THE PREMIER MAGAZINE OF BROADBAND COMMUNICATIONS

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FEBRUARY 1998

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Reader Service 2

in perspective

Set-top deals: Brilliance or blunder?

You've seen the headlines: "TCI signs deal with Microsoft for set-top operating system;" "TCI, Sun ink PersonalJava pact;" "GI sells 12 million set-tops to TCI and others." The ink was barely dry on some of these deals before analysts and industry observers were hailing the deals as the latest in a series of brilliant moves by TCI CEO John Malone to bring the nation's largest MSO back from the brink of financial collapse. But while the headlines scream success, it's debatable that the deals themselves will turn out to be technical nirvana. In fact, they could upset the apple cart.

Remember that TCI made these deals with two goals in mind: to jump-start its foray into digital TV; and to compel the industry at large to do the same thing via an interoperable, standards-based platform. There's little doubt in my mind the former will be achieved; it's the latter I'm not so sure about.

It's debatable that these deals will result in technical nirvana

ROGER BROWN, EDITOR

Under the "OpenCable" initiative, cable operators want to develop and specify a digital set-top design model so that they can replicate the success they had in the cable modem arena through the MCNS process. The goal, as it was for MCNS, is to get manufacturers to agree to build products that conform to the specification. This could eventually allow customers to actually own their set-tops, which would help the MSOs by freeing much-needed capital that today is sunk into proprietary set-tops.

If successful, the OpenCable initiative would attract a variety of world-class electronics manufacturers to the industry. Competition between them would become fierce, and set-top prices would drop, while innovation would flourish.

But did the cable operators throw that possibility out the window by signing such a huge deal with GI? Did that monstrous deal have a chilling effect on other manufacturers? And why did TCI sign a deal before CableLabs actually defined an OpenCable box? Or does a deal of this magnitude define the OpenCable box as TCI's set-top?

Malone's ability to galvanize the industry is unquestioned, and in this case, should be hailed. But six months from now, will all the major operators continue to see eye-to-eye when it comes to OpenCable?

Under the GI deal, even if TCI and others deploy digital set-tops as fast as they possibly can, GI will have essentially the entire market to itself for a long time. What incentive does Zenith, Samsung, Toshiba or anyone else have to get into the game?

On one hand, cable operators have said they want to make overtures to manufacturers to get cheaper set-tops and sell them at retail. But by giving all their business to one player, they may have just perpetuated the old, business-as-usual, single-source model.

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Getting a sneak-peek

44 Wonder what scientists are cooking up in the world's fiber optics labs? Here's an update on dense wavelength division multiplexing (DWDM) technology, plastic fiber, erbium-doped fiber amplifiers, and more.

Redefining state-of-the-art

24 Get ready for the next Renaissance in fiber optic technology. New products–from scalable nodes to DWDM to lasers–are giving cable engineers more tools to upgrade their networks.

COVER ILLUSTRATION BY LARRY AUERBACH

One Company Has Delivered More Satellite & Broadband RF Technology To This Planet Than Anybody.

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Advanced Networking

50 **LECs make DSL moves.** Local exchange carriers are finally getting their acts together in the use of high-speed digital subscriber line technology. **Adding more tools to the fiber toolbox.** New options for future-proofing networks, from 1310 nm, to 1550 nm, to EDFAs (erbium-doped fiber amplifiers). **HFC: The 'Ethernet' of broadband solutions.** Understanding the history of the local area network (LAN) can teach broadband network designers some lessons. **DWDM pays off.** A comparison of DWDM vs. time division multiplexing for increasing the capacity of fiber networks.

Broadband Business

78 **The economies of fiber.** As lasers, transmitters and receivers, and fiber optic cable drop in price, it makes perfect business sense to drive fiber deeper into broadband networks. **More bang for the buck.** When it comes time to expand bandwidth, using dense wavelength division multiplexing can be an affordable alternative to deploying more fiber.


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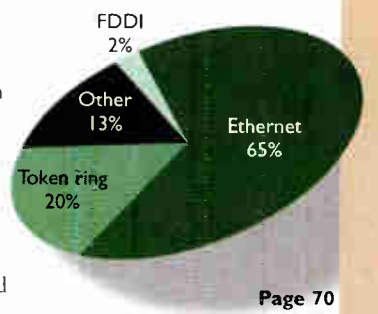

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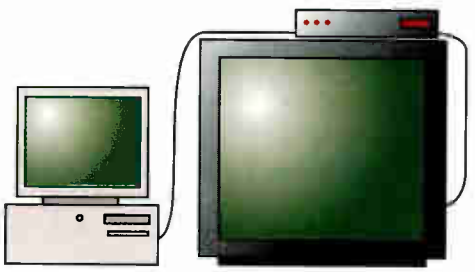
upfront

LATEST NEWS AND INSIGHT

TCI forges Microsoft, Sun deals

Tele-Communications Inc.'s well-documented push for an interoperable, interactive digital set-top came two steps closer to reality in the form of two blockbuster announcements with Sun Microsystems and Microsoft for middleware and an operating system, respectively.



The deal with Sun calls for TCI to incorporate the PersonalJava platform as the standard software application environment, which will allow myriad applications to be downloaded automatically to the viewer. This deal will also allow developers to create "applets" that can run on any consumer device that is connected to the cable network.

Also, after a marathon round of telephone calls that concluded in the wee hours, TCI and Microsoft agreed to a deal where TCI will license a version of the Windows CE operating system in at least 5 million of those digital set-tops.

This version of Windows CE has been developed for the television environment, with integrated support for Internet content and technology from WebTV Networks Inc. Microsoft and TCI expect that Windows CE will be available for the advanced digital set-top devices that TCI will begin to deploy in late 1998 or early 1999.

Sony buys a stake in GI

In yet another deal that trades cash and market share for a portion of the company, General Instrument forged a strategic alliance with Sony Corp., that would have the two companies collaborating on digital TV devices while, at the same time, give Sony a five percent equity stake in the company.

The companies are discussing future generations of digital cable TV devices and high definition television (HDTV) products, as well as incorporating new features like Sony's Home Network architecture into GI's advanced digital set-top boxes.

Sony, when definitive agreements are reached, will purchase 7.5 million new shares of GI common stock for $25 per share (a deal worth $187.5 million).

"We believe that Sony's expertise in digital consumer electronics and its strong retail brand complement General Instrument's strengths, and will certainly be significant assets for the development of the next-generation digital set-top based on GI's platform," said GI Chairman and CEO Edward D. Breen.

Another one bites the dust

Originally attracted by Southern New England Telecommunications Corp.'s (SNET) cellular holdings, SBC Communications Inc. instead will become the latest telecom giant to get even larger by merging with SNET altogether.

The $4.4 billion transaction will combine companies with complementary wireless businesses and strong local telephone company operations. SNET already provides a range of telecommunications services, including traditional wireline, wireless, long distance, Internet and data in Connecticut, in addition to wireless service in Rhode Island and western Massachusetts. SBC provides wireless service in the Northeast markets of Boston, upstate New York and Washington, D.C./Baltimore.

But what that means for SNET's video venture remains unclear. SBC has already pulled the plug on its own Richardson, Texas video trial and closed down PacBell's video venture when it acquired that company. SNET, meanwhile, acquired a statewide cable franchise in Connecticut and has been busily constructing a hybrid fiber/coax network to support cable services.

"We (SBC and SNET) share a similar commitment to providing high-quality, one-stop telecommunications service, and this merger strengthens our ability to compete successfully," said Edward E. Whitacre Jr., SBC chairman and CEO.

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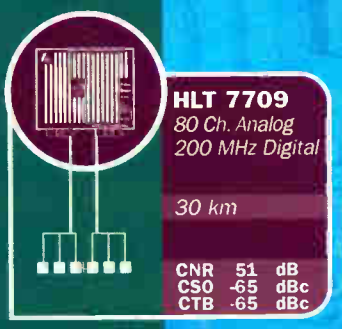
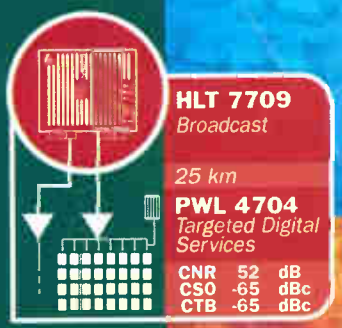
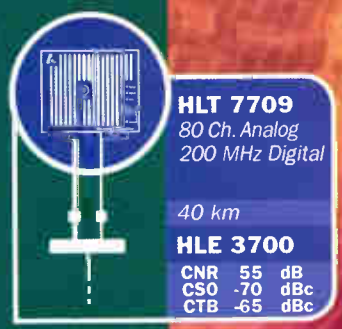


Efficient Distribution



1550-to-the-Node with Digital Narrowcast



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upfront

LATEST NEWS AND INSIGHT

Spyglass group zeros in on cable/Web applications

Spyglass Inc., a major supplier of software and services to the TV industry, has established a technology and consulting group to develop advanced Web-related applications and provide general technical and market support to the cable and satellite television industries. This is the first time the company has created a focused group to address the needs of a specific market segment.

Cable industry analysts are predicting that tens of millions of digital and advanced analog set-top boxes will be deployed to consumers in the next 12 to 24 months. These boxes, along with new satellite decoders, will be capable of delivering a host of interactive services based on open standard Internet technologies. "Through the OpenCable initiative, the cable companies have spent a great deal of energy to make certain that the software for their next-generation boxes is not controlled by any one company," said Randy Littleson, vice president of marketing for Spyglass. "The key is not the operating system, but rather the applications that will run on the box. In one year, the cable companies will deploy more Web-enabled devices than have been shipped by all other market segments combined."

The company is touting its "small footprint" Web browser and e-mail offerings as well-suited to memory-constrained set-top boxes. Littleson also said Spyglass' parental control filtering software enables cable companies to offer both tiered and unlimited Web access, while giving cable customers the ability to restrict what content is displayed in their homes. And, the company's server-based Web browser and content conversion server application can assure that the disparate types of content being created for the Internet can be displayed effectively on the family television.

Spyglass is already working with WorldGate and PowerTV, among other companies.

