, keep component count to a minimum.

Table 5: Electrical stress multiplier, π_S

	Electrical	Stress curve
% Stress	C	E
10	0.6	0.4
50	1.0	1.0
90	1.7	2.6

Table 6: Electrical stress definition

Definition of electrical stress	
% Electrical stress for resistor	Applied power/ rated power
% Electrical stress For capacitor	Sum of applied DC voltage plus AC peak/rated voltage

Table 7: Temperature stress multiplier, π_T

Operating temp., °C	Temperature stress curve			
	3	7	8	10
30	0.9	0.6	0.6	0.4
40	1.0	1.0	1.0	1.0
65	1.4	2.6	3.0	6.8

Table 8: Hypothetical customer interface unit bill of material

Device description	Quantity **	Device FIT
100k Gate digital IC	2	150
Microprocessor	2	100
256k DRAM	2	180
Relay	4	560
256k PROM	2	81
Total CIU FIT		3262

***For purposes of illustration, we are oversimplifying the CIU construction. We are assuming that the quantities and types of devices in the above table are a most likely representative of the reliability of the real CIU.*

Hybrid fiber/coax availability modeling

Model used for telephony services:

The average availability (up-time) goal for plain old telephone service (POTS) subscriber loop has been set to be 99.99 percent or no more than 53 minute average unavailable time per year. There are many reasons for this high level of reliability and availability, but one simple one is public reliance on telephone access for emergency 911 services. This objective, incorporating all network equipment between the local switch and the network interface (excluding the local switch and the customer premises terminal equipment), refers to the long-term average service to a typical customer.

Telephony-like services over HFC should therefore strive to achieve this goal, if they are to be the only means of providing telephone service in the area. In our discussion herein, we will attempt to assess the challenges in meeting this goal and highlight some additional measures that need to be considered in order to achieve this goal.

According to the above definition, the "subscriber loop," consists of: the headend switch interface unit (HSIU), headend power, headend optics TX, headend optics RX, fiber-node optics RX, fiber-node optics TX, plant power, up to three cascaded amplifiers and the customer interface unit (Figure 1).

Using (2), (4) and (5), the end-to-end availability measure of the above model can be expressed as follows:

$A = A_{HEP} * A_{HSIU} * A_{FOptics} * A_{ROptics} * A_{PP} * (A_{Amp})^m * A_{CIU}$, where (8)

A_{HEP} = Availability of the headend powering equipment

A_{HSIU} = Availability of the headend switch interface unit

$A_{FOptics}$ = Availability of the forward optics

$A_{ROptics}$ = Availability of the reverse optics

A_{PP} = Availability of the plant power

A_{Amp} = Availability of amplifier

m = Number of amplifiers in cascade, we will use m = 6, to account for reverse amplifiers too

A_{CIU} = Availability of customer interface unit

$A_{FOptics}$ and $A_{ROptics}$ are further broken down into,

$A_{FOptics} = A_{Flaser} * A_{Freceiver}$, If no redundancy is used

$A_{ROptics} = A_{Rlaser} * A_{Rreceiver}$, If no redundancy is used

If redundancy in the optics is used, then equation (5) can be applied.

In order to calculate the individual availability measures, knowledge of the MTBF and MTTR is necessary. The MTTRs were given in Table 1.

Analysis of the model

In order to get some idea about the expected availability measure of the end-to-end telephony model, we have to use some actual experienced numbers. In the above model, there is not much experience with the HSIU and CIU components, simply because these are products in the early phases of deployment.

To get an idea of the availability, we will create a hypothetical customer interface unit. Here is the bill of material for this hypothetical CIU (see Table 8).

Using the following coefficients and assumptions

π_E = 1.5 (Outside plant)

π_Q = 1.0 (Quality level II, average)

π_S = 1.0 (Designed, such that devices are not electrically stressed)

π_T = 1.3 (All devices fall in temperature curve 8, assume 45°C operating temperature)

λ_{SSCIU} = 6361 FIT ⟶ MTBF = 157,208 (hours)

A_{CIU} = 0.9999618

One significant difference between the design of the CIU and the HSIU, is that there is great incentive in keeping the cost of the CIU as low as possible. This prohibits the use of redundancy in the design of the CIU. On the other hand, the HSIU can afford to employ equipment duplication and protection, because its cost is shared by many hundreds of potential subscribers.

To estimate A_{HSIU} we assume that the FIT is 10 times better than that of the CIU. This is not an unrealistic expectation, because the HSIU equipment will provide a much higher level of equipment protection, plus the operating environment will be much more benign and stable. Therefore

$$A_{HSIU} = \frac{1572080}{1572080 + 4} = 0.99999745$$

To further continue the analysis we will consider four cases (See Tables 9 -12):

Case I: Trunk and feeder with 20 trunk, one bridger and two line extender amplifiers. The annual return rate of the amplifiers is assumed to be 2 percent. For two-way telephony service, the reverse path should be turned on. This results in an equivalent of 46 amplifiers in cascade in the reliability model. We see from Table 8 that the end-to-end availability is 99.93 percent. This number would further be aggravated if the dependence on commercial power were to be incorporated. It is common to see a power outage in one segment of a cascade and not at the neighborhood. Taking all of these factors into account, it is easy to understand why so many people have a distaste for cable TV service. Regardless of the power issue, we see that the trunk and feeder architecture is really not suitable for telephone services.

Case II: Hybrid fiber/coax, with no optical redundancy. Even though in this example the optics perform less reliably than the amplifiers, the end-to-end availability has improved to 99.97 percent.

Case III: Same as Case II, with optical redundancy. Using redundant optical equipment, despite their relatively low reliability, improves the end-to-end availability to 99.987 percent.

Case IV: Same as Case III, with more reliable amplifiers. Deploying six times more reliable amplifiers results in 99.995 percent end-to-end prediction.

Therefore, using the hypothetical CIU and HSIU, applying redundancy in the optics and assuming that $A_{PP} = A_{HEP} \cong 1.0$, we were able to meet the Bellcore requirement of 99.99 percent long-term availability. It is important to note that the only way that A_{PP} and A_{HEP} will be relatively high is through use of power back-up (i.e. batteries). Even then, the availability of emergency generators and emergency crews is essential in preventing extended power outages and in meeting the above requirement. The cable plant power has historically not been backed-up; therefore, a cable plant being designed for telephone services must take all of the above into consideration.

Table 9: *Case I. Trunk and feeder 20 + 3 in cascade*

	Annual return rate %	Calculated MTBF (hrs.)	MTTR (hrs.)	Calculated availability
Forward laser	N/A		4	
Forward receiver	N/A		6	
Coaxial amplifiers	2	438,000	6	0.999986302
Two-way cascade length	46			0.999370066
Reverse laser	N/A		6	
Reverse receiver	N/A		4	
CIU	5.6	156,429	6	0.999961645
HSIU	0.58	1,564,286	4	0.999997443
System				0.99932918

Table 10: *Case II. HFC with no optical redundancy*

	Annual return rate %	Calculated MTBF (hrs.)	MTTR (hrs.)	Calculated availability
Forward laser	9	97,333	4	0.999958906
Forward receiver	9	97,333	6	0.99993836
Coaxial amplifiers	2	438,000	6	0.999986302
Two-way cascade length	6			0.999917812
Reverse laser	9	97,333	6	0.99993836
Reverse receiver	9	97,333	4	0.999958906
CIU	5.6	156,429	6	0.999961645
HSIU	0.56	1,564,286	4	0.999997443
System				0.999671476

Other issues in consideration of availability:

Ingress: The cable plant reverse path suffers from a phenomenon called ingress. Ingress is the infiltration of 5-40 MHz energy off air (or through other means of energy coupling) from the various openings (primarily in the soft coax drop) into the plant. It is important to understand the effects of ingress on channel availability. All the considerations so far concentrated on electronic equipment reliability and up-time. Interference from ingress can conceivably jam the upstream transmission, effectively making the service unavailable to the subscriber. Analysis of ingress and quantifying channel availability as a function of interferer characteristics and CIU characteristics is not the focus of our discussion. However, we will mention that how a vendor's product treats ingress can have significant bearing over the availability of the channel to the point that electronic equipment reliability could be over-shadowed. For example, through the use of frequency agility, rugged modulation, and narrow carriers, a higher immunity to ingress can be expected. Given this, it is easy to compute $A_{channel}$ based on experimental information available on the plant ingress. Once $A_{channel}$ is computed, it can be treated as another serial link in the reliability block diagram analysis to provide the real service availability measure.

The ability to shut off or attenuate various

parts of the return system will be critical to problem isolation and detection.

Proactive system tests: This is simply finding faulty units before the customer does. An important feature that will differentiate various cable telephony products is their background and foreground diagnostic capability. As an example, a CIU in concert with the HSIU could be running background tests while the service is not being used. If failures are encountered, the results are transmitted to a central location, whereby maintenance staff are dispatched. The fact that the CIU is primarily going to be located at the side of the house makes maintenance activities non-intrusive. The maintenance crew can service the fault, long before the subscriber becomes aware of the problem. This is a major departure from the traditional entertainment cable and is one of the major advantages of the "demarcation point" concept. Bit-error-rate tests conducted in this manner at various frequencies can be utilized to "qualify" potential segments of return spectrum, before assignment.

Cables and connectors: These are other unknown sources that can and will cause service interruptions. Intermittent connections are a major source of ingress and signal degradation that can adversely affect channel availability. Intermittent connections are likely to result in long outages because the trouble will most likely be in the house cabling. Access and troubleshooting become quite a problem.

Plant power: It was mentioned earlier that power reliability and availability must be taken into consideration and cannot be overlooked in providing telephone-like services. Batteries must in fact be in place and in good condition to be utilized under commercial outage situations. Status monitoring may be well-justified to verify this on a routine basis.

Software reliability: It will be critical in advanced systems to be able to diagnose problems before they occur, for preventive maintenance reasons. In the event of an unexpected failure, there is a high value attached to the ability of the product to automatically and correctly reconfigure redundant signal paths and raise appropriate notification. Because this intelligence is primarily realized through software, its reliability becomes of paramount importance.

There is no effective gain-control technique in the return path today

Return spectrum management: There will be a high value placed on the ability to manage and control the various signals present on the return spectrum. Without this capability, many new and existing products and systems which utilize the return band for communication will overlap, contend and collide with high priority signals resulting in unpredictable communication and sub-optimal spectrum utilization.

Fiber path diversity: Considering the extensive deployment of fiber, failures because of cable cuts could become a primary constraint. Optical cable path diversity may be well-justified.

Return power sensitivity: It has been shown that the return path can be overpowered if signals of arbitrary amplitude are permitted. The return amplifiers (just like forward amplifiers) will become non-linear if signal input power is too high. There is no effective gain-control technique in the return path today, and the return laser may be particularly susceptible to high power inputs.

Table 11: *Case III. HFC with optical redundancy*

	Annual return rate %	Calculated MTBF (hrs.)	MTTR (hrs.)	Calculated availability
Forward laser	9	97,333	4	0.999958906
Forward receiver	9	97,333	6	0.99993836
Coaxial amplifiers	2	438,000	6	0.999986302
Two-way cascade length	6			0.999917812
Reverse laser	9	97,333	6	0.99993836
Reverse receiver	9	97,333	4	0.999958906
CIU	5.6	156,429	6	0.999961645
HSIU	0.56	1,564,286	4	0.999997443
System				0.999876883

Table 12: *Case IV. HFC with optical redundancy and improved reliability*

	Annual return rate %	Calculated MTBF (hrs.)	MTTR (hrs.)	Calculated availability
Forward laser	9	97,333	4	0.999958906
Forward receiver	9	97,333	6	0.99993836
Coaxial amplifiers	0.3	2,920,000	6	0.999997945
Two-way cascade length	6			0.999987671
Reverse laser	9	97,333	6	0.99993836
Reverse receiver	9	97,333	4	0.999958906
CIU	5.6	156,429	6	0.999961645
HSIU	0.56	1,564,286	4	0.999997443
System				0.999946739

Conclusion

This article introduced the reader to some of the concepts of reliability analysis and some of the real-world problems encountered in the hybrid fiber/coax plant. Quantifying service and channel availability to a subscriber is not a trivial task and requires a great deal of information gathering and analysis. Complex systems, in particular, where a great deal of module inter-dependency exists, cannot be easily analyzed. It was stated that electronic equipment up-time will not be the only factor in ensuring channel availability: issues such as connections and ingress must also be considered. We also concluded that optics redundancy and power back-up are very important in meeting telephone service availability requirements. It is possible to meet the availability requirement of 99.99 percent with proper network design, planning and routine monitoring. Care must be taken in the selection of network components and their associated modulation and spectrum formats. OSS for these networks will be complex and necessary. CED

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Digital video and transport connectivity options

Creating an infrastructure for new services

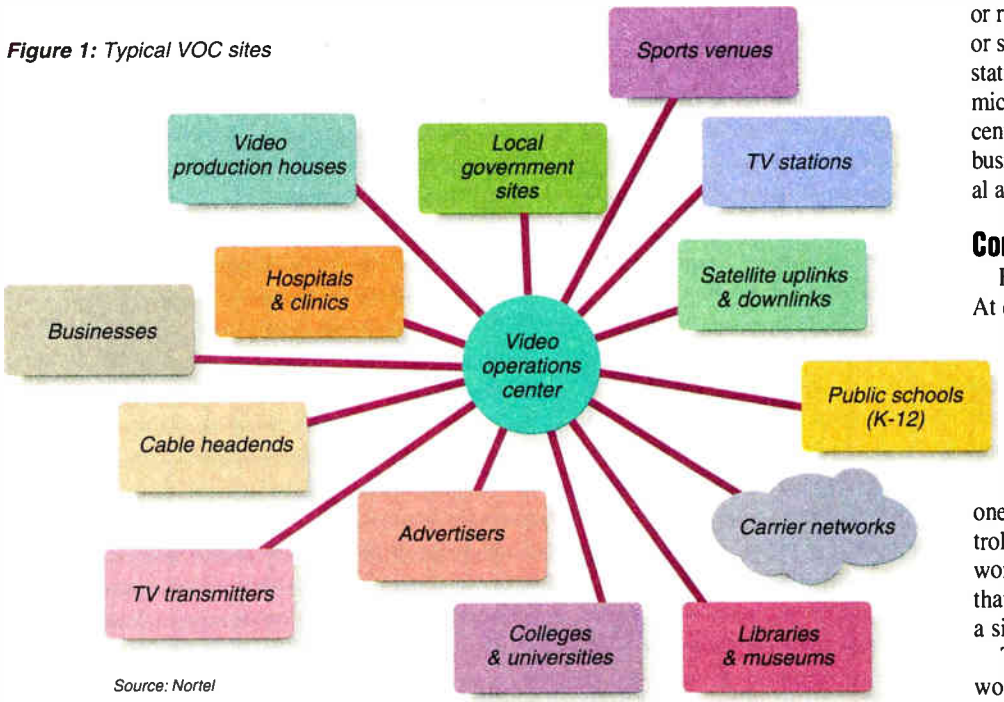


Figure 1: *Typical VOC sites*

Source: Nortel

By Jay Shuler, Senior Manager of Broadband Applications, Nortel (Northern Telecom), Atlanta

Many cable providers understand the compelling need to migrate to an all-digital network, for reasons including pristine signal quality over any distance, rock-solid reliability (bit error rates of up to 1 error in 1,000,000,000,000,000), compatibility with existing long-haul telecom networks and flexibility to accommodate every conceivable type of service. Simply stated, digital is more efficient than analog–capable of sending a greater number of video signals down the pipe.