Spyglass' focus

- Parental control
- Web content filtering
- Electronic programming guide
- On-line advertising
- E-mail
- Web browser
- Chat service
- Community-based information
- Interactive programming
- On-line games

Patent fever

Watch out, you Internet/cable TV vendors, because Interaxx Technologies Inc. has merged with Interaxx Television Network Inc. (ITN), its wholly owned subsidiary.

That means the company which holds several patents related to integrating Internet and cable TV networks plans to keep a watchful eye on others who may be in violation of those patents.

Interaxx Technologies intends to exploit patents owned by ITN, according to company executives. "I hear how all these large companies have vision and want to combine the Internet with cable TV. Our patent, dated 1991, established this vision, and we intend to profit from (it)," said James Deegan, president and CEO.

LMDS is coming to Denver

Two new Denver-based broadband wireless operators, Formus Communications and JATO Communications Corp., intend to pilot test two-way, high-speed data, voice and Internet access and Web services via Local Multipoint Distribution System technology.

Stanford Telecommunications Inc. will provide the subscriber terminal units and the network interface units, which will initially connect Formus and JATO offices and selected service partners.

The system will operate using a 30/1.8 Mbps multipoint access link based on the Digital Audio Visual Council (DAVIC) standard. "We believe that DAVIC will emerge as the standard for distributing two-way data services over broadband wireless," said Gary Flood, director of broadband marketing for Stanford Telecom.

The pilot project network incorporates radio transmission equipment provided by Millitech Corporation and is supported by an ATM/Frame Relay backbone from Newbridge Networks. Formus and JATO plan to also invite additional LMDS vendors to participate in the upcoming trial. Internet links will be provided by a Denver-based affiliate of Verio, a national ISP.

Formus and JATO are currently completing a field trial of LMDS technology with Hewlett-Packard at its Wireless Systems Group Facility in Cupertino, California.

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LATEST NEWS AND INSIGHT

Netscape, @Home buddy up

Netscape Communications Corp. and @Home Network, through its @Work Division, will expand their two-year relationship to provide hosted electronic commerce solutions for enterprise and business customers. Specifically, @Work has selected Netscape's CommerceXpert Internet commerce application software suite to deliver hosted business-to-business commerce services to enterprise customers, mid-sized companies and small businesses.

@Work plans to build a scalable, transaction-based applications platform on top of its existing broadband, distributed network infrastructure to offer hosted services for virtual private networks (VPNs)—open, encrypted Internet-based networks—which provide high-volume transactional e-commerce capabilities for business customers.

Since its inception, @Home Network has been using a combination of Netscape SuiteSpot server software and Sun Microsystems' SPARC Solaris-based servers to deliver its broadband Internet services, with Netscape Communicator as the default browser and e-mail client software for subscribers. Through this expanded agreement, @Work plans to offer transaction processing capabilities for full-scale business-to-business transactions over the Internet.

AT A GLANCE...

Wave of the future? GE Plastics hopes so. The company is openly pitching set-top suppliers on the value of thermoplastics, which "can address the challenge of EMI/RFI shielding and demonstrate a leading-edge look," according to GE. The company also says the plastic is cheaper and that those cost savings can be passed along to both the OEM as well as the consumer.

GI integrates SRS audio into set-tops

General Instrument has become the first cable set-top terminal manufacturer to sign a license agreement with SRS Labs to incorporate SRS Labs' audio enhancement technologies into digital cable set-tops.

GI plans to include both the core SRS 3D sound technology, as well as SRS Labs' new virtual audio technology, TruSurround, in products for introduction in late 1998.

TruSurround, a Dolby Laboratories-certified virtual audio technology, creates an immersive sound image which gives the listener the impression that sound is wrapping around his head.

A cable set-top equipped with TruSurround allows cable subscribers to watch movies in cinema quality 3D sound using their traditional two-speaker television or stereo system. In fact, TruSurround works best by simply maintaining the normal parallel placement of the original two speakers.

Because this technology does not require the two speakers to be pointed directly at the listener, it maintains a broad sound image which can be enjoyed by anyone in the listening area, regardless of his seating position, and even if the listener turns his head or is not sitting square to the audio source.

Because TruSurround is backward compatible with stereo, the cable subscriber will get the effect whether the movie is broadcast in stereo or surround sound, according to SRS executives.

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TV/PC market set to soar, study says

Will you be watching TV on your PC in the future? The growing interactivity of computers and televisions, in combination with the development of the Internet and higher bandwidth connections, is setting the stage for impressive growth in the PC/TV convergence product markets, according to research from Frost & Sullivan.

The U.S. market for PC/TV convergence products generated $89 million in 1996, which was an increase of 109 percent over the previous year, the research shows. The market is forecasted to grow at a healthy tempo, reaching a rate of 74 percent in 1998.

Currently, the market is divided into four segments: PC/TV systems, scan convertors, TV tuner cards, and set-top boxes.

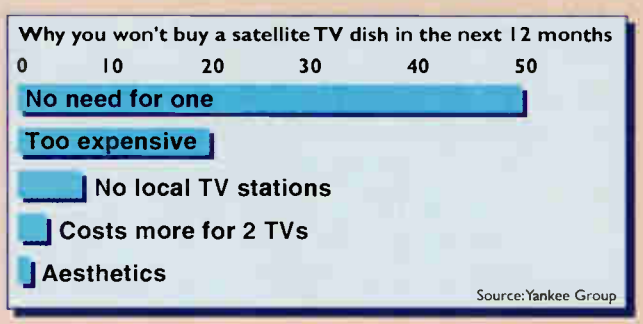
"The market for set-top boxes is forecasted to have the highest expansion with a compound annual growth rate of 71 percent," says Information Technology Analyst Rufus Connell. "Positioned as a consumer appliance connected to a television and a telephone line, set-top boxes can exploit the installed base of televisions in nearly 100 million households. The challenge for this industry is to provide Internet access and e-mail facilities at a reasonable price."

The U.S. market for PC/TV convergent products is relatively new. While two devices, the scan convertors and the TV tuner cards, have been on the market since the early 1990s, large screen PC/TV systems and set-top boxes were introduced only in the latter half of 1996.

"In the set-top box market, brand recognition of established companies has led to licensing agreements and alliances between the consumer appliance manufacturers and the designers of set-top boxes," says Abha Garg, a Frost & Sullivan analyst. The designers of set-top boxes include WebTV, Sun Microsystems Consumer Technology Group (formerly Diba), Coollogic, Teknema and Zilog.

Now comes the hard part

A new survey from the Yankee Group indicates that in order to maintain significant subscriber growth, the Direct Broadcast Satellite (DBS) industry must heighten its efforts to attract customers who already subscribe to cable TV. The study suggests that as the number of DBS subscribers rises to more than six million, most of those consumers who were initially interested in the product have already bought it.



The survey of more than 1,900 U.S. households found that DBS has been most successful in areas where cable is unavailable. More than half of the households currently using DBS said they subscribe to satellite TV because they don't have access to cable.

"We expect DBS to continue to grow in these limited markets," said Bruce Leichtman, director of the Yankee Group's Media and Entertainment Strategies Group. "But the real challenge for DBS will be drawing customers from the much larger base of current cable subscribers."

To achieve this, the industry needs to increase the level of overall consumer interest in the product. Among consumers who were not likely to obtain a satellite dish in the next 12 months, nearly 50 percent said they have no need for one, and an additional 20 percent said that it is too expensive. Surprisingly, relatively few of these consumers cited the fact that DBS does not carry local TV stations (see table).

"While much of the focus has been on DBS' inability to deliver local channels, the core reason consumers don't buy DBS is because they have not found a need for the product," notes Leichtman. "Rather than battling amongst themselves for market share, the DBS players need to clearly articulate their strengths."

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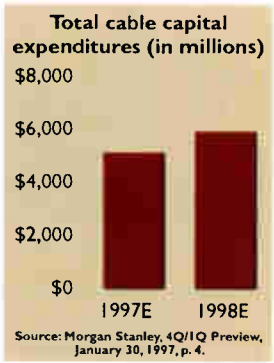
MSO spending slated to top $6B in '98



The country's burgeoning information and Internet access need is creating a mini boom in capital expenditures, from cable network operators as well as broadband satellite companies, according to two new reports.

The National Cable Television Association says cable companies invested $5.3 billion in infrastructure improvements in 1997, and will bump that up to more than $6 billion in 1998. A lot of that expense will go toward upgrading networks to two-way capability, as cable operators move from the 20 percent benchmark to ever-greater numbers.

Much of the rest will go toward increasing bandwidth capacity. At least one-third of the homes passed by the five largest cable operators are 550 MHz or above, according to information provided by the industry and analyst Deutsche Morgan Grenfall.

Similarly, the broadband satellite systems market will expand dramatically over the next dozen years, reaching a total of $76 billion invested by 2010, according to a new market research report released by Pioneer Consulting of Cambridge, Mass.

Satellite manufacturers will reap the benefits of new space technologies and rapidly expanding demand for broadband data services in the global telecommunications market. Over the next decade, a plethora of satellites will be deployed to serve global data markets, particularly Internet-based data. New spectrum released in the Ka- and "millimeter wave" bands has created a significant market opportunity for satellite systems that can offer both broadcast and interactive data services.

MSO facilities above 550 MHz

	1996	1997E	1998E
Tele-Communications	32%	37%	37%
Time Warner	32%	44%	62%
US West Media	38%	58%	70%
Comcast	53%	73%	98%
Cox	65%	86%	100%

Source: Company data, Deutsche Morgan Grenfall estimates.

By 2010, Pioneer predicts, broadband satellite systems will serve more than 36 million subscribers globally, generating more than $77 billion in annual revenues.

Give me speed, or give me...

In a classic case of trying to fan the flames in the cable TV vs. telco war, a Microsoft executive recently told a telco audience that asymmetric digital subscriber line (ADSL) will be the method many consumers use to access the Internet and other information and entertainment services.

Speaking before the ADSL Forum Summit meeting in San Francisco recently, Craig Mundie, senior vice president of Microsoft's consumer platforms division, told the audience that the world is clamoring for faster access and more functionality from their personal computers.

"The world wants high-speed access to the Internet and more. It expects its PCs to become multi-function household and office appliances, providing new and faster services for communications, information and entertainment," said Mundie in his keynote presentation. He told the audience of nearly 450 executives and professionals from the communications and computer industries that all future Microsoft Windows operating systems will incorporate support for ADSL technology.

ADSL is a modern technology that provides high-speed digital transmission over the 750 million ordinary phone lines at speeds more than 25 to 100 times faster than today's new 56.6 Kbps modems. Extensive international ADSL technical trials are now moving to market trials and initial service deployments.

Mundie, who has been using ADSL in his home during the past year, added that the powerful advantage of the technology's "always-on" feature shouldn't be overshadowed by its broadband speed. "It's just as important to be continuously connected as it is to be connected at high speeds . . . . (Together, both features) fundamentally change the way in which people perceive the Internet and the appliances connected to it."

Mundie also reported that Microsoft was ramping up its ADSL trial with GTE during the next several weeks to include more than 1,000 homes and use of 6 Mbps ADSL.

TIMES-LINE

Times Fiber and the Cable Industry Celebrate their 50 Year Anniversary

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Times Wire and Cable is Established! First supplier of coaxial cable to the CATV industry.

1968

Times introduces low-loss cables to the industry.

1969

Times introduces copper clad center conductors saving the industry millions of dollars.

1976

Times introduces first commercial fiber optic system for CATV use, installed in NYC, using fiber manufactured by Times.

1978

Times Wire and Cable announces name change to Times Fiber Communications, Inc.

1979

Times advances dielectric state-of-the-art by introduction of low-loss gas-injected foamed polyethylene dielectrics.

Times develops 400 MHz expanded coax for CATV.

1981

Times establishes the world's first fiber optic earth station link.

Times introduces the fiber based MiniHub I.

1983

Times is first to introduce triple bonding for coaxial cable.

1984

Times is first to introduce a full line of CATV coaxial cable with 600 MHz capability.

1985

Times introduces lifeTime, its exclusive non-flowing floodant for aerial, underground and indoor applications.

Times introduces TX low-loss coaxial cable.

1986

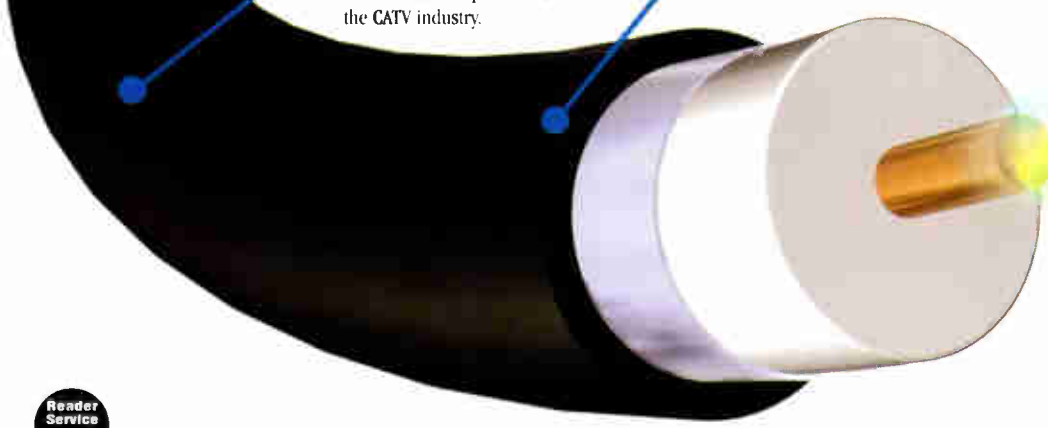
Times leads the industry again in introducing a full line of 1GHz cables.

1996

Times is first to develop RF capable 50 Ohm coaxial power cables for the CATV industry.

1998

50 year anniversary of Times Fiber Communications, Inc. and the cable industry.



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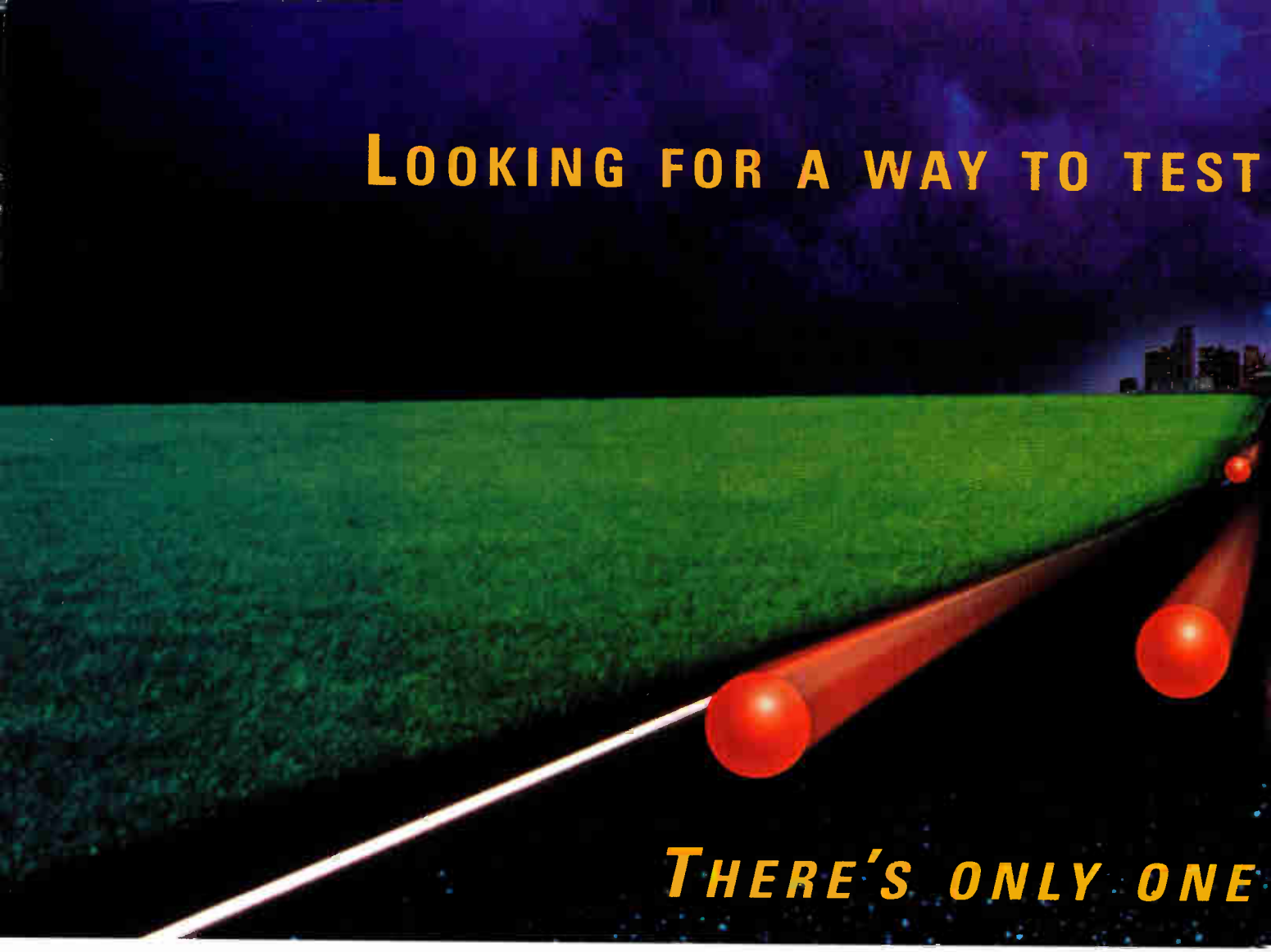

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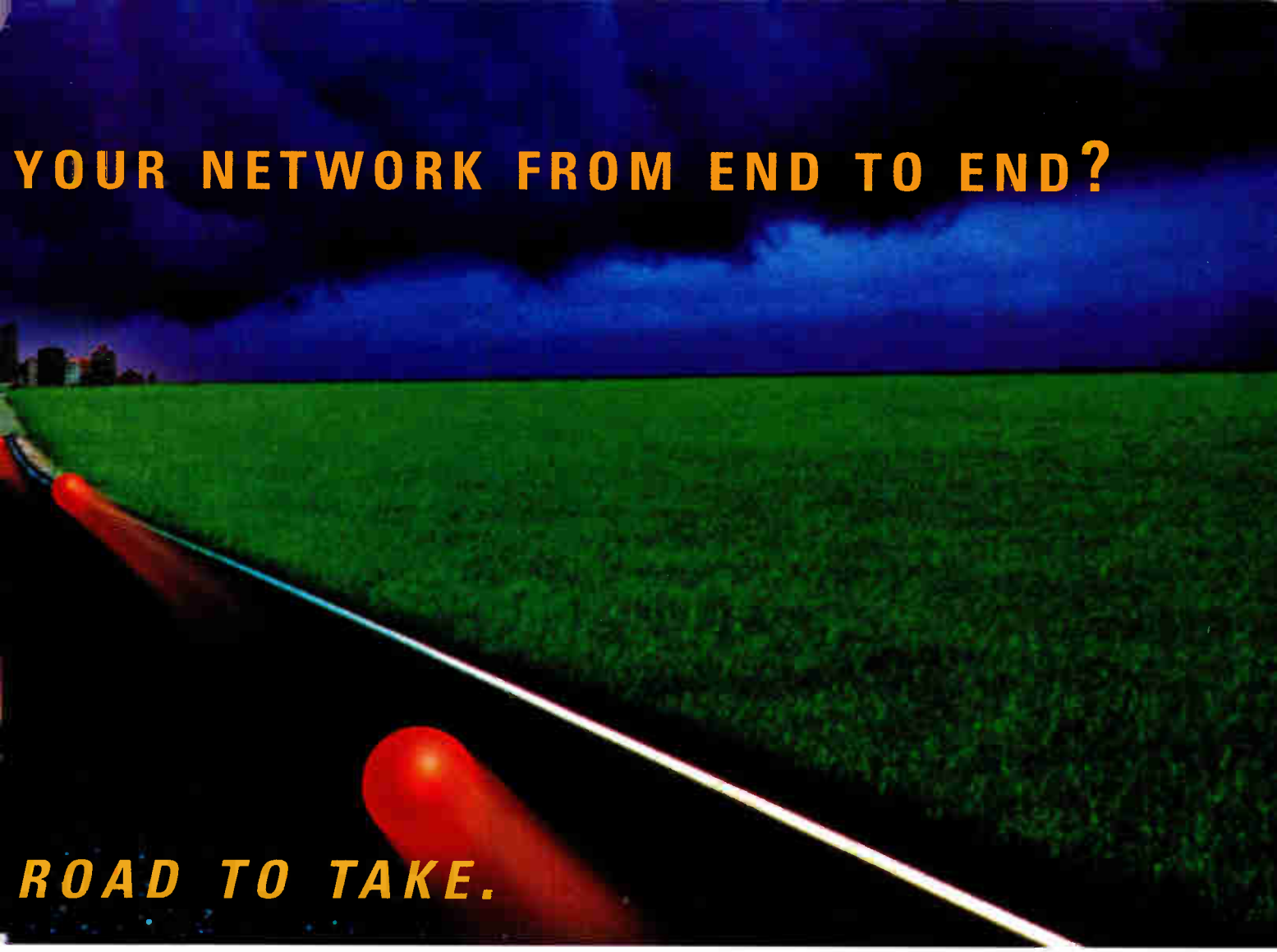