What cable providers may not have figured out is how to overcome the higher initial costs of a digital network in order to achieve the long-term revenue potential and operational cost savings.

Cable systems can improve the quality of their service and establish a foundation for new services through the construction of digital video linkages to area programming sources, including local television broadcast stations and satellite downlinks. Expanding this network to include local sports and news venues, production studios and institutional sites–and hubbing these sites to a switching center–can create new business and service opportunities.

Most important in distinguishing a good from a bad VOC network is the software

Those who have looked into the digital network are beginning to understand that the best short-term fit–and the easiest business case for cable companies to make–for digital technology is above the headend. One such application is known as supertrunking.

Another type of digital network, which is fully complementary and compatible with a supertrunk network, is the video operations center, or VOC. A video operations center network is a multi-site, switched digital network configured in a logical star that can interconnect hundreds or even thousands of video source and destination sites throughout a community, state or region. This network can provide on-demand or scheduled connections between headends, TV stations, satellite uplink and downlink sites, microwave relay points, sports venues, cultural centers, hospitals, schools, governmental and business sites for a wide variety of unidirectional and interactive video services.

Constructing a VOC

Figure 2 illustrates a typical VOC network. At each source or destination site is a digital video codec capable of providing broadcast quality video. These sites are connected in a logical star configuration to a central hub site, where there is a digital video switch. This subnetwork is called a *cell*. A network may consist of one or several cells. Each cell switch is controlled by a cell controller, and the entire network is controlled by a master control system that allows the switches to function together as a single, seamless video network.

The choice of technology is critical to network performance. The overall network must provide extremely high video quality and network reliability. The video codecs must be mutually compatible, and capable of delivering video at "contribution" quality, so that it is capable of withstanding some post-production in the studio. MPEG-2 digital video codecs are designed to support premium services such as interactive video, digital videotrunking and supertrunking.

Perhaps most important in distinguishing a "good" from a "bad" VOC network is the choice of network software. This software should allow a single network to be shared by many users. It should automate network scheduling and switching to provide 24-by-7 operation, while minimizing the number of network provider personnel required to operate and maintain the network. Users should be able to schedule their own network sessions at any time of day using widely available technology (i.e., IBM-compatible or Macintosh computers), while providing for

the security and privacy of each user's sites, schedule and sessions. Users should have the flexibility to grant temporary and explicit access to one or more sites or sessions to one or more other users, to allow sharing of programming. The software (and switch) must allow either bidirectional or unidirectional, point-to-point or multicast video routing. And it should explicitly support multiple switched video applications, such as broadcast trunking, distance learning or video conferencing, in order to gain maximum leverage of the network investment. Figure 3 is a screen shot of one such scheduling system.

Async or Sonet?

The transmission system can be either DS-3 asynchronous or Sonet (Synchronous Optical Network) fiber or microwave. Single-mode fiber is the most reliable and highest-capacity choice with the longest unrepeated range, but there may be links in the network that can only be spanned affordably using digital microwave facilities. Broadband digital microwave comes in capacities from T-3 (45 Mbps) to over 600 Mbps, at several different spectral frequencies. Individual links can be redundant, and/or microwave hops can form one or more links in a Sonet ring network, for maximum survivability.

The choice of asynchronous or Sonet is one of cost vs. the superior survivability and network management capabilities of the Sonet network. It is not unusual for end sites to gain access to the backbone via unprotected DS-3 or OC-3 "spokes," although Sonet access rings are becoming increasingly popular because of superior reliability in case of cable cuts. The advantages of Sonet become even more pronounced in the interoffice portion of the network, both between switching hubs and between network concentration points and the hub. Depending on the number of sites and the traffic patterns between sites, a broadband digital video network can require a lot of bandwidth in the network backbone–a level of bandwidth that can only be provided by Sonet facilities. Finally, Sonet facilities insure compatibility with adjacent telecom networks for future service interoperability.

Applications and justifications

The first application of a video operations center—the one that provides the greatest and earliest benefits to the cable company and its end users—will depend to some extent on the individual business drivers in each community. Logically, it is easier to start where there is the greatest need, where the users already have an existing budget for the type of service that a VOC provides, and where there is the greatest value in the application. It has been the experience of the author's company that, in most metropolitan areas, the best initial customer for VOC services is the broadcast community, which includes the cable company itself. Once the network is established and generating revenues, interactive video sites can be quickly added to leverage incremental revenues out of the installed base. The network provider should plan from the start for rapid network expansion. Not only does this allow for more end users and potential sources of revenue, but it increases the value of the network to each user by providing more sites with which they can communicate.

VOC connections between cable ops and local TV stations improve video quality

Improving existing service

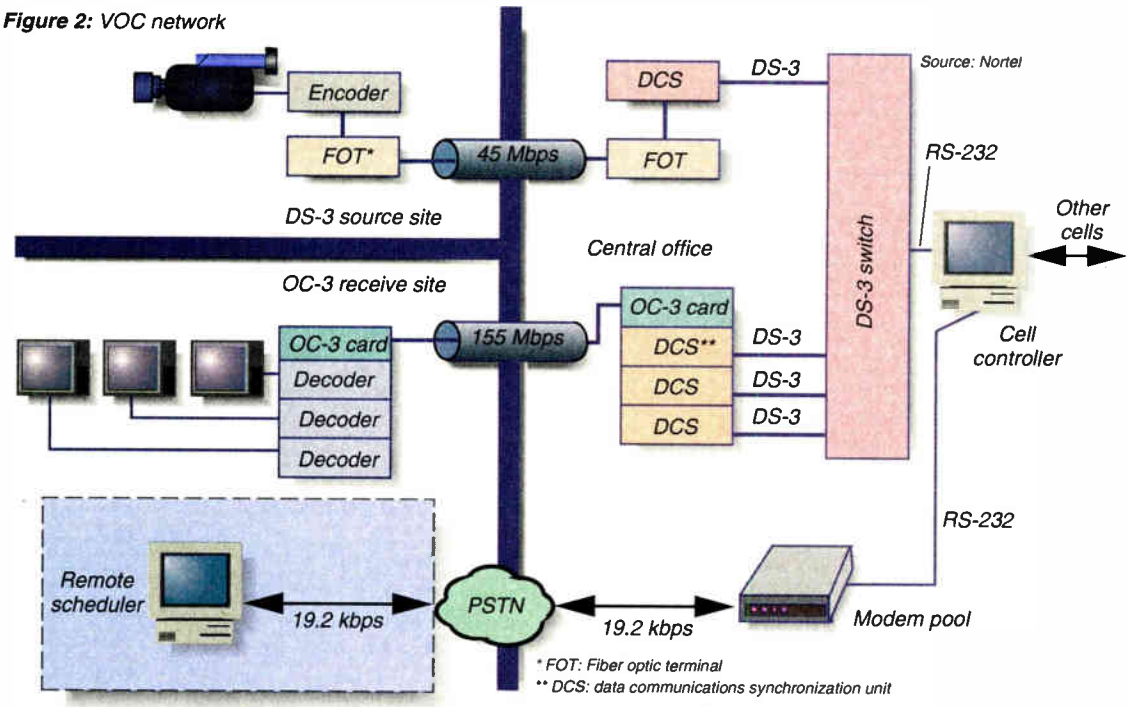
Relying on off-air reception from local TV stations exposes the cable system to many of the same reliability and quality problems that caused their subscribers to come to them in the first place. Severe weather can degrade signal-to-noise before the signal even enters the cable system. VOC connections between cable providers and local TV stations benefit both parties by dramatically improving video quality and network reliability.

For the broadcaster, improved video quality makes the channel more attractive to viewers. For the cable provider, the ability to achieve 60 dB or better at the headend gives it greater headroom to accommodate losses in the distribution network, allowing larger systems in terms of geographic and subscriber reach.

Serving commercial customers

Ambitious owners also have the opportunity to establish revenue-generating switched digital video networks that can serve a variety

Figure 2: *VOC network*



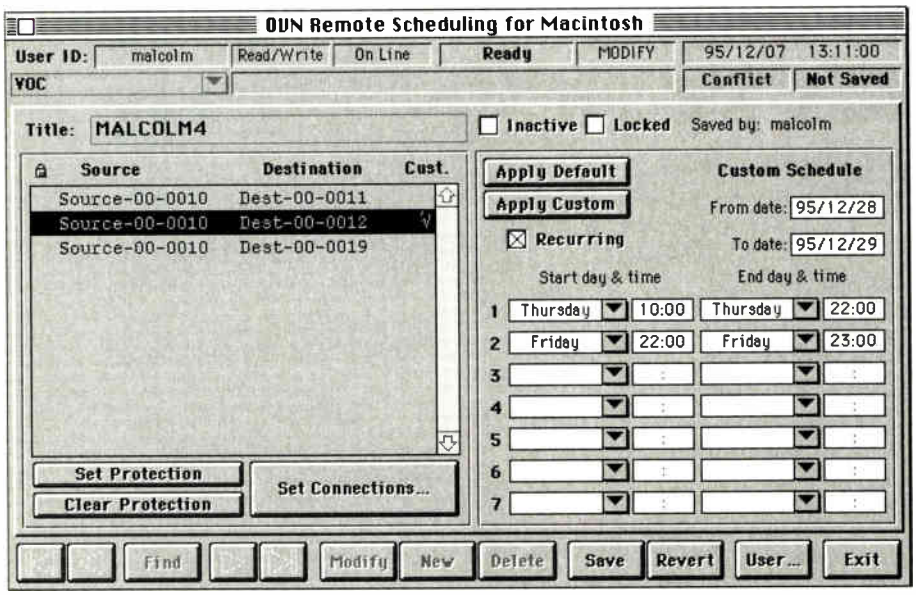


Figure 3. VOC remote scheduling. *Source: Nortel*

of commercial customers, including TV stations, news bureaus, venues and local video production houses.

The microwave spectrum is getting very crowded in many metropolitan areas, and it is often difficult to establish lines of sight between electronic news gathering sites and local TV production studios. Broadcasters typically have elaborate microwave routing schemes, with expensive arrays of microwave receivers and transmitters on top of tall buildings or nearby mountains. These relay points are expensive in terms of equipment, real estate and signal degradation. The same video operations center network that connects the headend to the TV broadcasters can also minimize the need for such facilities, while actually simplifying local sports and news coverage.

Among the first sites to add to the video network are local sports venues. This facilitates live coverage of professional, college, and even high school football, baseball, basketball, hockey and other major sports. Instead of sending an expensive microwave truck to cover the game, the VOC allows the broadcaster to dial into the scheduling system over a standard modem line and set up a connection through a digital video codec.

When the camera crew arrives at the game, it merely plugs into a codec pedestal, and the video is sent directly to the studio. For nationally televised games, this video might go directly to a network point of presence (POP) for transmission to a national network studio. This method is used in many cities today.

Video-linked performance venues such as symphony halls, drama theaters and outdoor amphitheaters enable broadcasters and cable operators to bring local cultural programming to their viewers and subscribers. Museums, aquariums and libraries are yet another source of programming, with regular and special events that do not normally get much notice in the community.

The ability to easily air these events provides another tool with which local broadcasters and cable systems can differentiate themselves from direct broadcast satellite and other national-level programming.

Community conferencing services

An intelligently planned video operations center network can even serve local businesses and government by providing the infrastructure for premium video conferencing, distance learning, telemedicine and remote arraignment services.

Local K-12 schools, community colleges, and universities have a need to share facilities, teachers and other educational resources through digital networking. A video operations center network can allow fully-interactive distance learning so that high schools can share specialized math teachers for Calculus, science teachers for physics and biology, language teachers, creative writing teachers, art, etc. Connecting K-12 schools to community colleges and universities allows advanced placement (AP) and vocational education to be provided to high school students, and allows local classrooms to be used after hours to provide adult and continuing education classes to parents and employees who could not otherwise afford the time to take them.

Video links between hospitals, clinics, retirement homes and doctors' offices facilitate remote diagnosis and consultation. Telemedicine can improve patient care and save time and money by keeping patients closer to home in lower-intensity care facilities while leveraging highly-paid specialist physicians across a wider geographic area.

The same network allows telemedicine and distance learning for inmates and correctional staff

Connecting to courtrooms, judges' chambers and correctional facilities allows the provision of remote court arraignment and "virtual courtroom" services, which have been shown to save millions of dollars in transportation and security costs, as well as accelerating the judicial process. The same network also allows telemedicine and distance learning for inmates and correctional staff.

Interworking with long-haul networks

A network that interconnects with all the major media sites in a metropolitan area–and which provides encoded, broadcast-quality video transmitted over standard DS-3 facilities–makes an attractive access network for the national networks and video network providers. By facilitating easy access and standard network interfaces, the VOC could pre-empt competitive entry by a second provider, and help protect market position.

Interworking with supertrunk networks

If the cable provider has an existing supertrunk network, a VOC network can provide management of program content to the super headend for distribution to the local "mini-headends." Basing both the VOC and supertrunk network on Sonet technology allows seamless network management of both applications through a single network management system.