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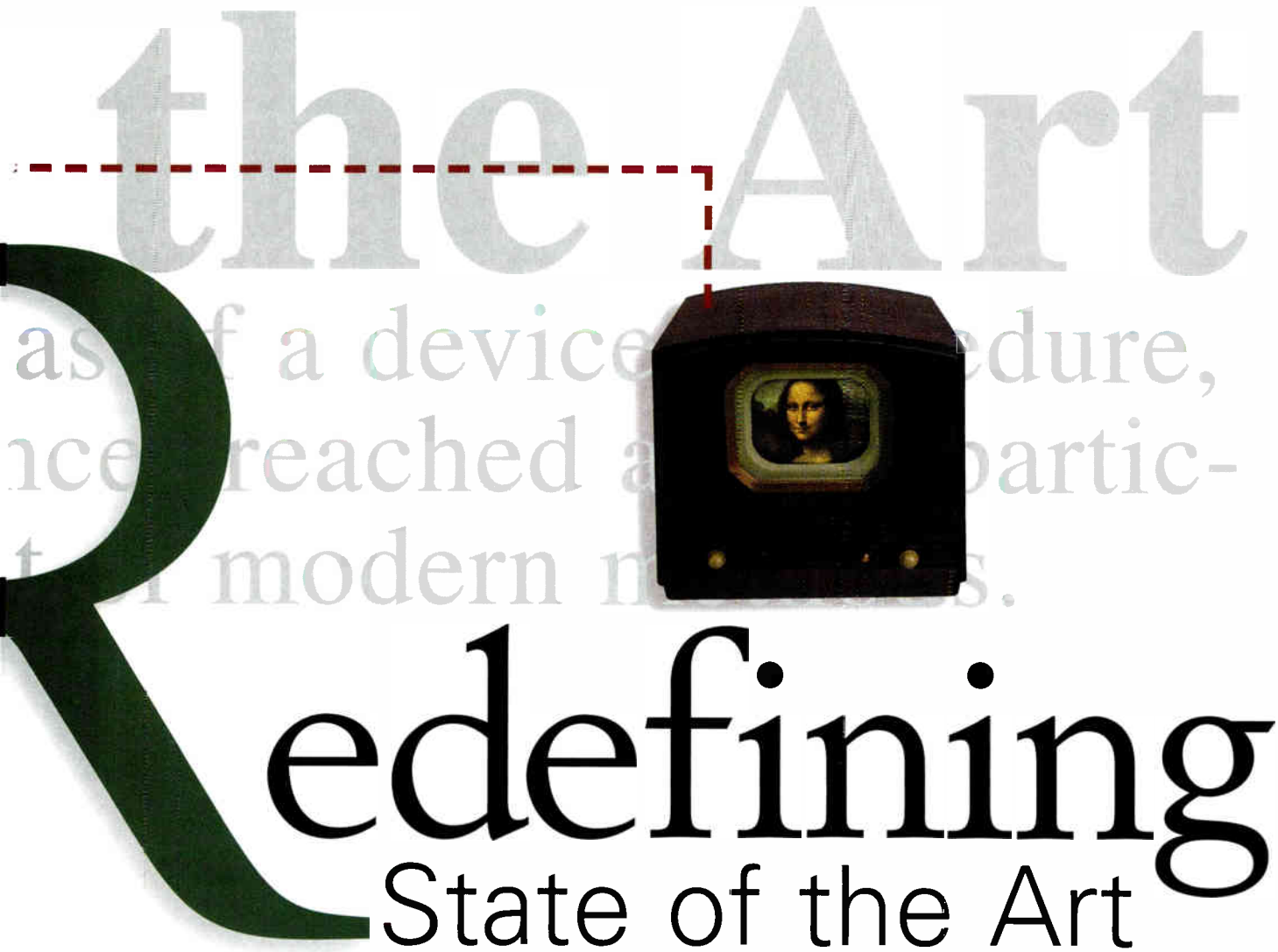


Redefining State of the Art

By Michael Lafferty and Dana Cervenka

New developments in fiber optics, and lower pricing, have put glass back in the picture for a growing number of operators.

It used to be that fiber optic technology, when it first garnered its "state-of-the-art" moniker, was something many cable professionals thought was on par with "Flash Gordon" or "Star Trek" (depending on your age). But today, there aren't many engineers who would consider upgrading or building a broadband network without some amount of glass cable.

While the cost of boosting fiber content in networks will never be cheap, the demand for more capacity is beginning to grow. Such things as high-speed data, near-video-on-demand, video-on-demand, and IP and HFC telephony are spreading out on cable's palette of services.

Yet, when it comes to fiber optics, engineers are loathe to go in and rip up what's already in place. Riding to the apparent rescue are new fiber optic technologies, in both hardware and software. There is also a renewed interest by both vendor and operator alike in dense wavelength division multiplexing (DWDM). With these new developments, fiber optics has taken on a renewed lustre and is once again on the cutting-edge of technological advancement in the broadband communications industry.

Wavelength envy?

Dense wavelength division multiplexing will be TCI's "technology of

Redefining State of the Art

choice" for new fiber construction down to the secondary hub level, says Oleh Sniezko, director of transmission engineering for TCI Communications Inc. Sniezko says that TCI has been driving the industry's manufacturers to apply DWDM technology to analog transmission, and thus "significantly simplify" the MSO's cable network.

"All the processing equipment will either be in the headend, or at the customer's home," he explains. "That way, the network is simplified, because it is fully transparent to whatever services you want to introduce."

Sniezko says TCI was due to test one operational DWDM system in the latter part of January, and another in the second week of February, at another manufacturer's facility. He expects that by the second quarter of this year, manufacturers will be able to provide a DWDM system that can be deployed in the field, which will also be scalable.

"We are riding on a very steep part of the price curve today because this is a new technology," he says. "We expect that by making (DWDM) scalable, we'll ride on a shallower part of the curve in two to three years."

One of the industry's most aggressive operators when it comes to state-of-the-art technology and fiber deployment is Time Warner Cable (TWC). And, while the company continues its break-neck pace on HFC rebuilds around the country, Paul Gemme, TWC's vice president for plant engineering, says the company still has some questions about DWDM and where it fits into the overall picture.

"We've been upgrading our plant now for the past several years," says Gemme. With more than 200,000 miles of fiber plant, most of which is 750 MHz HFC to 500-home nodes and fully two-way, the company is close to having 50 percent of its total plant mileage upgraded."

Often, Time Warner's solutions end up being a conglomeration of different vendors' equipment. "We tend to take the best of what's available out there," says Gemme. "We try to package it together in our own fashion. Sometimes that entails using several manufacturers because nobody's got a corner on the brain market and the technology is pretty close.

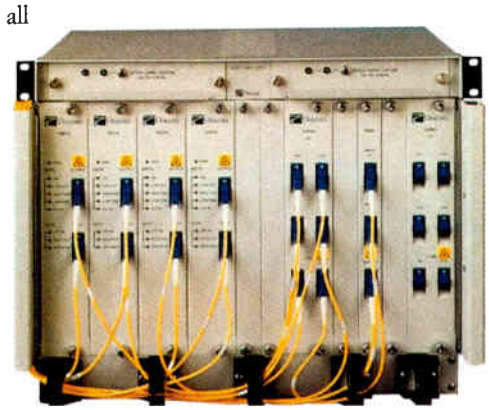
"But we do testing, and we have an approval process. So, based on who's meeting the specifications and it's usually someone different for 1550 nm (equipment) vs. 1310 nm. It's all over the map. You've got to be continually looking at it and understanding that you will change vendors as new projects come on."

Gemme and his TWC cohorts are keeping their collective eye on technologies like DWDM and asking some basic questions, while trying to keep their options open at the same time. "Everybody is always asking whether we're going to run out of reverse bandwidth or forward bandwidth first," says Gemme. "I don't think anybody knows. So, we want to be prepared for both. To hedge its bets on these types of services, as well as high-speed data, Gemme says the company will continue to run six fibers per node "so that we could ultimately break down node sizes from 500 homes, on average, to probably 150 to 200 homes."

This concern for forward bandwidth capacity, says Gemme, is having an impact on his deliberations on DWDM. "We're looking at it and saying, 'Where does it fit? Does it fit in our architecture? Does it allow us to put (in fewer) fibers per node?' We're not sure yet. We don't think that using 1550 for distribution for the nodes, for example, makes a lot a sense because you're broadcasting–and the ultimate goal is to narrowcast or have more bandwidth per home passed.

"Typically, we're doing that by using 1310 and only splitting our transmitters two to three times. The pricing is coming down on that stuff. So, we're buying transmitters today that we only need to split twice to be as cost-effective as we were three years ago. We are getting to the point where narrowcasting or providing more bandwidth in the forward path per home passed is becoming a reality."

While Gemme hasn't reached a conclusion on DWDM, he's a true industry veteran in noting that when it comes to so-called state-of-the-art technologies and money, he's never one to say never. "It's always the game of economics," says Gemme. "You know, which technology is crossing that economic line first. And, right now, we still think fiber is pretty reasonably priced. We will be testing a lot of WDM stuff this year. It could be that mid-year I'll be telling you a totally different story if things work out the way I'd like them to."



Osicom's GigaMux DWDM

DWDM picture getting crowded

A number of traditional broadband equipment manufacturers showcased new dense wavelength division multiplexing products at December's Western Show, signaling increasing MSO interest in the technology.

ADC Telecommunications rolled out a new 16-channel dense wavelength division multiplexer/demultiplexer, as well as its new OTAU (Optical Test Access Unit). As MSOs create more superheadends, says Jeff Korkowski, director of product management for ADC Telecommunications Inc.'s fiber products group, DWDM is suddenly making a lot of sense. "If you are going short distances, for example, from a fiber optic transmitter out to a node, you would not use DWDM," he notes.

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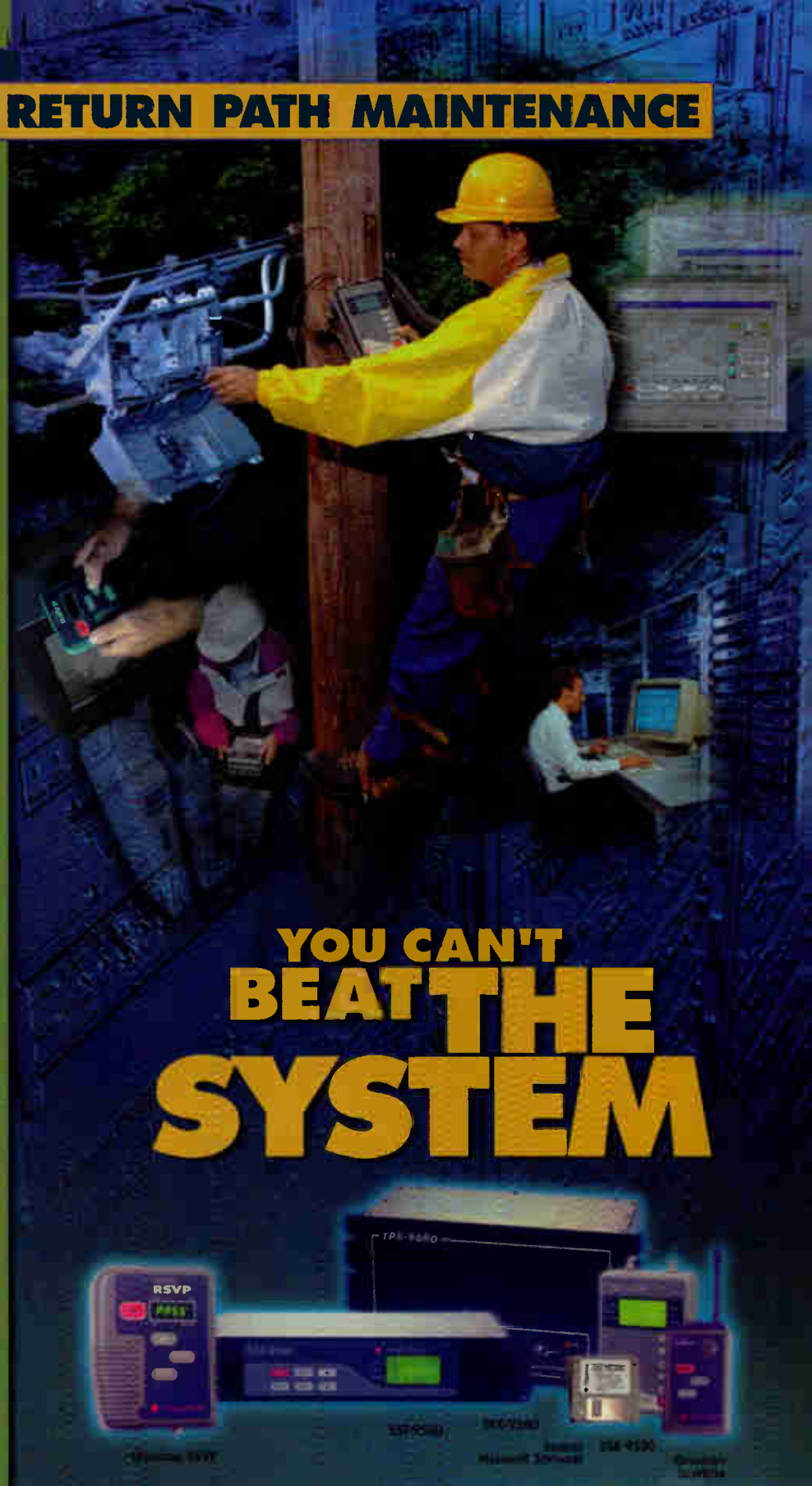

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Redefining State of the Art

occurs when you can multiplex four or eight channels and thereby avoid having to use repeaters to overcome the signal losses associated with long links. "If an operator can multiplex four or eight channels, and instead of using a repeater, use an amplifier, he can amplify all four or eight units with one unit," he says.

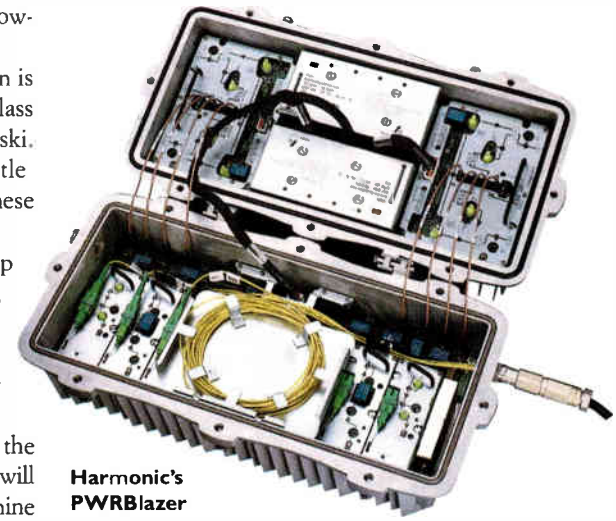
In addition, as cable operators move toward offering new services like telephony, data and PCS, it's more economical to use DWDM, says Korkowski, than to put new fiber in the ground to ease capacity crunches. While ADC is currently shipping the product out for "lab testing," it should be available in quantity sometime this July, says Korkowski.

ADC's version of the DWDM utilizes fused biconic taper technology and Fiber Bragg Gratings to separate, or demultiplex, the signals. The grating acts as an optical filter would, reflecting certain wavelengths of light and allowing others to pass through.

"The elegant nature of the design is that the light remains within the glass structure at all times," says Korkowski. "We haven't glued filters onto little devices, or tried to precisely align these pieces."

ADC's OTAU, designed to help operators remotely test fiber systems, is a multiple fiber switch that sits in a headend or remote site and makes the physical connection between any one of the fibers and the test set.

"Fiber counts will go up, and the time is coming when an operator will need the ability to quickly determine where an outage is, and direct a crew to that specific area," says Korkowski. And, he adds, the number of people who understand what is on any particular fiber is minimal. Besides further automating the testing process under



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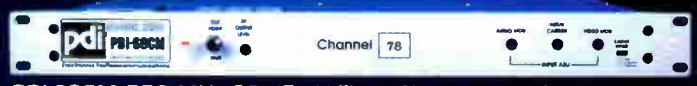

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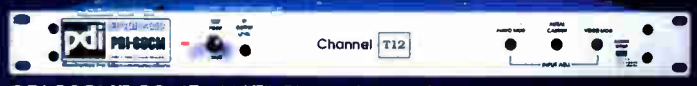

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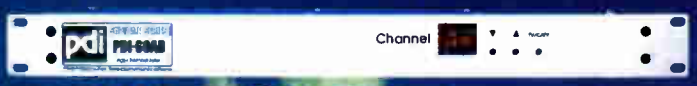

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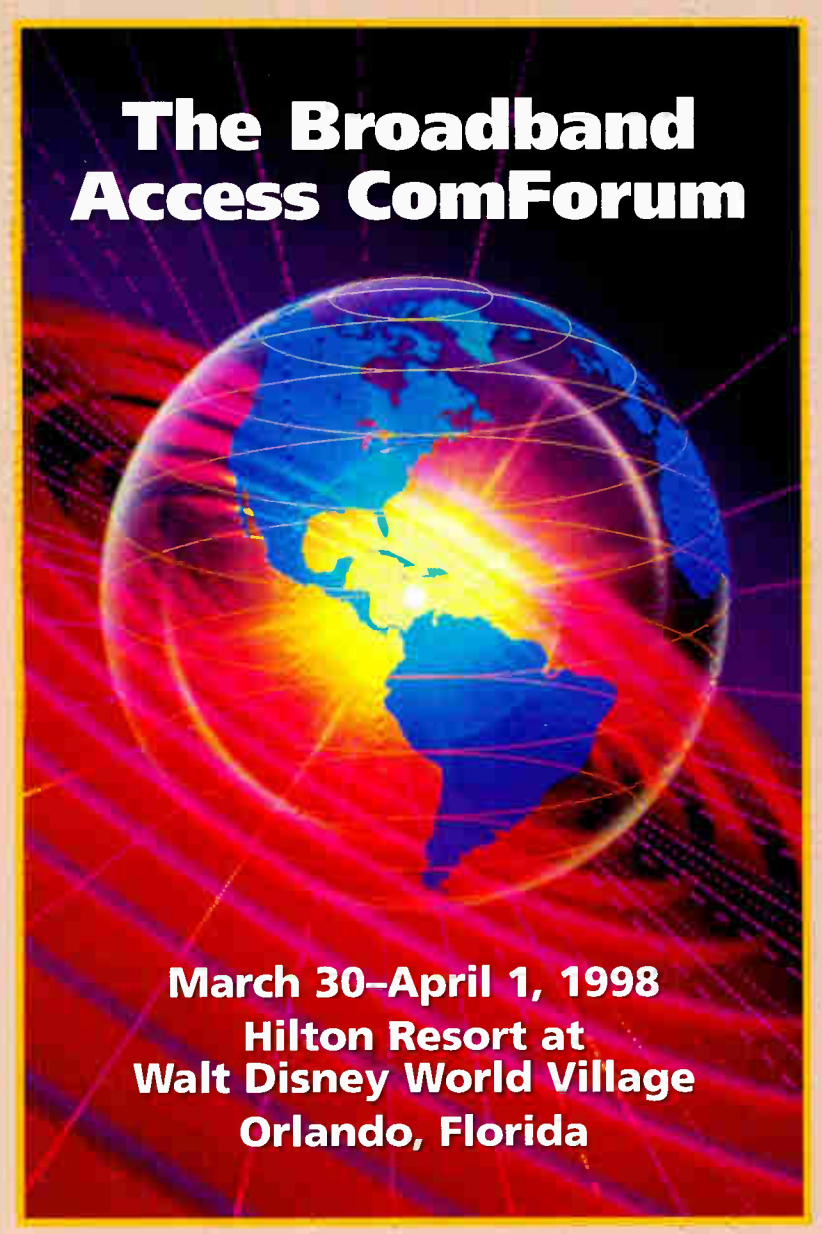

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Redefining State of the Art

normal conditions, an OTAU could save valuable time in the event of a fiber cut, he adds.