It also allows voice, data and private line service to be served off the same network infrastructure, with almost unlimited capacity, reliability and ease of operation, while providing the foundation for the ATM networks of the future. CED

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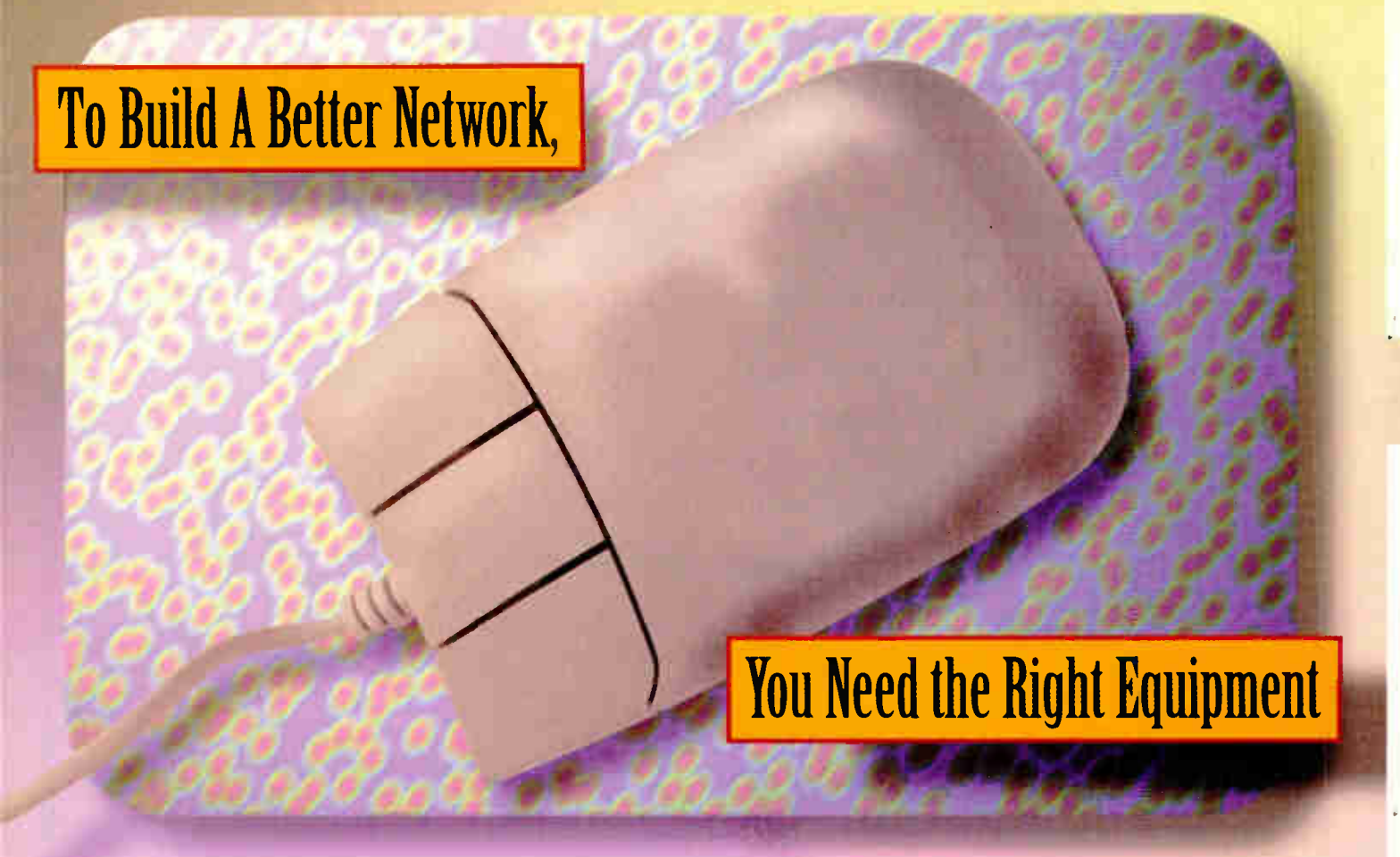

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HEADEND EQUIPMENT

CONSTRUCTION EQUIPMENT

Proactive return path maintenance

It's time to sweat the small stuff

By Bill Morgan, R&D Project Manager, Hewlett-Packard

Editor's note: *This article is part two of a three-part series on the return path. The final installment will appear in the February issue.*

In last month's issue, we discussed return path alignment procedures and solutions to some of the problems that may be encountered while turning on the return path. Activating the return path is only the first step toward offering subscribers interactive services. If the quality of the service you provide is not superior, your customers will look to your competitors. To keep the competitive edge, you will need to be able to find and fix problems before they are visible to your customers. In this article, we will discuss the importance of a return path preventive maintenance program and look at issues surrounding proactive maintenance of the return path.

As fiber is installed deeper into today's cable systems, and the number of cascaded amplifiers is reduced, the tendency is to pay less attention to keeping the remaining amplifiers operating at their optimum performance. But with the activation of return path services, optimum performance is even more critical. Attention to detail is mandatory, regardless of the number of cascaded amplifiers and the age of the plant. Technicians need to be obsessed with details and investigate all discrepancies. In other words, don't ignore the small stuff!

Any maintenance program, forward or return, requires a schedule to make it happen. You need a list of daily, weekly, monthly, semi-annual and annual inspections and procedures to be performed. Establish a checklist and keep it updated as the system architecture changes. Information from the routine tests should be recorded and kept in a database as a history of the active network.

Return vs. forward

Preventive maintenance for the return path is similar to many of the current maintenance programs used in the forward path. These methods include periodic system sweep, end-of-line monitoring and periodic performance tests. Because the return path is configured differently and carries different services, some of the return path tests have changed. As an example, a carrier-to-noise measurement in the forward path can be made relative to a measured visual carrier because the forward path carriers are always active. Quite often, return path carriers are only on when transmitting data, so a carrier-to-ingress measurement in the return path must be made relative to an intermittent data carrier or its expected level.

Cable operators are discovering that maintaining the return path is much more difficult than the forward path. The cost of maintaining a bi-directional system is currently two to four times greater than the cost of maintaining the forward path alone. Much of the increase in labor is related to multiple trips to the same location repairing self-inflicted problems. The goal of return path maintenance is to minimize trips to a given site by maintaining precise gain alignment. This can be accomplished by adding return path sweep testing and ingress monitoring to the normal forward path test program.

Sweep testing

Routine sweep testing of the forward and return paths gives the technician many advantages over other alignment methods. Forward path sweep response data is valuable information for the technician as he is troubleshooting the return path. The improved frequency resolution inherent in today's return path sweep systems enables the technician to find and fix problems before they become customer complaints. Some examples of return path problems identified by sweep testing are pictured in Figures 1 and 2.

Figure 1: Reflections

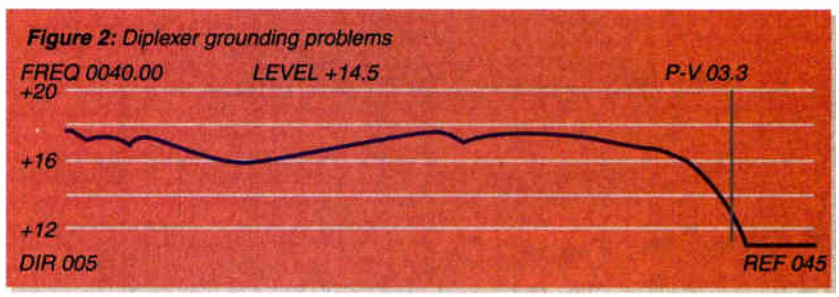


Figure 2: Diplexer grounding problems

Maintenance costs will be reduced if the technician sweeps the forward and return paths at the same time. Combining the two tests eliminates a second trip to the same location and minimizes housing openings which can aggravate ingress and leakage problems. In addition, many amplifier designs have return signal paths on the forward amplifier motherboard. Therefore, if the forward amplifier is replaced, the return amplifier may also be affected. Faulty grounding of the modules in the amplifier can cause ingress problems in the return, but only have a minor effect on the forward path. Checking both forward and return paths at the same time can help eliminate future problems in both directions.

The sweep tech needs to understand the importance of return path unity gain, the prop-

er levels to insert into the return, and what levels to expect at the headend.

In last month's article (see October issue, page 42), we discussed using a level matrix to set the sweep source level. This matrix is just as important for maintenance as it is for alignment. If these levels aren't well controlled, all the work done during initial alignment can be wasted. Routine sweeping of the return should include sweeping the fiber link and reconfirming the normalized levels at the headend (the "X" level) to verify the performance of the optics.

Some manufacturers' distribution equipment will recommend different optimum input levels. This is sometimes found when comparing the recommended input to the return amplifier gain block and the fiber node return laser. This is a deviation from the unity gain theory. The gain block (return amplifier and cable loss) can have either gain or loss in order to set the signals to the correct level for the fiber node. But the philosophy that each amplifier in the return path is adjusted to compensate for the loss of the section of cable following (in this case, the cable and passives between the fiber node and the first amplifier) still holds true. If your sweep gear uses an insertion point loss variable to adjust the actual sweep source level, this loss may be adjusted to compensate for the variation.

The safest approach is to sweep and align the new return before connecting it

It is important to maintain a history of amplifier serial numbers, pad and equalizer values, and performance data for identifying trends. Keeping a record of the previous sweep results in the amplifier housing, or any place easily accessible to the technician, will also help to prevent or track down problems. Technicians should compare the current and previous results and question any discrepancies. Don't just change pad or equalizer values if the sweep insertion level is correct, and the levels at the headend are incorrect. Find the problem! The goal is to continually improve the performance of the system. Small incremental improvements each time the location is visited will keep the system at peak performance.

Table 1: Source level matrix

	Type of hardware			
	Laser hub	Line extender	Trunk amp	Bridger
Sweep input level	+10 dBmV	+10 dBmV	+10 dBmV	+10 dBmV
Internal coupling loss	9 dB	1 dB	5 dB	13 dB
Test point loss	30 dB	0 dB	20 dB	20 dB
Tap loss		24 dB		
Cable loss		8 dB		
Total insertion point loss	39 dB	33 dB	25 dB	33 dB
Source level	+49 dBmV	+43 dBmV	+35 dBmV	+43 dBmV

If it is necessary to sweep from a tap in the return, you can use this same level matrix. Determine the new source level by ignoring the amplifier test point loss and adding the loss from the tap to the amplifier output (return input). The level matrix in Table 1 illustrates an example of this new calculation. This same approach can be used for testing the return path from any return insertion point in the system.

Turning on new sections

Connecting new forward plant to an operational forward plant usually presents little risk to the existing system, with the exception of the power demands and tap insertion loss. In contrast, connecting new return plant into an existing system can create major problems. In Figure 3, if the last three amplifiers were connected into the system with zero attenuation, and the gain and slope controls set to the maximum output level, this could result in a significant increase in noise at the laser and disable the return.

It is extremely important to check the pad, equalizer, gain and slope values before connecting the new equipment.

The operator has a couple of choices when connecting new return plant to operational sections. The safest approach is to sweep and align the new return before connecting it. This method requires a return sweep system with a portable sweep receiver placed at the node and connected to the return feeder under test. When using this approach, the sweep source level is determined using the same source level matrix discussed earlier. The return amplifier pad and equalizer are then adjusted to achieve the required level at the return input to the node. This approach allows the technician to locate and fix any ingress problems before connecting the new section to the existing plant. After the new section is aligned, it can safely be connected to the existing return and a final check made for overall performance.

A more expedient approach is to maximize the pads in the new return section or disable the return amplifiers at the time of installation and then connect the new section to the existing trunk. Now the new section can be aligned in the same manner as the initial alignment using a return sweep receiver at the headend. The operator needs to be aware that using this approach, an ingress problem in the new section may impact the existing return before the ingress can be located and repaired.

Ingress monitoring

Some of the test equipment currently used for sweeping the return path makes it easy to check the headend return ingress while sweeping. Monitoring ingress as part of the sweep routine enables the technician to continually lower the composite ingress distortion as part of the routine maintenance. In addition, having access to headend ingress while sweeping provides an excellent troubleshooting tool when problems occur. By comparing the ingress at the

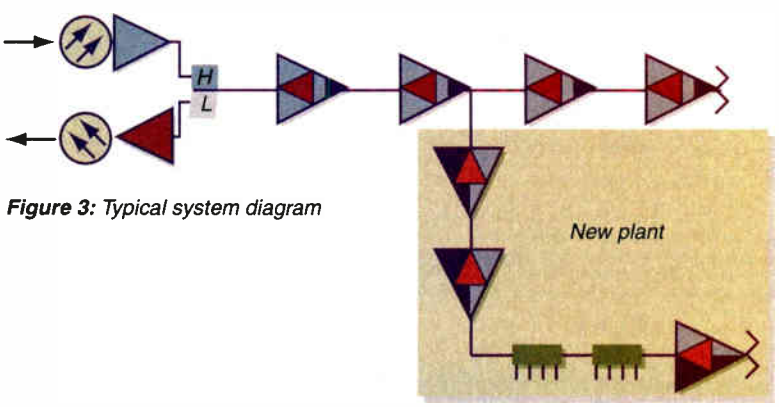


Figure 3: Typical system diagram

Figure 4: *Return path ingress performance*

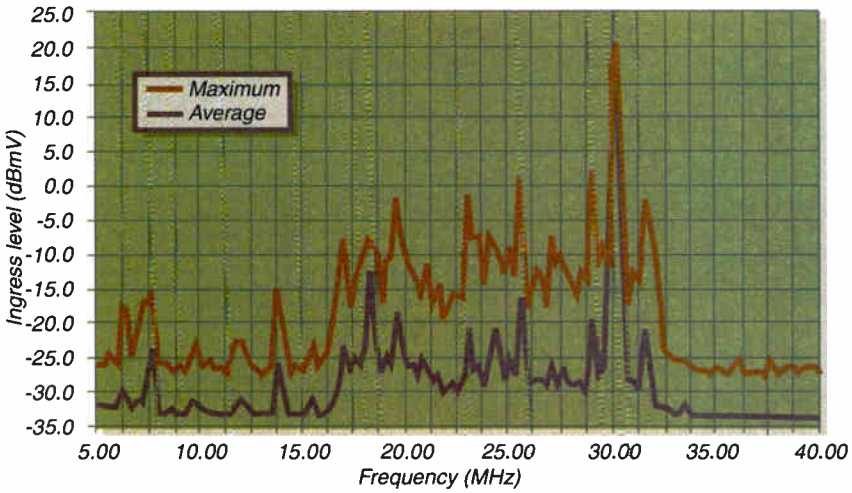
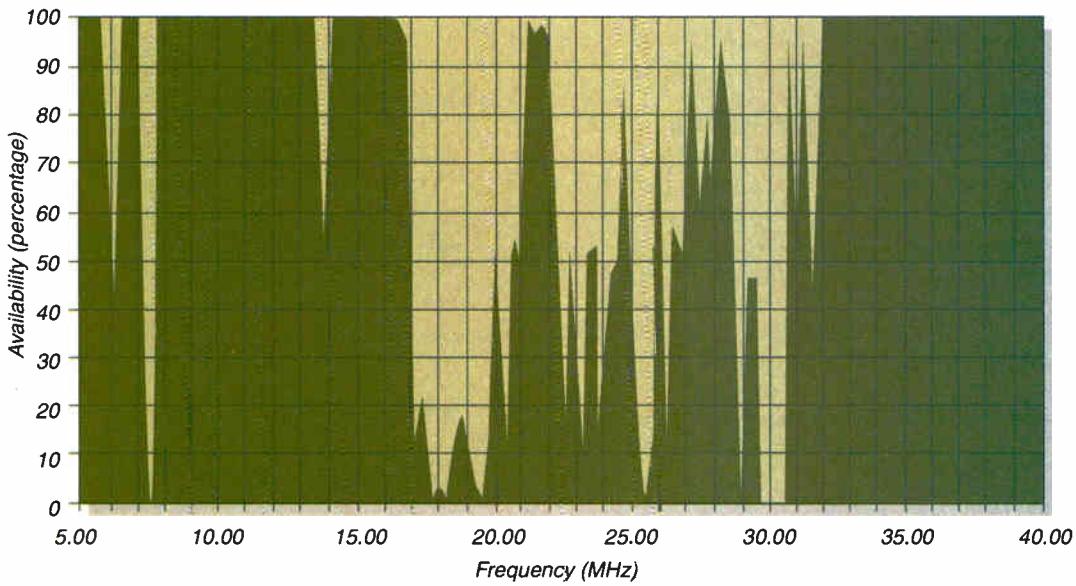


Figure 5: *Percentage of return path availability*



current field test location to the ingress at the headend, the technician can isolate the source.