Synchronous Group Inc. unveiled its new 1x32 Dense Wave Division Multiplex System at the Western Show as well. Vince Borelli, chairman for Synchronous, believes DWDM is an important development that not only piggybacks on current technology and meets future capacity needs, but increases system value as well. "With DWDM," says Borelli, "you probably would never have to do more than 32 wavelengths. If you did more than 32 today, you're looking at some phenomenal data capabilities.

"A lot of the cable operators put anywhere from four to six fibers, on average, to every node they go to. And they're using 1310 nm. But all of that 1310 has nothing to do with this 1550. You can wave division multiplex 1550 on top of that 1310 all day long. And it won't interfere with anything at 1310.

"But, the point is, if you want to invest in an optical plant and all you want to do is 1310, and that's all you think you can do, then it has a certain (i.e., fixed) value. But, if all of a sudden you can do all this other 1550 data trunking, obviously, the plant just goes up in value."

To help its DWDM effort along, Synchronous also debuted its new Sirius-D digital Erbium Doped Fiber Amplifier, which has been specifically designed and tested for digital applications. It also introduced its new Spectrum Series Digital Transmission system, which provides uncompressed digital transmission. Available as a standard 16-channel per fiber system, the introduction of the new transmission technology allows operators to carry up to seven 16-channel systems on a single fiber.

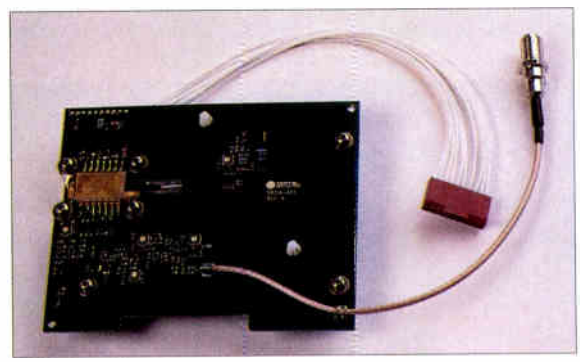
Scientific-Atlanta Inc. took the wraps off of a second major component in its end-to-end solution for transporting two-way digital and analog services over a single fiber. S-A's Dense Wave Division Multiplexing platform is the newest addition to its Prisma Optical Networks family of optoelectronics products which is currently under development and scheduled for release in the second quarter of 1998.

Despite the technology's bad rap as being too expensive, S-A's Vice President for systems marketing, Lee Johnson, thinks DWDM is a technology whose time and price has come. "We feel like," says Johnson, "from a customer standpoint, it's a cost-effective solution because it allows you to get your revenues sooner. You can deploy a system like this a lot quicker than you can lay fiber. So, dollar-for-dollar, it gives you a faster bang for your buck.

S-A's open-standards, eight-channel DWDM platform, says Johnson, will multiplex up to eight Prisma Digital Transport systems on the same fiber, increasing per-fiber transmission to 128 video channels. This represents an aggregate data transmission rate of nearly 20 gigabits per second. When used with S-A's Prisma fiber amplifiers, the platform will enable transmission distances of up to 160 km (approximately 100 miles) without the need for Sonet regenerators.

Johnson

One vendor's perception of the DWDM market was reflected in what it didn't bring to the Western Show. According to Ken Regnier, IPITEK's (Integrated Photonic Technology) director of marketing and strategic planning, the company decided to leave its 8-channel DWDM solution home in 1997. "We actually showed an 8-channel DWDM at last year's show (1996)," says Regnier. "It was a prototype. But we really just put a floater out there to say, 'OK, where does this stand in our pecking order of product development? Is this something that has such an overwhelming demand that we put everything else aside and get that finished?'



Ortel's new DFB transmitter board

"We gained a lot of experience by showing it. I think the demand will be there, we just don't see it now. But we're poised. So, if customers really start to show (an interest) and are willing to pay the premium, then we'll be there."

In the meantime, IPITEK continues to develop new products in its uncompressed digital, fiber optic transmission and broadband RF analog transmission lines. Some of its newest product additions include a new 1310 DFB laser transmitter module and a 1310 laser transmitter. The transmitter module has a bandwidth of 862 MHz and features a dual RF input with greater than 50 dB isolation, switchable automatic gain control (AGC) circuitry and field adjustment of the optical modulation index (OMI).

A new entrant in DWDM technology is taking a decidedly short-range view of the market. While many DWDM solutions are aimed at long-haul transport, California-based Osicom Technologies has positioned its GigaMux DWDM Fiber Optic Transmission Systems for short-haul metropolitan applications. According to James True, vice president for marketing at Osicom, the company has achieved cost savings for its short-haul (5 to 120 km) 16-channel DWDM system by designing a scalable system from the inside out.

"We designed growth in GigaMux from the core out," says True. "You don't

Redefining State of the Art

have to buy a complete core on day one. A lot of the products require buying a complete capacity core and then adding channels as needed. What we've done is designed a core that is scalable based upon what the demand is.

"We're also completely transparent to the data format and the speed. And because the metropolitan arena does not require the amplification of long-haul applications, we've removed the cost of that as well. In addition, the whole core of the GigaMux is passive. There's absolutely no power going into it. That makes it immune to power fluctuations and such things as temperature instabilities. Bottom line, the passive design results in an unprecedented meantime between failures (MTBF)."

True says the product is currently undergoing trials at NASA by Dynacs Engineering, a technical services subcontractor at the Kennedy Space Center in Florida. The trial involves carrying critical digital video signals from the launch pad to the Launch Control Center over fiber optic cable.

I'll see your 1310, and raise you 1550

Meanwhile, in the 1550 nm realm, the Broadband Communications Division of ADC has introduced two new Homeworx transmission systems, which include models for single and dual fiber supertrunking, and single fiber distribution.

Ongoing consolidation of systems, with increasing reliance on the creation of superheadends for program distribution, is one factor creating operator demand for 1550 nm gear, says Frank Weiss, product line manager, Homeworx AM Products. "And, to a lesser degree today, but developing more into a trend in the future, is the use of 1550 superdistribution types of architectures, where the broadcast portion of the signal is put on to the 1550 laser at the regional headend, and then transported in fiber directly to the optical nodes. So you have the mother of all transmitters up at the headend, and at the hub locations, you just have EDFAs that boost the signal and send it on its way. That's a very economical way of sending lots of bandwidth to lots of people, from a central location." Shipments of ADC's new 1550 transmission products will begin this April, adds Weiss.

Philips Broadband Networks is another firm believer in 1550 nm technology. Tom Tucker, product manager for the company's headend optics, thinks it fills a natural void in the progression of technology in the industry. "One of the driving forces in 1550," says Tucker, "is that over the last few years

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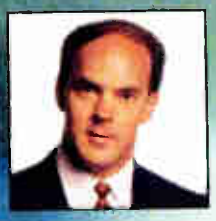

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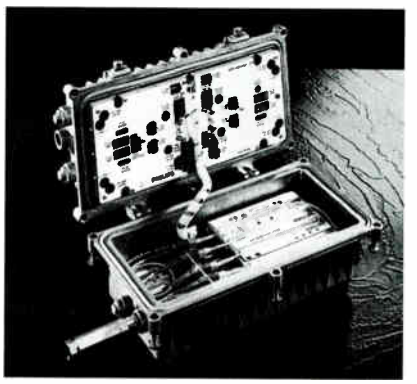
there (have developed) applications beyond the reach of 1310, and the alternative was digital. And because digital transport is more expensive, 1550 helps create an intermediate cost alternative." Tucker likens 1550 to something "between what 1310 couldn't do and what digital could do."

Toward that end, Philips introduced its new Diamond Link 1550 nm Broadband Transport System as a long-haul trunking alternative to digital transport applications. Several transmitter models and a variety of optical amplifiers are available so that operators can easily accommodate long-range trunking or high-count splitting applications.



Philips' Diamond Marquise amplifier

Philips is also getting its digital house in order. The Western Show saw the debut of its new single-channel digital system for cable headend interconnects. As such, the system has been designed for applications in which signals in the channel line-up gather at the master headend and are then distributed digitally to various remote headends.

In addition, says John Decker, product manager for long-haul fiber optics, Philips' recent strategic alliance with Artel Video Systems Inc. will soon bear digital fruit. Decker says Philips is leveraging some of Artel's core technology and "then doing a collaborative development that will come up with a new system that is quite a departure from what the industry has seen up to this point, in that it is significantly smaller, has more range and lower cost than other digital interconnect systems available."

Toward more painless upgrades

Aiming to appeal to operators who are hedging their bets about future services and necessary upgrades, several manufacturers have announced fiber products which are designed to be upgraded on the fly.

C-COR Electronics has introduced its Navicor line of AM fiber optic nodes and upgrade capabilities, which features a number of common modules that can be swapped in and out of standard housings. "This set of products, and the architecture that we have come up with, allows cable operators to navigate the upgrade of the broadband network as it evolves into the future," says C-COR President and CEO Scott Chandler.