Continuously monitoring ingress will also help the operator predict problems in the system by viewing slight changes in the system's performance over time. This process helps the operator direct maintenance technicians to potential trouble locations before system performance degrades.

Proper monitoring provides a measure of the availability of the system and a look at the performance of the return path. Problems in the return path can cause an increase in the ingress signals received at the headend. By sampling, storing and time stamping these measurements, the performance of the system can be viewed over time. These measurements can be compared to current measurements for troubleshooting purposes. We may be able to compare the time of an increase in noise to an installation of a new section of the system, a particular weather pattern, an accident, or even the installation of a new subscriber.

Return path maintenance requires more diligence than the forward path

One method of tabulating ingress data is to store peak and average values which give an indication of long term performance. An example of this type of data collected over a two-hour period is shown in Figure 4.

Another method is to record the number of times ingress is detected above a given threshold. This method can be used to provide a measure of percent availability. An example of this type of data also collected over a two-hour period is shown in Figure 5.

The NCTA engineering committee is in the process of developing recommended measurement practices for the return path, and among these efforts is radiated and conducted ingress. Results from this effort should be available early in 1997 and will provide guidelines for these measurements.

Summary

The successful delivery of two-way services to subscribers requires a higher reliability system. An effective proactive maintenance program can help achieve this level of performance while reducing resource demands overall. The key points to remember are:

1) Return path maintenance requires more diligence than the forward path

2) Routine sweep testing of the return will prevent problems and minimize repeat trips

3) Ingress management requires continuous monitoring of the return path. CED

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Samsung, Diba partner on Internet TVs

RIDGEFIELD PARK, N.J. and MENLO PARK, Calif.–Samsung Electronics Co. Ltd. and Diba Inc. have announced a partnership to develop a new line of Internet-enabled television sets.

Samsung's Internet TV will use the Diba Application Foundation to support a range of Internet services, including browsing the World Wide Web and accessing electronic mail. The first offering, a 29-inch Internet TV, will allow users to access information from the Internet by pushing a button on the remote control. A built-in electronic keyboard can be displayed onscreen and manipulated with the remote control for inputting and transmitting data, including electronic mail. Another option is a wireless keyboard. The television has a built-in 33.6 kbps modem for quick Web content access and delivery.

The two companies plan to deliver Internet TVs to the Korean market for the 1996 Christmas retail season. Samsung will export Internet TVs to the U.S. and Japan starting in 1997.

WKU installs Zenith cable modems

BOWLING GREEN, Ky.–Western Kentucky University (WKU) has installed high-speed cable modems in four of its residence halls, and plans to double that number soon.

HomeWorks Universal cable modems from Zenith Electronics Corp. will provide 800 students with high-speed Internet access through WKU's own WesternCable system and its WKUNET computer network.

The university installed a broadband cable network in all 18 of its residence halls and data wiring in 14 of the halls several years ago, according to Charles Anderson, vice president of information technology at the Bowling Green campus. "And we set a goal of adding computer access to the other four by 1996," he adds.

GI modems available to Continental subs

CHICAGO–General Instrument Corp.'s SURFboard cable modems are now commercially available to Continental Cablevision's subscribers in the Jacksonville, Fla. area.

Continental will install SURFboard cable modems into subscribers' PCs, enabling cable modem and Internet service for a monthly fee. No equipment purchase is required.

Last July, Continental placed an order with GI for 10,000 modems and associated network equipment. At the beginning of this month, the service was slated to be available to all Jacksonville-area subscribers.

CBIS will bill for TCI Telephony Services

CINCINNATI, Ohio–CBIS has signed an outsourced cable telephony billing and customer management contract with TCI Telephony Services Inc., a unit of TCI Communications Inc.

Under terms of a three-year agreement, CBIS will provide customer management and billing services including rating, service order entry and bill finishing, as TCI Telephony Services enters the telephony market.

CBIS will utilize several billing modules from Commsoft Inc., a provider of wireline telephony software, in its Orlando Data Center complex.

"The CBIS platform offers a solution for customer billing and management, alongside our aggressive development of TCI's SUMMITrak system," said Sadie Decker, senior vice president for TCI Advanced Information Technology.

DEC to use Vela video compression

ST. PETERSBURG, Fla.–Vela Research Inc. has been selected by Digital Equipment Corp. to provide MPEG-2 video compression/decompression technology for its new AlphaStudio Broadcast systems. The AlphaStudio will be marketed to broadcast stations for distribution of video clips.

DEC will utilize Vela's Centaur MPEG-2 encoder system to digitally compress video into MPEG-2 compliant video bit streams which are then stored on Digital's AlphaStudio systems for later retrieval. The compressed video is reconstructed upon playback by Vela's SCSI-2 decoder boards which are embedded in the AlphaStudio system.

CableData signs marketing deal with IBM

RANCHO CORDOVA, Calif.–CableData Inc. has announced a new U.S. Business Partner marketing agreement with IBM. Under the new deal, CableData and IBM will jointly market CableData's Intelecable software system, complementary IBM business support software such as data warehousing and marketing decision support packages, IBM system integration and consulting services and the IBM RS/6000 to U.S. television and telecommunications providers. The agreement will enable the two companies to offer their customers "a range of seamless, full service solutions," according to company executives.

West End signs distributors in Taiwan

KANATA, Canada–West End Systems Corp. has signed a memorandum of understanding with two distributors in Taiwan–Sun Moon Star Co. Ltd. and Toyon Technology Corp.–for the marketing, distribution and support of West End's hybrid fiber/coax access communications equipment.

West End's WestBound 9600 broadband communications products enable the transmission of digital voice, data and LAN communications over HFC and telephony infrastructures.

Alcatel picked by ADSL consortium

PARIS–Alcatel has been selected by the Joint Procurement Consortium–formed by Ameritech, BellSouth, Pacific Bell and SBC Communications–as a supplier of ADSL high-speed data access equipment, pending successful contract negotiations. Alcatel was chosen from the companies which responded to the consortium's solicitation for bids on ADSL (asynchronous digital subscriber line).

Collectively, the operators anticipate that ADSL technology will be used by thousands of customers within the next 18 months and will serve more than a million of their customers by the year 2001, according to information released by Alcatel.

Alcatel's ADSL system has been shipped to customers in the U.S. and in Europe in the context of pilot projects.

Cable Technologies signs marketing deal

WILLOW GROVE, Pa.–Cable Technologies International Inc. has signed an agreement with L.G. Precision/Goldstar to become its marketing arm to the cable and wireless industries. Cable Technologies International is carrying the company's full line of test equipment, including multimeters, pattern generators, scopes and counters.

NUKO, BroadBand demo MPEG-2 via ATM

SAN JOSE, Calif. and RESEARCH TRIANGLE PARK, N.C.–NUKO Information Systems Inc. and BroadBand Technologies have completed tests that demonstrated live transmission of multiple streams of MPEG-2 digital video via an ATM signal, a necessary capability for the transmission of digital video over fiber-to-the-curb (FTTC) networks.

The tests utilized the NUKO Highlander multi-channel MPEG-2 video encoder system and ATM multiplexer, the BroadBand second generation FLX-2500 platform and a Samsung set-top box.

TCI in Peoria selects SDI product

SALT LAKE CITY, Utah–TCI's cable facility in Peoria, Ill. has selected SDI equipment to upgrade its commercial insertion system to digital. The Peoria facility notes that it has been running at 99.3 percent accuracy since going on-line with the SDI system. CED

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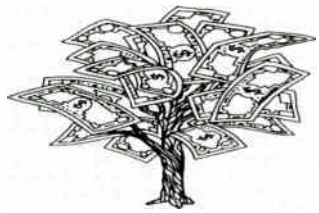

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CED

PCS may be true road to cable telephony

Voice over coax proves harder than some had thought

By Fred Dawson

The cable industry has arrived at a moment of truth in its telecom agenda, where strategists must either find new approaches to getting into voice-based services or face the possibility that the long-pursued opportunity may be out of reach.

There's no better gauge of the daunting nature of the all-wireline approach to cable delivery of telephony than the fact that the three companies with the most robust approaches to network design, two of them telephone companies deploying new plant, the other Time Warner Cable, are reporting the push to voice-over-coax is harder than they thought.

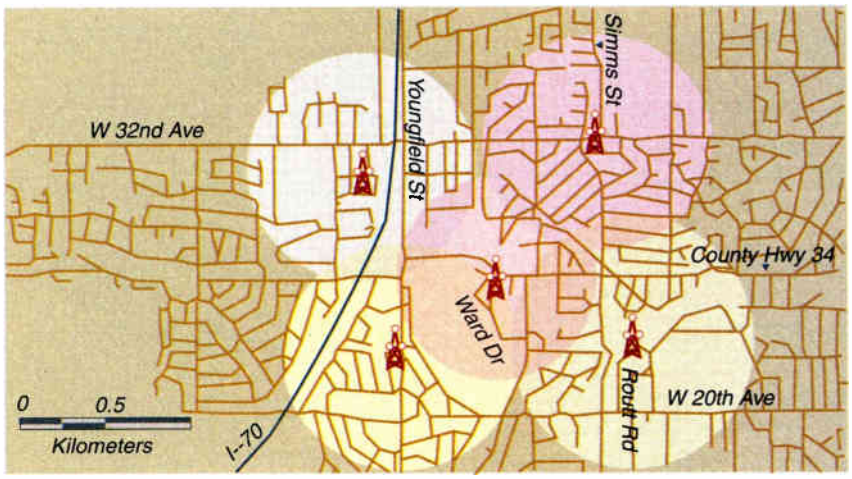

Figure 1: Coverage map. In a test over TCI facilities in Lakewood, Colo., PCS Solutions' CMIs delivered robust signals over four coverage areas measuring 2,000 feet in radius, and one, located on a small hill, measuring 2,500 feet.
Source: PCS Solutions.

On the cable front, as has been widely reported over the past month, Time Warner is drawing down its ambitious charge into the residential voice market, ostensibly out of concern over regulatory uncertainties, but more fundamentally, out of concern over the costs of making its plant robust enough to meet the performance demands of lifeline telephone service. As noted in this space on several occasions this year (see, for example, the February issue), the deeper MSOs have probed the challenge of wireline telephone service over hybrid fiber/coax networks, the steeper the climb to robust performance has seemed.

On the telco side, delivering telephone service over HFC is proving tougher than expected for Pacific Bell and Southern New England Telecommunications, resulting in significant delays of their service rollouts. "At this point, we're not looking at large-scale (HFC) construction much before '98," says Craig Watts, spokesman for Pacific Bell, which now has passed some 330,000 households with HFC facilities but has connected only a few hundred with voice service.

But, for all the drawbacks, no one is prepared to say "Forget it" when it comes to cable moving into the voice business. In the widely-embraced future scenario where broadband networks are the norm, and competition is based on provision of a full package of digital voice, data and video services, there appears to be no choice but to be a player on the telecom side.

The good news, if it can be called that, is that these are rough times for all the would-be entrants who assumed that with the passage of the telecom bill the gates would swing wide open in the local exchange market. In other words, cable does not run so great a risk of seeing other newcomers to telecom competition leap ahead as it rethinks its strategy, given the fact that the established telcos and their state regulators have greatly clouded the competitive picture by mounting court challenges to the FCC's interconnection and other rules aimed at implementing the act.

Even better news from a cable perspective is the fact that delivery of wireless services over HFC is proving out, with Cox Communications taking the lead in demonstrating the cable microcell integrator (CMI) is capable of supporting commercial PCS services under real market conditions on a par with all-wireless configurations. Moreover, vendors are now bringing products to market that will support delivery of wireline-equivalent as well as PCS-type mobile services over the cable/CMI infrastructure.

Cox California PCS Inc. put CMI technology supplied by Lockheed Martin Corp.'s Sanders unit via primary contractor Lucent Technologies Inc. through a rigorous test during the Republican Party Convention in early August, with friendly users making "many tens of thousands of calls," according to Bruce Crair, vice president and general manager of the Cox Communications subsidiary. "We found that, from a network operations perspective, we could see no difference in performance between areas covered by CMIs and those covered by (tower-based) macrocells," Crair says. "And the same was true from the customer perspective."

Cox, a partner in the Sprint PCS venture with Tele-Communications Inc. and Comcast Corp., and holder of a pioneer's license for its work in CMI development, will use the cable-based distribution technology wherever there is adequate cable plant available and a deal can be struck with the local cable operator for use of the plant, Crair says.

Officials are holding back specifics of launch plans at presstime, though they make clear the service will be underway very shortly.

Based on what Cox is finding, cable operators could have a bigger opportunity in PCS than many planners might have assumed. Having decided to deploy CMIs with 2.5 watt transmitters, Cox has found CMIs "provide substantial coverage, better than what we

thought," Crair says. While cable plant has to be in good condition and two-way capable, it doesn't have to be state-of-the-art 750 MHz capacity with fiber to 500-home nodes to support PCS, he adds. "We can do this over 450 MHz systems," he says.

Crair notes that CMIs are an especially good fit with CDMA (code division multiple access), the air interface technology Sprint PCS is deploying nationwide. Along with providing strong resistance to noise interference, the CDMA spread spectrum method of signal distribution makes it easy to handle mobile calls in CMI coverage areas, he says.

"With CDMA, you don't have to worry about whether the CMI can hand off calls quickly enough to support full mobility," Crair notes. "Multiple CMIs are transmitting on the same frequency, so there's no need to switch frequencies as you go from cell to cell."

The other leading supplier of CMI technology, PCS Solutions, which is a joint venture between ADC Telecommunications Inc. and PCS Wireless Inc., is also reporting outstanding results from recent testing, in this case in conjunction with a project backed by Sprint, TCI and Cable Television Laboratories. The PCS Solutions test results show that five CMIs, in most instances propagating signals at a radius of 2,000 feet, provided coverage on a par with coverage from a single macrocell tower-mounted transmitter.

"We were quite happy with what we saw," says Dan Huslig, director of engineering for PCS Solutions. "Performance was better than we expected."

The test, conducted in a largely residential area consisting of one- to three-story buildings with "moderate" amounts of foliage, inserted various types of impairments into the signal stream to calculate acceptable interference levels on the cable plant affecting both the CDMA signals and the control signals used to communicate between the headend interface convertor and the strand-mounted CMIs. "We had been thinking the coverage radius per CMI would be in the range of 1,000 to 1,500 feet at acceptable interference levels, but found the radius can comfortably be extended to at least 2,000 feet within required specifications," Huslig says.

The biggest factor in what could become a much higher level of interest in wireless telecom among operators is Sprint Spectrum, which has returned to a fairly strong emphasis on use of cable networks after nearly a year of downplaying the concept in favor of a rapid all-wireless building out. Not only is the company impressed at CMI performance; it's also finding it harder than anticipated to nail down tower sites in key markets.

"We're not dependent on cable networks to fill out our systems," says Sprint Spectrum president Andrew Sukawaty, "but there are certain advantages to deployment on the cable TV backbone, which Cox clearly has demonstrated in San Diego. We're working with all our cable partners to take advantage of that approach."

While Sprint intends to launch 15 to 20 markets by year's end, with some as early as this month, Sukawaty says the "numbers are still in flux," with early launch locations "popping on and off the list" as a result of action taken by cities to stall wireless buildouts pending completion of new tower site planning initiatives. "When you have 80 to 90 percent of your cells finalized and then you have a moratorium in a key area that is vital to your business plan, it might not make sense to go forward immediately," Sukawaty says.

While Sprint is unlikely to match Cox's level of CMI use in every market, it is likely many markets will make greater use of cable infrastructure than even the CMI vendors had expected. Asked whether vendors' projections of 10-30 percent coverage by CMIs is a reasonable benchmark, Sukawaty replies, "We don't have firm figures yet, but it could go higher where we have cable networks available."

Along with strong performance from CMIs, Sprint is finding that cable's fiber backbone infrastructure is often superior to fiber links offered by other carriers for PCS backhauling, Sukawaty says. "Cable has installed a lot of fiber, and it's much newer than many of the links offered by other providers," he adds.

All things being equal in terms of having ready access to cable plant or to tower sites in a given market segment, Sukawaty says Sprint would likely pick CMI deployment over the all-wireless approach at this point. "The cable network is proving to be very reliable," he says.

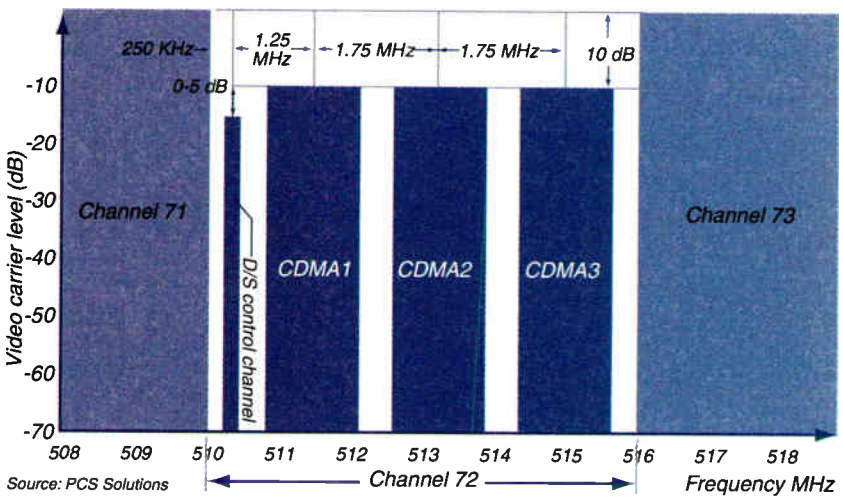

Figure 2: Downstream signal allocation. Three 1.25-MHz CDMA channels are positioned within the 6 MHz downstream and upstream channels of the cable network as indicated (also see Figure 3). CMIs modulate outgoing signals to the 1.9 GHz PCS frequency, and incoming frequencies to the cable channel levels.

Notwithstanding the current level of activity with CMIs, the technology could become a much bigger factor in PCS network deployments, notes Sanders' Powers. "We believe that once the technology is out there and working in a commercial environment, they'll realize this is a very effective and economical approach," he says.

A cable operator doesn't have to be a licensee to take advantage of the opportunities, given the large number of PCS players that are looking for ways to quickly build out their networks at relatively low costs. "The service can provide an incremental revenue for the cable operator with very little operational involvement, as long as the PCS operator knows what he's doing," Crair says.

Already, the CMI technology is having an impact on the thinking of operators in the immediate vicinity of Cox's PCS operation, Crair notes. "We're starting to

see some excitement from other operators in our area," he says. "They're looking at the PCS product as something they can have in their portfolio along with television and high-speed data, which can better equip them to confront a competitor like Pacific Bell, who is moving in with PCS and wireless cable."

Adding new appeal to the wireless play for cable is the emergence of fixed wireless local loop technology as an acceptable competitor with traditional wireline service. With demand driving some 30 vendors to bring WLL product to market in the U.S. this year and next, there's an opportunity for cable to bypass its drop cables with wireline-equivalent service that didn't exist before.

"We are watching these developments very closely," says Joseph Cece, president of Cablevision Lightpath, the telecommunications division of Cablevision Systems Corp., which is undertaking a large-scale market test of residential voice services this fall.

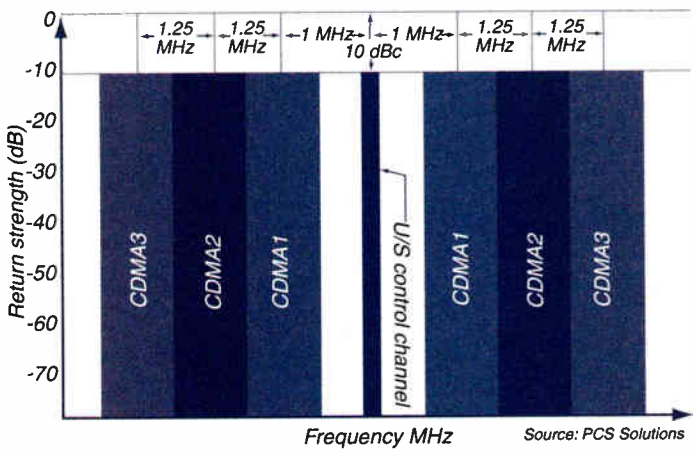

Figure 3: Upstream signal allocation.

The growing telecommunications industry support for WLL options has prompted suppliers of CMIs to begin planning product options for fixed services as well. "Everybody that makes these devices (CMIs) is pursuing WLL options," says Sanders' Powers. "We have tests planned in that area, but I can't go into any details at this point."

Motorola Corp., which recently introduced the first CDMA-based WLL system in the U.S. and is supplying several commercial deployments overseas, is also working on a cable-oriented version of the technology. Cablevision has decided to do some preliminary testing of Motorola Corp.'s equipment, Cece says, adding, "One of the reasons we're interested in working with the Motorola system is their commitment to developing a wireless local loop system," Cece says.

"We've seen quite a few business cases from PCS licensees that describe cable-oriented applications," said Mike Malone, director of product marketing for Motorola's personal communications division in Fort Worth, Texas. "Cable makes a lot of sense as a backhaul medium connecting base stations to switches, especially when plans call for use of a large volume of base stations."

The cell-based Motorola system delivers traditional single-line service with support for advanced voice and data features such as caller ID, call forwarding, call waiting and distinctive ring service. Signals are delivered to a 3.3-pound, 9-inch x 9-inch x 2-inch fixed wireless terminal mounted on the wall inside the user premises which is connected via standard interior telephone wiring to traditional corded or cordless phones, answering machines and computers.

The system uses a low-power, unity gain omnidirectional antenna, as opposed to the more common directional antennas used in other vendors' WLL systems, thereby reducing the installation and ongoing quality of service maintenance hassles, says Bill Marsh, manager of digital WLL product for Motorola's Cellular Infrastructure Group.

"The beauty of this approach is that it delivers a radar-like effect where the network finds the subscriber unit, rather than requiring three hours for a professional installer to set the direction or to reset it if the wind blows the transmitter off course a little bit," Marsh says.

Initially, Motorola worked on a high-power directional antenna-based design but "found that more power is a crutch for poor system engineering," he adds. The system, which is equipped with eight-hour internal battery back-up, uses over-the-air programming and activation to further minimize installation time, Marsh says. Costs of deployment are below the average telecommunications industry wireline network costs, he adds, declining to be more specific.

The radius of coverage for the WLL cell depends on a number of factors, including density of users and the amount of traffic per user. "The radius in a very dense population area with 6,000 subscribers or so to a square kilometer might be seven-tenths to one kilometer, and we've seen designs for the 1.9 GHz version that have radii all the way out to 15 Km," Marsh says.

Given the traffic and density requirements associated with WLL, PCS licensees exploring this application require a lot of base stations, which means there's a premium on size and cost, Malone notes. Motorola has just introduced a 210-pound base station that can be pole-mounted, and within the next year, will introduce a station half that weight that can be strand-mounted, he adds.

"There's a tradeoff between size and call capacity." Malone says. "The smallest stations can handle 30 calls at once, versus up to 300 calls at once for the largest."

"Many PCS licensees see an opportunity to offer long distance carriers a much lower cost access route. given that their PCS peak usage tends to be drive-time, while residential long distance is heaviest at night," Malone adds. "The cable network offers a way to connect a lot of base stations back into the central switch and control units at low cost."

So far, there have been no major deals between PCS licensees and cable, outside of the Sprint venture. But, with a glut of PCS players looking for ways to cut costs, and some percentage of those looking for a WLL connection, the cable industry may soon find its move into telephony tracks much more closely with PCS than many strategists anticipated. CED

The issue: Interconnects

Cable companies that are serious about entering the telephony or high-speed datacom markets will have to be able to send and retrieve signals across traditional cable system franchise boundaries to cover wider geographic areas. This is a major break with tradition, where each cable system was its own island. Some say it can't be done easily.

What do you think?

The questions:

1. Has your system consolidated headends by adding fiber to your system?

❑ Yes ❑ No ❑ Don't know

2. Has your system considered constructing one regional "superheadend" to serve the community?

❑ Yes ❑ No ❑ Don't know

3. Has your system either considered interconnecting or already completed an interconnect project with an adjacent cable system owned by other MSOs to fully "cover" the metro area you serve?

❑ Yes ❑ No ❑ Don't know

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

❑ Yes ❑ No ❑ Don't know

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

❑ Yes ❑ No ❑ Don't know

6. Do you believe an interconnect could bring your system more revenue through data delivery to businesses, advertising or other services?

❑ Yes ❑ No ❑ Don't know

7. How important will interconnects be in the future?

❑ Very ❑ Somewhat ❑ Not at all

8. Today, would you be inclined to deploy Sonet equipment or go with a less costly analog or proprietary uncompressed digital fiber system?

❑ Sonet ❑ Proprietary ❑ Don't know

9. Do you think cable operators can overcome individual preferences (i.e. signal security) to be able to interconnect their systems effectively?

❑ Yes ❑ No ❑ Don't know

10. Do you think a new set of standards should be created to allow for neighboring cable systems to interconnect seamlessly?

❑ Yes ❑ No ❑ Don't know

11. Do you think the cable TV industry should do more, less or about the same amount of work to determine the feasibility of interconnecting?

❑ More ❑ Less ❑ About same

Your comments:

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RESULTS

The issue: Making two-way work

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

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

Cable systems are busy upgrading their networks to HFC architectures and installing return path channels to capitalize on the latest directive: To offer some sort of interactive services to derive more revenue from subscribers. And increasingly, the service of choice is either data or standard cable TV fare, not telephony. In fact, a large majority believe it will only be another 12 to 24 months until such services are offered over their networks.

But, there are well-documented noise and ingress problems with active return plant. In fact, operators are split on whether this poses a "slight" problem or "no" problem; however, a majority admit it may take some advanced modulation method, like spread spectrum, to make it all work.

Not surprisingly, most respondents say we'll all be interacting more with our TVs–not our PCs–seven years from now.

When it comes to market acceptance, most said they can get somewhere between 10 percent and 30 percent buy rates for $5 movies-on-demand, but they were split about buy-rates for high-speed data at $40 per month. Guess we'll have to wait and see on that one.

Congratulations to Frank Brady Jr. for winning $50 just by faxing his questionnaire. To qualify for a future drawing, fill out the survey on the previous page and send it in!

The results:

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

Very important	Somewhat important
62%	**15%**
Not important	Don't know
23%	**0%**

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

1-2 years	3-4 years	5+ years	Don't know
62%	**15%**	**15%**	**8%**

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

Yes	No	Don't know
69%	**31%**	**0%**

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

Yes	No	Don't know
75%	**25%**	**0%**

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

Difficult	Slight problem	No problem
46%	**46%**	**8%**

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

Yes	No	Don't know
46%	**31%**	**23%**

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

TV	PC	Don't know
54%	**38%**	**8%**

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

Less than 5%	5-10%	10-30%	30+%
8%	**38%**	**46%**	**8%**

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

Less than 5%	5-10%	10-30%	30+%
38%	**38%**	**23%**	**0%**

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

Yes	No	Don't know
85%	**15%**	**0%**

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

Data delivery	Telephony
31%	**8%**
Interactive TV	Plain old TV
15%	**38%**

Your comments:

"We're rebuilding now using HFC and offering telephony and Internet by Jan. 1, 1997."
– Frank Brady Jr., TCI Tri-Valley, Livermore, Calif.

"I think interactive is the way cable TV companies need to go."
– Humphrey Lewis, Jones, Surfside, Calif.

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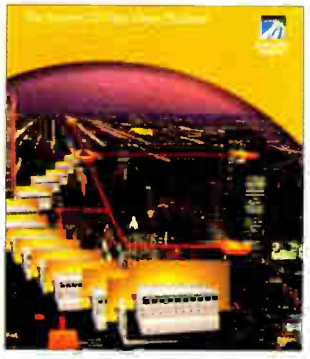

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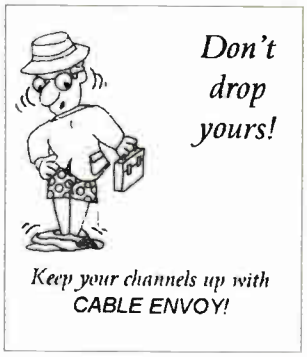

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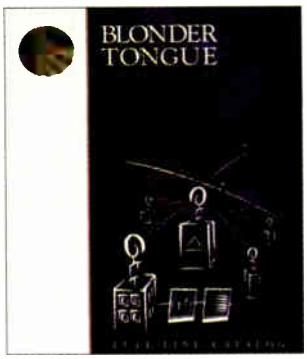

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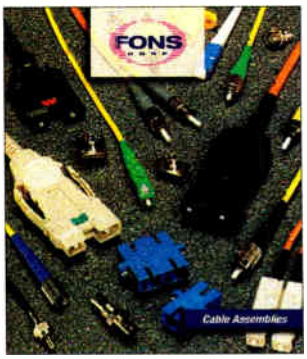

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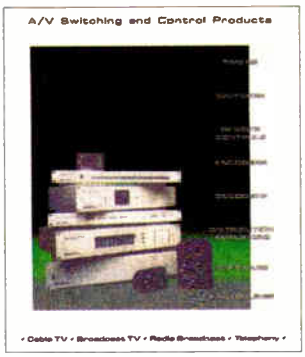

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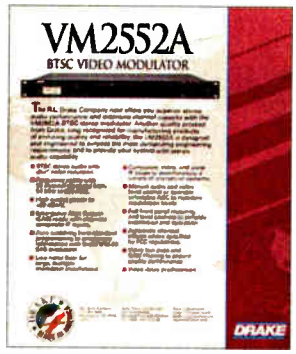

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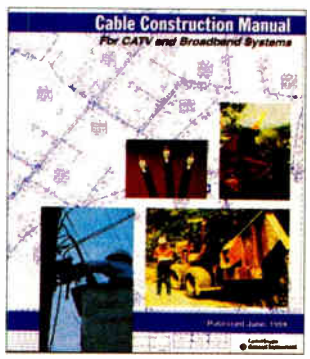
Reader Service No. 115

Cable Construction Manual for CATV Broadband Systems

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

For more information, call
(800) 982-1708



Reader Service No. 116

The Best Catalog in the Industry

Toner is a manufacturer and distributor of cable television equipment. As a single source supplier, their catalog is a comprehensive collection of the best equipment in the industry. Toner's products and services include RF system design, custom built headends, fiber optics, modulators, processors, satellite IRD's, commercial inserters, RF amplifiers, drop amps, passives, and test equipment.