"Say an operator is doing 1,500 homes per node today. With this architecture, as his network evolves, he can turn some of his amplifiers into nodes, and maybe move it down to 500 homes per node. And if, in five years, a hot spot develops, . . . the operator can surgically go in and make that a 100-home node area."

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The Navicor line features the new Quadrant, a four-active output bridger and node which is scalable, with the ability to handle up to four optical transmitters and receivers, and featuring redundant power supplies. The Quadrant is available in both 750 MHz and 862 MHz versions and offers multiple reverse transmitter options.

"The modularity gives operators more flexibility," explains Chandler, "so they don't have to overengineer their networks today. They don't have to say, 'I want three data receivers.' Why three? 'Well, my marketing folks say that there *may* be really heavy data usage.' The modularity gives the operator the ability, where he can configure it with less today, and if the marketing folks appear right, the network can be upgraded later on."

Harmonic Lightwaves also got into the game with its PWRBlazer Scaleable Node, which rounds out its line of node receivers to include a mini node, suited to fiber-rich architectures, and a "middle-of-the-road" node which falls between the other two in terms of flexibility.

"We came up with a node that can be economically installed , and then could be upgraded easily in the future to handle just about anything the industry could evolve into, whether those services include Internet access, video-on-demand or other interactive services," says Eric Schweitzer, product manager of receiver systems for Harmonic. "Rebuilds are very expensive. And if an operator can put in a node today that has this flexibility, they can avoid having to do a rebuild in the future, which should save money in the long run."

Designers of the scalable node split the RF amplifier into two output modules, which allows the user to configure the node for different numbers of outputs. There are also two extra ports which can be used either for direct pow-

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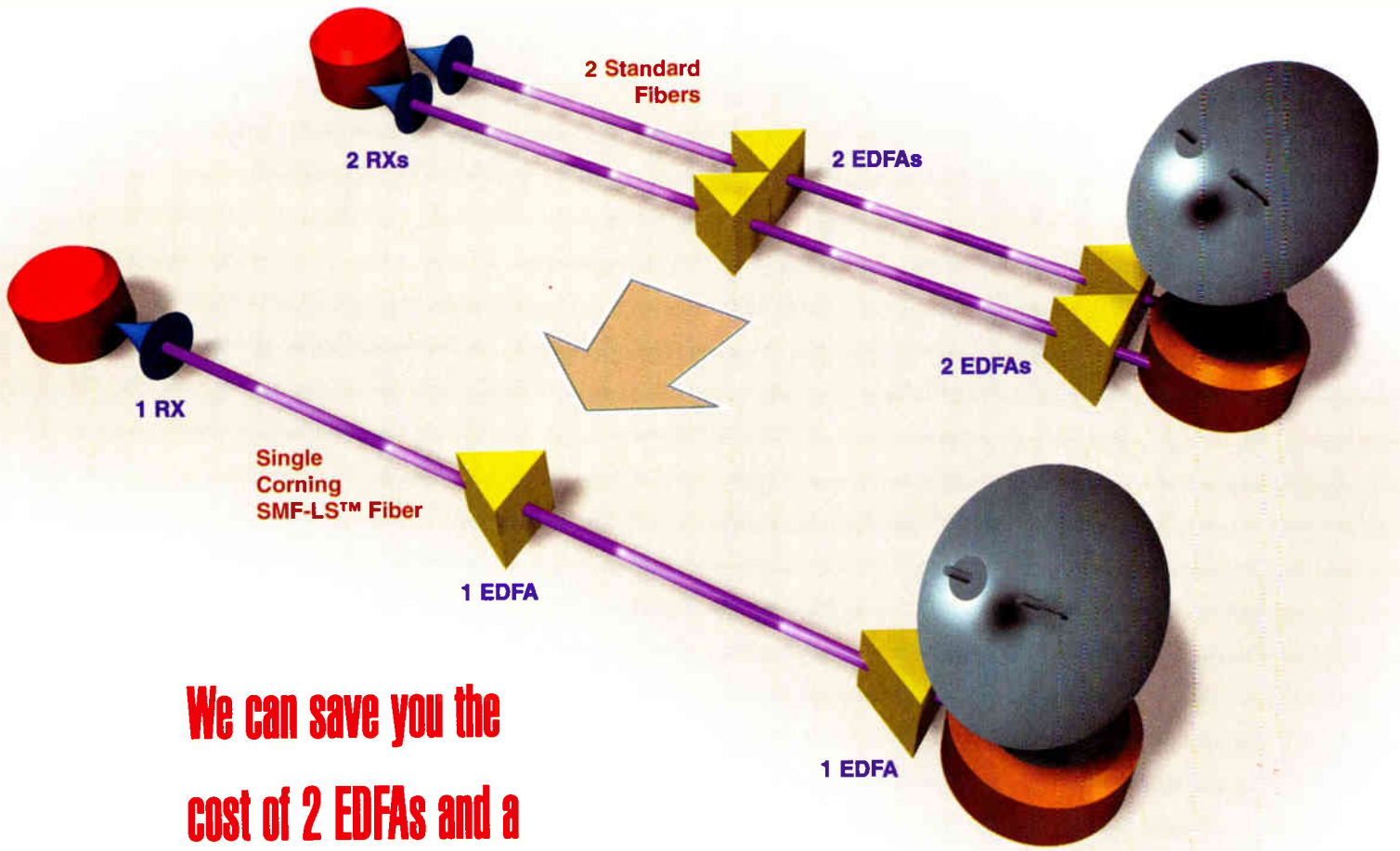

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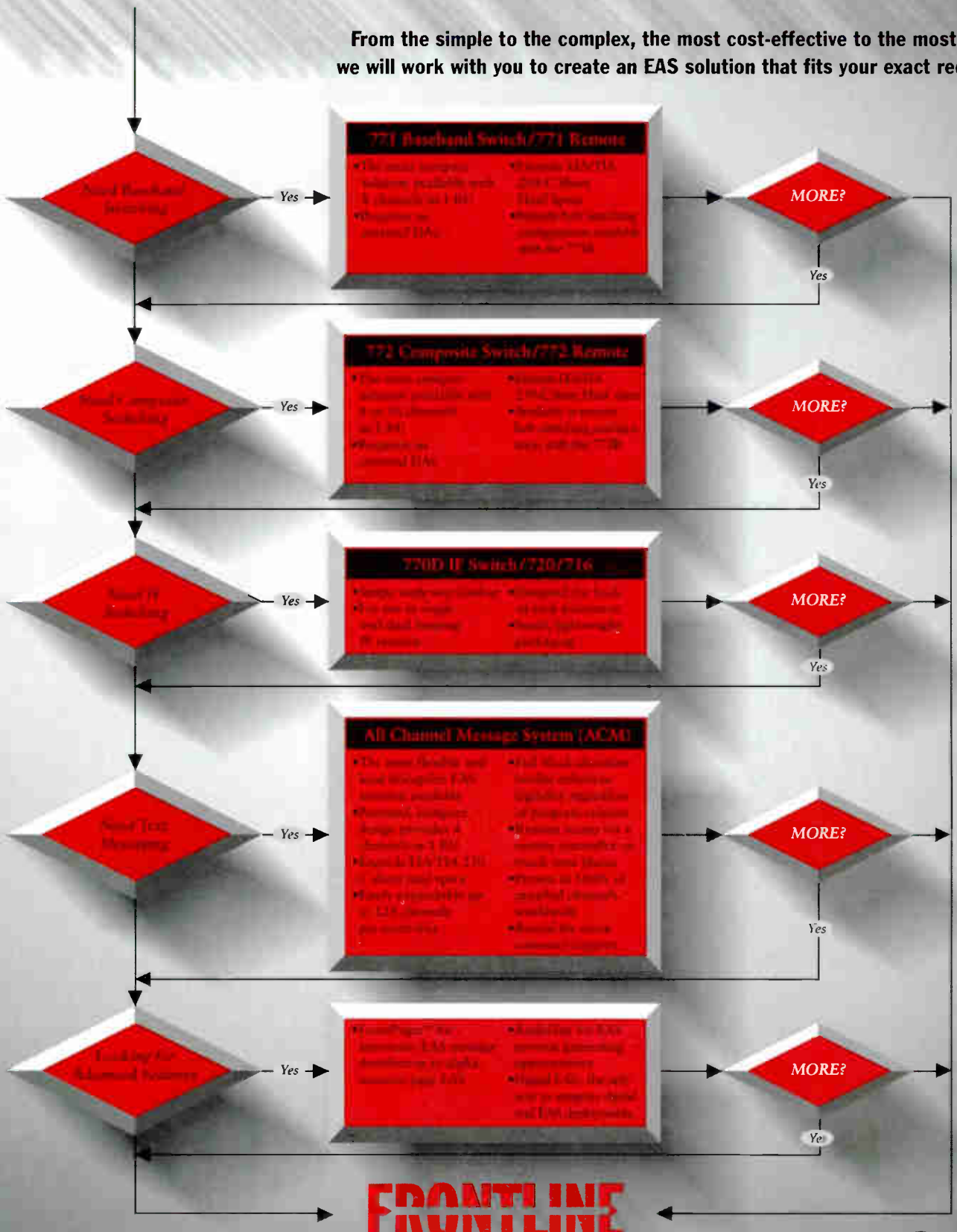

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Redefining State of the Art

ering or direct return input to a dedicated return transmitter.

"Direct return input is starting to become significant, particularly in PCS systems, where you want to keep the cable return and the PCS return on completely different fibers," says Schweitzer, "so that ingress on the cable TV system doesn't wipe out the PCS communications." The node also contains eight optical module slots.

"The other thing we found people were really asking for is redundant powering," says Schweitzer. In response, Harmonic designed the node with two power supplies which operate in redundant modes, and which can be driven by either one of two power buses.

But redundancy is not worth much, says Schweitzer, if the node is not monitored. "Unless you monitor the node, you are not preventing outages, you are delaying them, so we have integrated full network management capability."

And finally, ADC's Broadband Communications Division has also stepped up to the plate to answer MSO requests for scalable optical nodes with its ISX3000 series, a new family of optical distribution nodes.