For a copy of the catalog call
(800) 523-5947 or **(215) 675-2053**

Reader Service No. 117

Lectro ZTT Uninterruptible Power System

The Lectro ZTT solves today's and tomorrow's power problems in advanced communication networks. A field selectable design allows system operators to deploy the 60VAC version to support current needs while planning for future upgrades. Modular construction allows for ease of installation and service. The Lectro ZTT is on of the premier products from **Exide Electronics Emerging Technologies Group.**

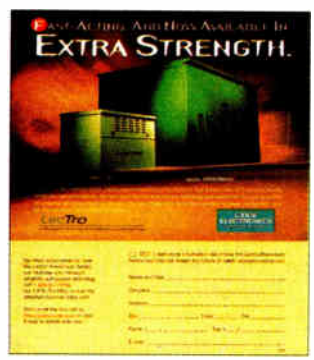
For more information call
(800) 551-3790 or fax **(919) 713-5350**

Reader Service No. 118

Lectro Powernode

Exide's Lectro Powernode's modular design can accommodate up to four ZTT modules allowing you to increase your power capacity as you provide more advanced broadband services to your node locations. Easy access and the flexible nature of the design means service is easier and can be performed while the system is on-line. Discover how the Lectro Powernode family can improve your network reliability with proven technology.

For more information call
(800) 551-3790 or fax **(919) 713-5350**



Reader Service No. 119

Philips Offers Data Sheet on 9000T Series Telephony Tap

Philips Broadband Networks, Inc. has launched a series of product data sheets, including one detailing the company's 9000T Series power-passing telephony tap, featuring the Tel-Spot, Philip's unique reflective indicator for quickly identifying a telephone-ready tap from ground level, even at night. To request literature or for additional information:

Telephone **(800) 448-5171**
(in NYS (800) 522-7464)
International **(315) 682-9105**

Reader Service No. 120

Philips Broadband Introduces Four-Port Optical Node

The high-performance Diamond Net™ optical node amplifier (6-DNA), from **Philips**, features four active Power Doubling™ outputs that improves system performance and reliability. The new four-port DNA can be configured and adapted to add greater reach and flexibility in design. The unit has a patented design with many features to increase control of the powering system. For literature or additional information:

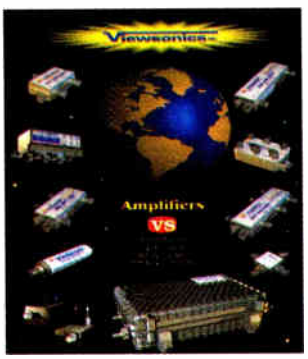
Telephone **(800) 448-5171**
(in NYS (800) 522-7464)
International **(315) 682-9105**

Reader Service No. 121

NEW! Amplifier Catalog

Viewsonics Inc. offers a full color catalog containing photos and specifications for all of their amplifiers, including their newest low noise models with the figure at 3 dB and 3.5 dB, depending on the gain, as well as several new 2-way models. You'll find their amps all over the world including places you've never heard of. For your FREE Viewsonics Amplifier catalog:

Call **(800) 645-7600**
and/or fax
(407) 998-3712



Reader Service No. 122

Budco's 1996 Cable Catalog Available!

Budco markets and distributes installation tools, construction supplies, marking, identification, and security products to the CATV industry. Budco distributes products from: Aervoe-Pacific, Arrow, BennerNawman, Brady, Cablemaid, CablePrep, CablePro, CableReady, CableTek, DFS, Diamond, Engineering Unlimited, F-Conn, Jameson, Klein, Lemco, M&B, Master-lock, Preformed, Redington, Cablematic, Sargent, Sturgeon Bay, Tyton, and others. And the taplock, the industry standard for marking drops. Call **(800) 331-2246**

Reader Service 123

West End Systems Corp. 9604 Universal Subscriber Drop

WestBound 9604 Universal Subscriber Drop provides connection to HFC networks. Providing analog and digital voice, FAX, ISDN BRI, V.35, X.21, V.24/RS-232 and Ethernet LAN connectivity to any combination of 56/64 Kb/s, n#56/64Kb/s and ISDN switched services. Voice, data and LAN features maximize the use of a 256 Kb/s symmetrical aggregate link. **West End Systems Corp.**

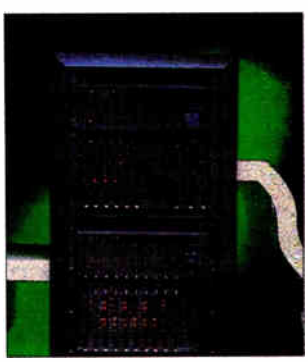
Call **(613) 623-9600** or fax
(613) 623-0989

Reader Service 124

West End Systems Corp. 9600 Broadband Access Manager

WestBound 9600 Broadband Access Manager combines functions of an integrated voice and data multiplexer, a digital cross-connect switch and a frame relay access switch for HFC networks. Multiservices platform can be managed locally or remotely from a West End network manager, integrating Time Division Multiplexing and Frame Relay applications with expansion capabilities to SONET/SDH & ATM. **West End Systems Corp.**

Call **(613) 623-9600** or fax
(613) 623-0989



Reader Service 125

Eagle Telephone and Ingress Suppression Traps

Need to activate your sub low spectrum for telephone or other two way communication? **Eagle** has the answer, no matter how complex your return system may be. A complete line of high pass filters for the non-return subscriber or high pass filters with return window for the active-return customer. In addition, tier traps of every variety, audio reduction traps and the latest in positive filters, Side Band interdiction.

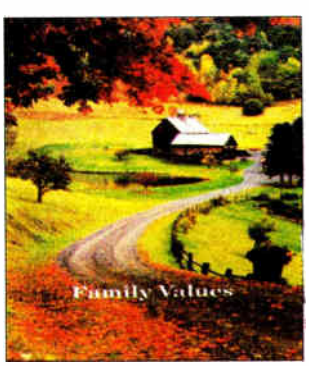
For literature or free samples call
(800) 448-7474 or fax **(315) 622-3402**

Reader Service 126

Technical Software from FamilyWare

This software family is used by thousands of cable operators worldwide to meet technical dept. needs. MOM (Monthly Outage Management) helps reduce outages. POP (Proof of Performance) documents proof tests. LES (Leakage Evaluation System) is the industry standard for controlling leakage. For details on the complete family, call **FamilyWare** today!

Call **(702) 827-2522** or
fax **(702) 827-1866**



Reader Service 127

ADC Homeworx Access Platform Overview

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

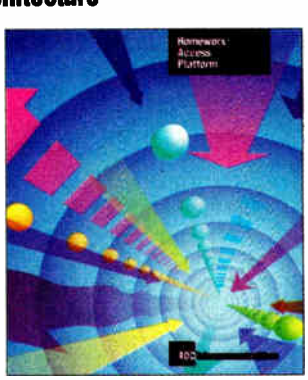
(800) 366-3891

Reader Service 128

ADC Frameworx Fiber Frame Architecture

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

(800) 366-3891



Reader Service 129

Cable Prep Offers Two Catalogs

Cable Prep® offers two different catalogs. Their newly printed catalog features updated product sheets and allows you to add their tech-tip sheets and newsletters. Or, their Windows®-based Interactive Catalog is also available — just point and click for information! Cable Prep has taken the guesswork out of matching tools to cables and connectors. Action shots in vivid color and printable instruction sheets included. Call the Cable Prep Marketing Dept. to order your copy today

(800) 320-9350

Reader Service 130

Strip Tools for Drop Cable From Cable Prep

Cable Prep® STRIP TOOLS FOR DROP CABLE. Easy to use, this compact color-coded tool is lightweight, rugged plastic and has a lifetime warranty. Only two cartridges needed for 59 through 11 (including quad) for a 1/4" prep. Two addtional cartridges cover the same range of cables for a 1/8" prep. The cartridges house non-adjustable tool-steel quality blades that ensure a perfect prep every time. Call today for more information:

Call **(800) 394-4046** or
fax **(860) 526-2291**

Reader Service 131

Avantron Annouces 2000 Series RF Spectrum Analyzer

Avantron is proud to announce the 2000 Series as a truly portable RF spectrum analyzer, weighing under 19 pounds, including the internal battery. The 2000 Series includes such options as Non-Interfering RF Sweep System and CATV return alignment. Measurement performances up to 1GHz, greater than 70 dB of dynamic range and a built-in frequency counter with 200 Hz accuracy. Visit Avantron at Booth #4724, at the Western Show in Anaheim this year! Call for more information:

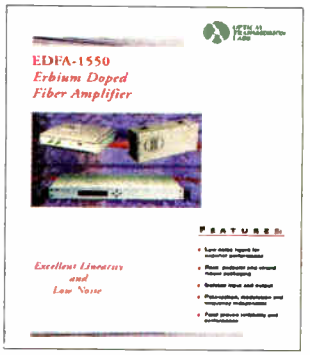
(800) 297-9726

Reader Service 132

1550 nm AM Transmission Systems: More Power & Options

Synchronous Group, Inc. is the leading supplier of high performance 1550 nm AM transmission systems for Cable, HFC and Advanced Network systems. Discover their new and expanded line of External Modulation Transmitters and Erbium Doped Fiber Amplifiers. Their new product catalog is now available. To obtain your copy, call today!

(800) 659-6750
or fax **(408) 362-4826**



Reader Service 133

CPS Series Power Systems

Alpha's CPS Series Power Systems provide a flexible and incremental powering solution for enhanced revenue-generating and critical lifeline communications services. The CPS Series supports incremental growth of the power node, allowing service providers to add additional power and reliability features as system requirements increase.

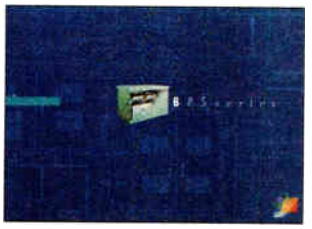
For more information call
(800) 421-8089 or **(360) 647-2360**

Reader Service 134

BPS Series Power Systems

BPS Series Power Systems from **Alpha Technologies** enable the immediate full-service deployment of centralized powering for enhanced revenue-generating and critical lifeline communication services. Flexible enclosure configurations, advanced network management capabilities and a long list of enhanced reliability options are all part of the BPS Series' innovative design.

For more information call
(800) 421-8089 or **(360) 647-2360**

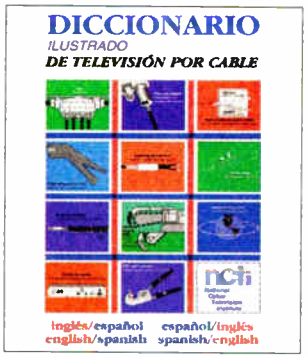


Reader Service 135

NCTI Spanish/English CATV Illustrated Dictionary

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

Call **(303) 797-9393** or
fax **(303) 797-9394**

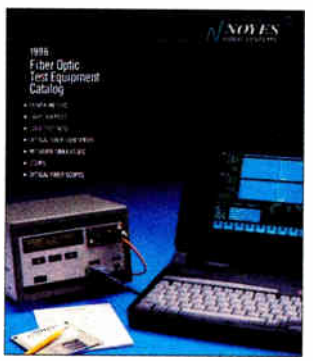


Reader Service 136

FREE 1996 Fiber Optic Test Equipment Catalog

Noyes Fiber Systems announces its new FREE 1996 Fiber Optic Test Equipment Catalog. The full color catalog provides an overview of the products and services offered by Noyes Fiber Systems including Optical Power Meters, Light Sources, Loss Test Sets, Return Loss Test Sets, OTDR's, Fiber Scopes, and Fiber Identifiers. Contact Noyes Fiber Systems, P.O. Box 398, Laconia, NH 03247.

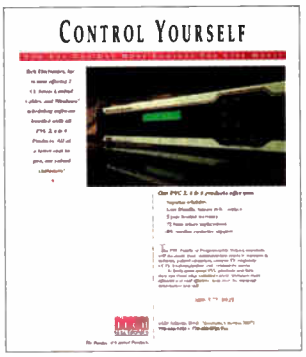
Telephone **(603) 528-7780**
(800) 321-5298 or fax **(603) 528-2025**



Reader Service 137

Unattended/Automated Playback for Local Origination

For over a decade, **Tech Electronics** has set the standard for highly reliable and cost -effective controllers for unattended/automated playback. The PVC Family of Controllers offers full functional control for up to 16 VCRs with three channel output. Creating and composing playback schedules is easy with Windows® based scheduling software. Software and two CC Series Control Cables are included with every PVC order. For more information, call

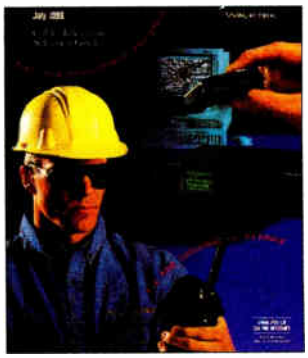


(800) 572-4935

Reader Service No. 138

FREE: Wavetek's 1996 CATV Selection Guide

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

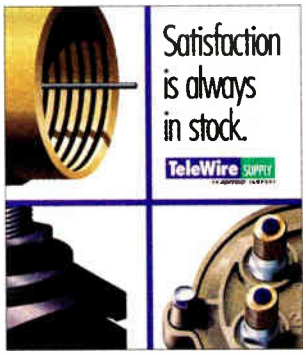


Reader Service No. 139

TeleWire Supply Offers Their Full Line Catalog

If rebuilding or upgrading your system is on your mind...this catalog should be on your desk! **TeleWire Supply's** new full line catalog includes virtually all of the quality, name brand products you need to build and maintain your network. Includes product and ordering information, glossary, and application tips. For more information, call

1-88-TELEWIRE
(888) 353-9473
or fax (303) 643-4797



Reader Service No. 140

E-TEK's New 1997 Catalog

E-TEK's new color catalog describes products including optical isolators, couplers, splitters, WDMs, combined optics, attenuators, laser sources, active/passive components, optical switches, laser amplifiers, controllers, and production and test equipment. E-TEK combines innovative excellence, affordability and fast delivery for a wide range of fiber optic applications.

Call E-TEK Dynamics, Inc.
1885 Lundy Ave., San Jose, CA 95131
(404) 432-6300 or fax (408) 432-8550

Reader Service No. 141

Universal Remotes with ENHANCED MEMORY RETENTION

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

Call (800) 777-2259

Reader Service No. 142

Free Sprint North Supply CATV Catalogs

Sprint North Supply is a leading nationwide provider of integrated solutions for voice, data, teleconferencing and CATV product needs through its 11 strategically located distribution centers. Offering more than 30,000 products from over 1,200 manufacturers, their broadband catalog also contains thousands of products from 97 suppliers. Also offered are the Fiber Optics, Outside Plant, Tools, Test and Supplies, and Security Product catalogs.

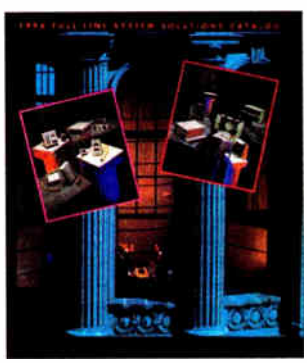
Call (800) 639-CATV or
fax (800) 755-0556

Reader Service No. 143

FIBER End-to-End Systems

Ortronics delivers leading edge fiber technology with our wall or rack mount cabinets, adapters, jumpers, pigtails, patch and splice accessories and fiber management. Other system solutions include multimedia workstation and closet products, raceway, patch panels, 110 cross-connects, wire management, interface cords, and more. Ortronics also offers custom products, technical support, training and our 25-Year Warranty Programs!

For more information call
(860) 599-1760 or fax (860) 599-1774



Reader Service No. 144

New CABLESPAN™ Brochure from Tellabs

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

(800) 445-6501

Reader Service No. 145

ANTEC Network Technologies

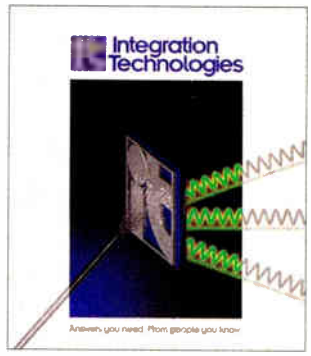
ANTEC Network Technologies specialize in and manufacture products that deliver your signal from headend to home, devoting more engineering resources to this critical link than any other company today. Rock-solid products — Laser Link® Optical Transmitters, Gateway Optical Receivers, LightLink Fiber Management System, ANTEC Fiber Cable, FiberPak® Family of Fiber Splice Closures, Fiber Apparatus, ANTEC RMT Network Passives, Regal Drop Passives and Digicon™F-Connectors.

Call (800) FIBER.ME

Reader Service No. 146

Providing "Best-of-Class" Solutions to Broadband Industry

Integration Technologies is a network design/engineering, systems integration, and OSS software development firm delivering best-of-class solutions to the broadband industry. From HFC network assessment through full project management and systems integration in complex upgrades, Integration Technologies delivers the technical capabilities needed to transition toward integrated voice, video, and data services. To learn more

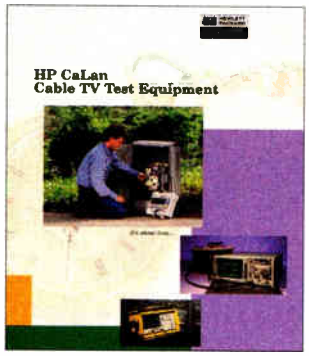


Call (800) 211-8424

Reader Service No. 147

New Brochure From Hewlett Packard

Hewlett-Packard's new cable TV test equipment brochure is now available, highlighting HP CaLan's complete line of test equipment for every task, at the headend and in the field. Featuring HP CaLan's new SWEEP/INGRESS ANALYZER — the industry's most essential tool for two-way system activation and maintenance, and the HP CaLan 8591C cable TV analyzer — the industry's only one-box tester for all non-interfering RF and video measurements.

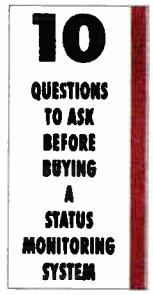


Call HP CaLan at
(800) 452-4844, x. 2009

Reader Service No. 148

Cheetah's Answer to Monitoring

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



(941) 756-6000

Reader Service No. 149

FREE Fiber Optic Route Redundancy!

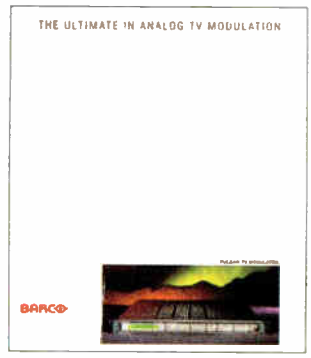
Hybrid fiber/coax (HFC) infrastructures should be extremely reliable, fault-tolerant and cost effective, permitting smooth transitions to the new services of tomorrow. With Switchable Optical Splitters (SOS), new fiber components manufactured by **OptiVideo Corporation**, self-healing, route redundant rings can be added to your system without additional transmitters. For information on how SOS can plug-and-play in your rebuild:

Call (303) 444-2160

Reader Service No. 150

Intelligent Microprocessor-Controlled Modulator

Barco's PULSAR, a unique microprocessor-controlled modulator, features complete software control and remote monitoring capability via an RS-485 interface and provides control of video and audio RF levels, modulation depth, frequency deviation, and input switching. When used in conjunction with BARCO's FMS 860 Headend Supervisor, alignment of RF levels can be accomplished automatically.



Call for more information
(770) 218-3200 or fax (770) 218-3250

Reader Service No. 151

Modems, Modems, Modems

ISC Datacom, Inc. manufactures broadband, frequency-agile RF modems for data transfer over cable systems. We employ our own engineering staff to handle special project design and new project development. Products include a traffic controller monitoring modem, a series of remotely addressable modems used by municipalities as well as schools and industry, data translators and headend modems, and Vertical Blanking Interval encoders and decoders. Call for more information:

(888) RF MODEM or (972) 234-2691

Reader Service No. 152

New Catalog from TRILITHIC

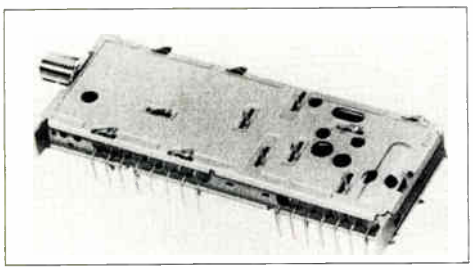
From signal level meters to leakage detectors, from frequency counters to calibration equipment, the new Instruments Catalog from **TRILITHIC** has all of the products you need to test and maintain your CATV/Broadband distribution system. Updated in September, the catalog now includes such popular new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

Phone (800) 344-2412

Reader Service No. 153

Up/down convertor for digital comm

SECAUCUS, N.J.–Panasonic Industrial Company is introducing a low-profile up/down tuner which offers a 125-channel solution for receiving digital data/video communications with a low-profile form factor (nominally



CT-10 up/down convertor

under 15 mm in height). Applications for the tuner include digital/analog hybrid set-top boxes, digital cable modems, digital HFC telephony and an interactive model with an integrated diplexer.

Combining filtering, AGC and PLL functions, the CT-10 digital model provides the following features/typical performance specifications: input tuning range of 50 - 810 MHz (860 MHz available); gain of 25 dB (35 dB available); CSO of 57 dBc; and CM of 57 dB.

Circle Reader Service number 51

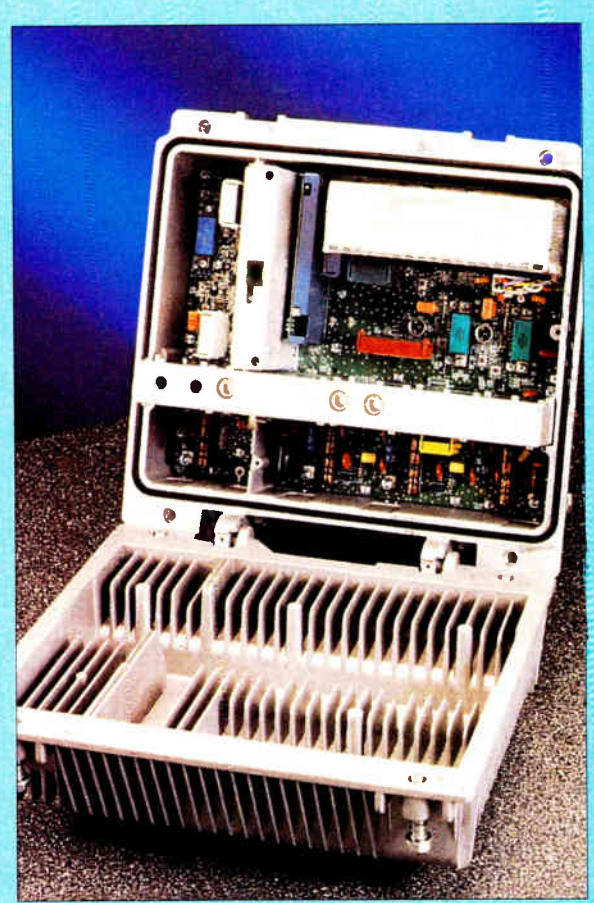
Dual purpose stapler

SADDLE BROOK, N.J.–Arrow Fastener Company Inc. has released a new dual purpose staple gun. The model T2025 shoots both round crown staples and flat crown staples.

The tool's staple height guide adjusts the distance that a staple can be driven into a surface, making it suited for wire or cable work. By moving the finger control, the user can regulate the machine's driving depth. For added protection to wire and cable, the T2025 has a specially-designed nose that fits over the wire, guiding the staple legs to either side of the wire jacket. Arrow manufactures four different sizes of round crown staples for the unit: 9/32-inch, 3/8-inch, 7/16-inch and 9/16-inch.

Staple gun

Circle Reader Service number 52



Broadband HFC transmit platform

ATLANTA, Ga.–Scientific-Atlanta Inc. has introduced its Adaptis broadband transmission platform, its first hybrid fiber/coax (HFC) platform designed specifically to support the advanced broadband systems of worldwide markets.

S-A developed the Adaptis platform for flexible architectures, greater bandwidth and more interactive services. The platform architecture provides the flexibility to work with existing systems or to enable easy migration from trunk-and-feeder type architectures

Microwave radio

TORRANCE, Calif.–Cable AML has announced a bi-directional microwave radio, designed to provide multichannel video and two-way telephony service from a central transmitter site to a number of receive sites.

The system carries 68 video channels, plus up to 24 data channels in the downstream. Each of the data channels can carry four T-1/E-1s. In the upstream, the system carries four T-1/E-1s per data channel from each of the receiver sites to the central site.

The bi-directional link has been implemented at 18 GHz by two coherent transceivers (one at each end), connected to a single polarization antenna. Each of the data carriers has a maximum rate of 10 Mbps of QPSK-modulated data. The system can be equipped for other digital modulation formats such as 64 QAM.

System design makes it possible to implement a single, central telephone switch facility at the headend of a video distribution system, providing simultaneous video delivery and telephone service at a lower cost than would be available by alternative system configurations, according to the company.

Cable AML has also announced a CARS band (12.7 to 13.2 GHz) solid-state broadband transmitter designed for applications requiring outdoor tower mounting. The new Model OTX-005 is used in situations where the transmitter needs to be mounted in an outdoor enclosure near the antenna.

Circle Reader Service number 53

Sonet alarm filtering system

CHICAGO–Clear Communications has released Clearview ProbableCause, a multi-vendor, intelligent, alarm-filtering and mediation system designed for synchronous optical networking (Sonet).

The system is designed to sort through the many "sympathetic" and redundant alarms typically generated by a Sonet network problem. The software then uses root cause analysis to identify the probable cause of a disruption. Sonet networks can generate hundreds of alarms from a single mishap, making it difficult to find the real cause of the problem.

Circle Reader Service number 54

Universal data processor

AMSTERDAM–TV/Com International Inc. has introduced its Universal Data Processor (UDP) for transporting high-speed data. The

Scientific-Atlanta Adaptis HFC Platform

to fiber-to-the-curb networks.

The platform also features single, dual and balanced triple amplifier configurations to meet various density requirements, as well as application modularity. The application module–forward-only, two-way or fiber–can be installed in the factory or in the field, depending on the specific network application.

Featuring a bandwidth capacity of 870 MHz, the Adaptis platform provides optional status monitoring and control plug-in modules to monitor active transmission components and pinpoint failures in the network before they affect subscribers.

Circle Reader Service number 50

UDP is the first in a series of the company's DVB-compliant data processing products that will add high-speed data capabilities to uplink, headend and downlink systems. Applications for the UDP include transmission of data files

TV/Com's Universal Data Processor

which could include programming content, educational or business information, software downloads and graphical files.

The company also announced a DVB/MPEG-2 compliant Transport Multiplexer (TMUX) that multiplexes up to four multichannel transport streams into a single transport stream. The capability allows full 54 MHz bandwidth transponder utilization. The TMUX is suited to digital satellite uplinks and cable headends, and for digital broadcast networks requiring video servers, redundancy and/or full transponder utilization.

Circle Reader Service number 55

Return path detector module

TRENTON, N.J.–Epitaxx has introduced its EPM718FJ-S CATV Return Path Detector Module which operates to 200 MHz in cable television return path receivers. The high linearity InGaAs photodiode chip in this unit achieves high responsivity at 1300 nm, -65 dBc IM2, and a low capacitance of only 0.75 pF. The module is also useful for other higher bandwidth AM systems with low channel loading.

Epitaxx's Return Path Detector Module

Circle Reader Service number 56

Digital set-top architecture

SAN JOSE, Calif.–VLSI Technology Inc. has announced the VISTA System-Level Silicon solution designed to enable a super-integrated, single-chip set-top box. VISTA represents the company's suite of digital video devices, application program interface (API) software and reference platforms.

The VISTA architecture is comprised of: network interface (VISTA NI) devices performing demodulation and forward error correction; system controller (VISTA SC) devices featuring the advanced RISC machine (ARM) processor and MPEG-2 demultiplexing and decryption; and audio/video (VISTA AV) devices providing MPEG-2 audio/video decompression and NTSC/PAL video encoding.

In conjunction with the VISTA announcement, VLSI has also introduced its new MPEG 2 audio/video decoder (VES6000) and NTSC/PAL video encoder (VES7000).

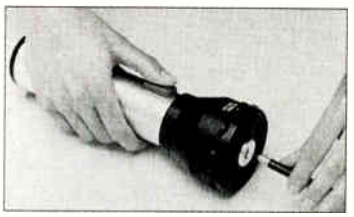
The VES6000 is a next-generation design that incorporates an integrated clock-synthesizer, a micro-programmable RISC architecture, true-color on-screen display (OSD), EDO and synchronous DRAM support, plus the ability to decode full MPEG 2 with full-screen OSD easily within 16 Mbits of DRAM.

Integrated into the VES7000 is an internal digital subcarrier synthesizer, which enables the system clock frequency to be set anywhere from 24 MHz to 30 MHz. It also supports data input compliant with CCIR-601/656, supporting both eight-bit 4:2:2 and 24-bit 4:4:4 formats for RGB and YCrCb. Three nine-bit resolution output DACs have also been integrated.

Circle Reader Service number 57

Coax stripping tools

SYRACUSE, N.Y.–The Remarcable Co. Inc. has introduced its 800 Series hand-held portable and 1200 Series bench-top coax stripping tools. The 800 Series is a portable, hand-held tool that can be powered by either a rechargeable nickel-cadmium battery pack, which provides approximately 200 strips per charge, or by an A/C power supply. The tool weighs three pounds (1.3 kg) and features easy interchange of blade cassettes for different applications.



800 Series hand-held stripping tool

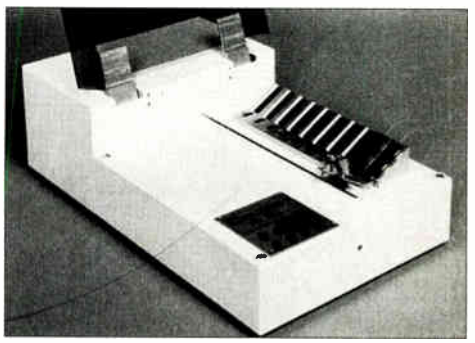
The 1200 Series has been designed to handle a wide range of cable types (PVC, Teflon, semi-rigid) and diameters from .030 inches (.75 mm) to .625 inches (16 mm). It uses an all-metal, quick change blade cassette that contains up to three super hard (83 Rockwell) steel blades. Blade depth is adjustable, and a strip length stop ensures consistent results.

1200 series bench-top stripping tool

Circle Reader Service number 58

Fiber alignment system

VANIER, QUEBEC, Canada–Exfo E.O. Engineering Inc. has introduced the MAS-950 Automatic Alignment System for testing fiber optic cables. Its Windows-based control software integrates smoothly with OTDR and PMD technology. Highly tolerant to vibration for easy movement between test locations, the unit's V-slot alignment system provides mechanical stability with a minimal number of moving parts.



MAS-950 Automatic Alignment System

Circle Reader Service number 59

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NOVEMBER

4-15 Fiber Optic Technician Training, produced by FiberLight International. Location: Estes Park, Colo. Call (970) 663-6445.

5 Analog Headend Technology, produced by Scientific-Atlanta Institute. Location: Atlanta, Ga. Call (800) 722-2009, press "3" when prompted.

5-7 Broadband-CATV Laboratory, produced by C-COR Electronics Inc. Location: State College, Pa. Call C-COR Technical Customer Services (800) 233-2267, ext. 4422.

6-8 Philips Mobile Training, produced by Philips Broadband Networks Inc. Location: Truro, Nova Scotia, Canada. Call (315) 682-9105, Ext. 389.

7-8 Operating Analog Headend Systems, produced by Scientific-Atlanta Institute. Location: Atlanta, Ga. Call (800) 722-2009, and press "3" at the prompt.

11-14 Broadband/ Multimedia and Local Loop World Forums, presented by the International Engineering Consortium. Location: The Broadmoor Hotel, Colorado Springs, Colo. Call (312) 559-4600.

12 Mid-South SCTE Chapter, Testing Session. Location: Time Warner Cable Office, Memphis, Tenn. Call Kathy Andrews (901) 365-1770, ext. 4110.

12-14 Broadband-LAN Laboratory, produced by C-COR Electronics Inc. Location: State College, Pa. Call Technical Customer Services at (800) 233-2267, ext. 4422.

13-15 Philips Mobile Training, produced by Philips Broadband Networks Inc. Location: Syracuse, N.Y. Call (315) 682-9105, Ext. 389.

14 West Virginia Mountaineer SCTE Chapter, Technical Seminar. Topic: Installer certification. Location: Holiday Inn, Bridgeport, W.Va. Call Steve Johnson (614) 894-3886.

15 Chaparral SCTE Chapter, Technical Seminar. Location: Albuquerque, N.M. Call Rick Padilla (505) 761-6290.

18-21 Fiber Optics 1-2-3: Installation, Design & Maintenance, produced by The Light Brigade. Location: Indianapolis, Ind. Call (800) 451-7128.

19-21 Cable Television Technology, produced by C-COR Electronics Inc. Location: Fremont, Calif. Call Technical Customer Services (800) 233-2267, ext. 4422.

DECEMBER

2-13 Fiber Optic Technician Training, produced by FiberLight International. Location: Dublin, Calif. Call (970) 663-6445.

4-5 Fiber Optic Technical Seminar, produced by ADC Telecommunications Inc. Location: Columbia, S.C. Call (800) 366-3891, ext. 2040.

5-6 Competition in Local Telco & Cable Markets, produced by Strategic Research Institute. Location: The Loews L'Enfant Plaza Hotel, Washington, D.C. Call (800) 599-4950.

9-12 Fiber Optics 1-2-3: Installation, Design & Maintenance. Produced by The Light Brigade. Location: Sunnyvale, Calif. Call (800) 451-7128.

11 T-1 Technical Seminar, produced by ADC Telecommunications. Location: Phoenix, Ariz. Call (800) 366-3891, ext. 2040.

11-12 Fiber Optic Technical Seminar, produced by ADC Telecommunications Inc. Location: Salt Lake City, Utah. Call (800) 366-3891, ext. 2040.

JANUARY

13-16 Telecommunications Engineering/Operations ComForum. Location: Dallas, Texas. Call the International Engineering Consortium (312) 559-4100.

22-24 Women in Cable & Telecommunications' Leadership Conference. Location: Loews Coronado Bays Resort, San Diego, Calif. Call Molly Coyle (312) 634-2353.

Trade shows

December

11-13 The Western Show. Location: Anaheim, Calif. Call the California Cable Television Association at (510) 428-2225.

January

8-10 SCTE Conference on Emerging Technologies. Location: Nashville, Tenn. Call SCTE National Headquarters (610) 363-6888.

February

3-6 ComNet '97. Location: Washington, D.C. Call IDG World Expo (800) 545-3976.

11-14 Expo Comm Telecomunicaciones Mexico '97, organized by E.J. Krause & Associates Inc. Location: World Trade Center, Mexico City. Call Caroline Ruggieri or Steve Sasse (301) 986-7800.

16-21 OFC '97. Location: Dallas, Texas. Call the Optical Society of America (202) 416-1980.

19-21 Texas Show '97. Location: San Antonio, Texas. Call the Texas Cable & Telecommunications Association (512) 474-2082.

New trend: Traffic control times two

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

Well, once again I'm sitting here, and the operative word is "sitting," in rush-hour traffic, so I decided to start drafting this column. Yes, I am one of those folks who attempt to get work accomplished while inching down the highway, and yes, I do understand that this increases my chances of being involved in a fender-bender. But currently, at the 0 mph that I'm traveling, the chances of any vehicle-to-vehicle contact are remote.

So first I'm wondering, is there anything that could help alleviate this situation and enable me to get to my destination more quickly, so that I can work at a more appropriate location–like on an airplane? And second, I'm wondering, if I keep wondering about improving traffic flow, how I'm going to get this column done.

Well, my two wonderings have some synergy this month. Specifically, in researching how networks targeted at one application can be developed into multiple application networks, I've come across a trend. Local governments, both individually and on a regional basis, are looking at infrastructure developed for traffic signalization purposes to be further developed to provide transport for other types of data, voice and video communications.

Typically, fiber infrastructure used for traffic signalization connects one or more central operational sites to signals or clusters of signals out in the field. The transport path is used for both central site monitoring of field operations from information received upstream, and control functions that send data downstream to the signals, including dynamic re-synchronization of signals to react to changes in traffic conditions and improve traffic flow. The system is often designed to be fail-safe. If the communications link is cut for any reason, operation of any individual signal reverts to a pre-programmed mode controlled by an on-street master unit.

In many cases, there is a significant amount of fiber capacity remaining once all necessary traffic signalization transport needs are met. Additionally, computerized traffic signalization systems are most often set up in a fiber grid along key arterials and high-volume collector routes. Putting these two facets together, then, provides a significant amount of fiber capacity that runs past a major portion of public facilities.

It is easy to see why it's attractive for a number of jurisdictions to pursue a concept that combines the traffic signalization system and the potential for a wealth of additional communications applications. The City of Denver is one such jurisdiction. The city, in association with the Denver Regional Council of Governments, is pursuing development of a communications infrastructure for this type of traffic signal system, beginning with the core area of Denver that houses the central business district. As part of this effort, Denver has already issued a request for statements of interest ("RFSOI").

The RFSOI was focused on obtaining conceptual proposals on how the communications sub-system for the traffic signal control system could be developed, including linkages from office locations to field-located master controllers, and then from the masters to individual intersections. The RFSOI also sought to obtain specific proposals on public/private partnership arrangements. For example, Denver had already been involved in a pilot project where the city and a telecommunications firm shared the cost to construct a joint-use conduit line, with pull boxes, splice vaults and other access points at sites of mutual need. Currently, a significant amount of information has been gathered through the RFSOI process and related discussions, and the city anticipates issuing a specific request for proposals regarding the communications infrastructure on or about November 1.

City-wide telecom applications

The City of St. Louis is involved in a similar project, and it already has a fair amount of fiber infrastructure in place. A significant portion of this fiber has been installed along major thoroughfares for traffic signalization as part of an overall congestion mitigation and air quality project. Based in part on a June 1995 strategic plan for information systems study commissioned by St. Louis and performed by the Center for Business and Industrial Studies of the University of Missouri–St. Louis, the city is now pursuing the development of an integrated information network that would enable city-wide telecommunications applications.

For example, such a far-reaching network could be used to develop a more integrated health care system; improve the quality, availability and efficiency of educational services; improve universal access to telecommunications services; and serve both public and private needs by encouraging partnership opportunities similar to the Denver initiative. These are all goals of the St. Louis Board of Public Service in pursuing development of this network, and based on the experiences and efforts of other cities, they would seem to be attainable.

As local governments continue to experience significant budget constraints in the face of ever-mounting demands for services, these types of network initiatives that build on existing infrastructure and strive for multiplicity of use could be critical. In this case, helping to improve vehicular traffic flow, while at the same time, improving the flow of data communications, would seem to be an excellent response to both types of traffic challenges. And at this point, having been able to increase my speed to a breakneck 3 mph, I would appreciate any easing of traffic congestion that I can get.

Ya' know, working while motoring wasn't all that bad when I only had the cellphone, microcassette recorder, steering wheel and laptop to contend with. But with the new car's five-speed gearshift added in, I just ran outta hands! CED

Have a comment?
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Reader Service 70

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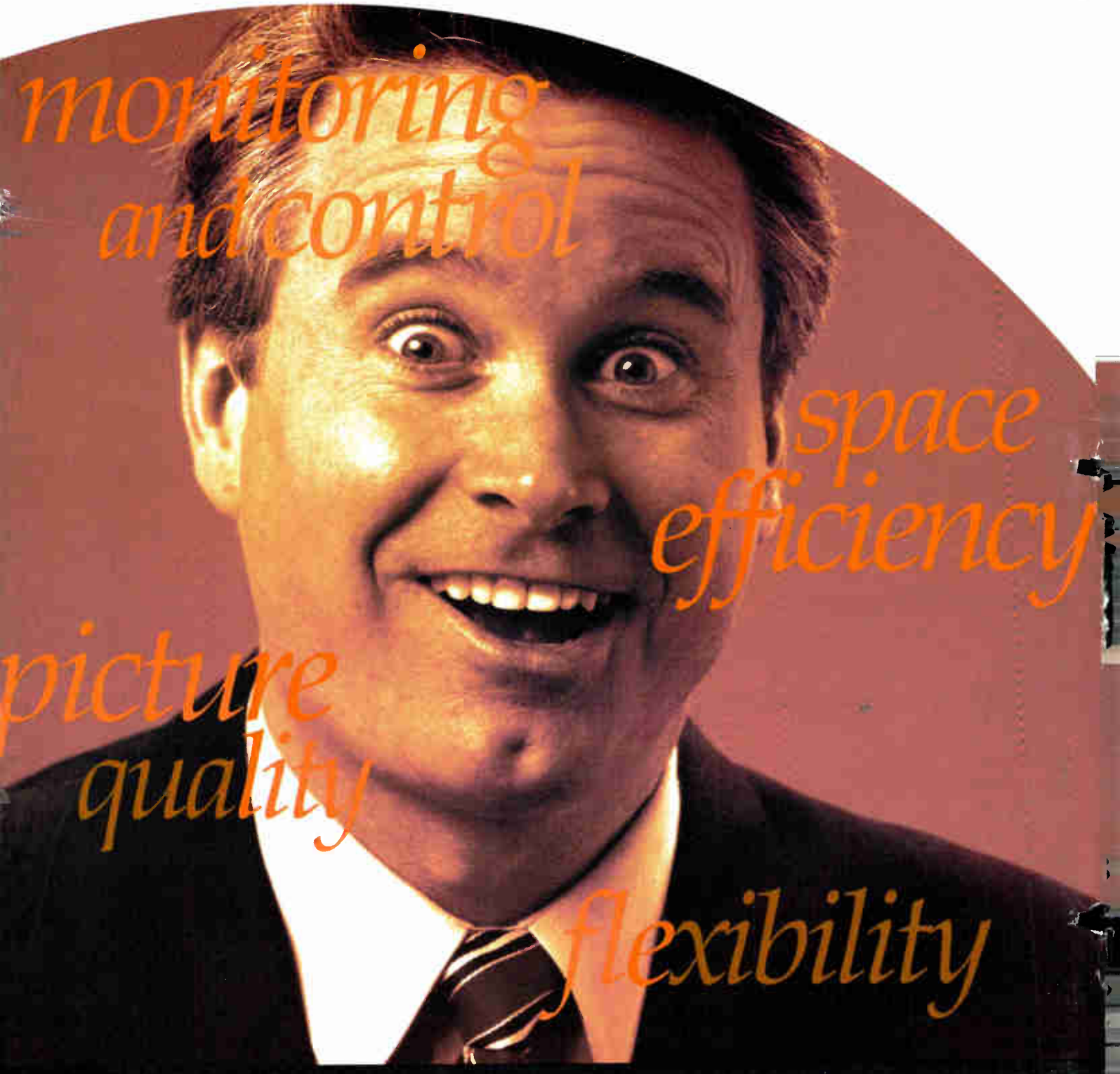

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