"One of the key things that we are trying to provide to operators is flexibility, and that is via modularity," says Steve Doherty, product line manager for outside plant equipment at ADC Broadband. "They want to be able to deploy something now, and then, they can change it to (fit) whatever their needs turn out to be. So we have made the enclosure that the electronics are contained within, which we call the casting or the housing, into our platform. And now, we are developing modules that operators can plug together (within the housing) to implement new architectures, to pass new services."

By the end of the year, ADC may be offering additional modules to support WDM, as well as EDFAs.

Higher level of integration

The move toward longer fiber links is also influencing the design of products at the component level. Ortel Corp. has added a couple of new members to its Platinum Performance Series of cable TV products, including a DFB transmitter board and a DFB laser module. The impetus behind the new designs came from a couple of different directions, says Bob Jordan, vice president and business manager of broadband communications products for Ortel.

First, operators require improved performance specifications; and second, power requirements continue to increase, as part of an MSO move

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toward going longer distances with fiber. "1310 nm laser transmitters generally are good out to about 30 km for the longest link, and after that, 1550 nm transmitters will pick up, but of course, with a big price jump," says Jordan. "For the cases that fit somewhere in that 30-40 km band, the systems will require both increased power and improved linearity."

The company's Platinum Plus series consists of a laser, plus a family of different boards that range from fairly straightforward, featuring simple predistortion, all the way out to integrated boards that feature hybrid amplifiers and some other associated electronics, says Jordan.

The new transmitter boards also include a higher level of integration than ever before, yet feature reduced circuit size and part count, which means that they also use less real estate–the smallest board is about the size of a credit card. The board also features power options between 2 mW and 16 mW, with improved distortion.

As for the new laser module, it differs from its predecessor in that it offers a standard, OC-48 pinout (vs. a proprietary pinout), as well as a negative bias.

Return path insurance?

To give network designers more options on the return path, General Instrument has developed a Frequency Stacking System (FSS) that it believes offers operators "a good insurance policy" against a jammed return path.

David Grubb, GI's vice president of marketing for transmission network systems, says the system essentially quadruples return capacity. "The system takes each of the four return inputs to the node and block converts them to their own frequency band. So, the return from port #1 may go between 100-135 MHz, then the next one goes at another block, etc. That allows the operator to send them all back on one fiber to the headend where the process is undone."


Grubb

"It's really an upgrade path," says Grubb, "to allow you to put in a node, and if down the road, you're doing telephony or a lot of data and you need more return capacity, it's a way to get that without doing any changes to the physical plant design. That way, you can design for a 500-home node, and you can effectively go to a 125-home node size without ripping up your plant." ■

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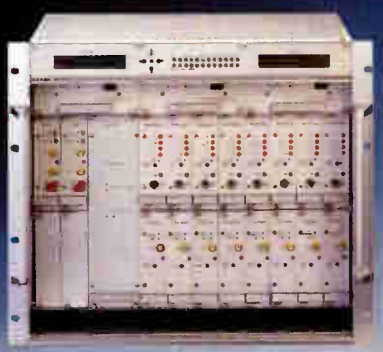

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A PEEK into the LAB

Possibilities for doing more with fiber optics–on the cheap

BY JAMES CARELESS

Increasing: that's the word that describes the importance of fiber optics to cable TV. As bandwidth demands go up, and two-way services begin to come on-line, cable operators everywhere are not only installing fiber, but driving it closer and closer to subscribers' homes.

For cable engineers, the big question is, "what's next?" What new fiber advances are on the horizon that will make fiber optic transmission do more, do it better, and–if possible–do it cheaper as well?

Without a doubt, the catchphrase that's on everyone's lips is wavelength division multiplexing, or WDM for short. Rather than continuing to add fibers to their networks as demand increases, cable companies can use WDM technology to transmit 8, 16, or even 32 channels over their networks, where only one existed before.

Surprisingly, WDM is not a new technology. In fact, it's been around "for about two decades," says David Paist, manager of strategic technology at Siecor Corporation. However, in the past it's been cheaper for cable operators to simply boost the data rates on their single channel TDM (time division multiplex) networks. That's why WDM has remained "a niche application."

So what's changed? "With the speed increases getting up to OC-192, the TDM electronics are getting a lot more expensive," says Paist. "Meanwhile, WDM technology has improved to the point where it's economical for some applications."

This explains why "WDM is something that folks are quite interested in these days," says Dan Harris,

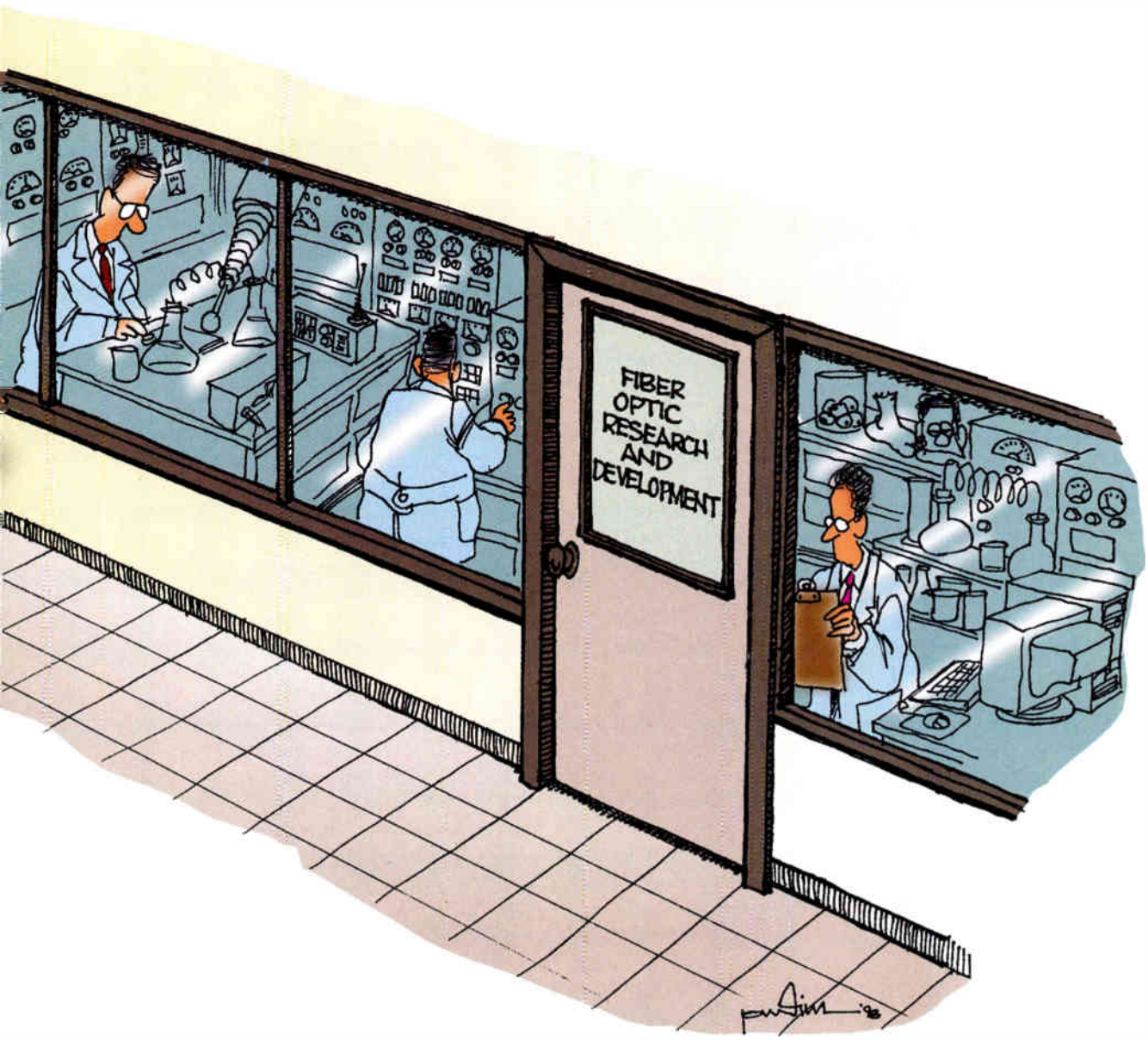


ILLUSTRATION BY ROB PUDIM

Corning's manager of market development, engineering and analysis. Currently, most of that interest is being shown by telephone long distance carriers, who are implementing WDM in their national networks. However, Harris says WDM is proving to be "an emerging technology for regional and metropolitan network applications. As the prices come down and the systems are tailored for the shorter distances, I think it's a matter of time before it will creep into those too. How much time this will take? That remains to be seen."

In the same vein of making fiber do more, Corning is also trying to squeeze more performance out of the medium. "Non-zero dispersion shifted fibers are a hot topic in the fiber world," says Harris. "What you're seeing, essentially, are fibers that are optimized to support many wavelengths over as long a distance as possible, with minimal dispersion. We also want to find ways to put more power into the fiber, and to find more creative ways to compensate or manage the dispersion that is there."

Ortel Corporation is also trying to find ways to pump more performance out of the technology. "That's why we've been working on higher powers and increased bandwidth," says Bob Jordan, Ortel's vice president of marketing. "That means getting into the range of 20 to 25 milliwatt lasers."

The next big question is transmission frequencies. Today, 1550 nanometers is the workhorse for one-way signal transmission, because 1550 nm signals can be efficiently amplified. And when it comes to distance, "physics favors the 1550 wavelength," says Jordan. In the

What Cable Engineers Think About the Drive to Fiberize

BY JAMES CARELESS

As always, cost is a big consideration for cable engineers. They like the sound of the fiber capabilities being touted by Corning, Ortel and Siecor, but they want them at a good price.

For instance, Robert Balsdon, vice president of engineering at Rogers Cablesystems in Canada, wants manufacturers to bring the cost of WDM equipment "down to the point where we can install (it) in the access plant, because we'll need (it) to make better use of our installed fiber base as we exhaust our `dark fibers'." He'd also like to pay less for broadband transmitters.

Paul Gemme, vice president of plant engineering at Time Warner Cable, would also like to see some price breaks. In fact, when asked what would be number-one on his

'I'd love to see a low-power 1310 laser on the order of $1,000'

wish list, he says, "I'd love to see a low-power 1310 laser that would probably cost somewhere on the order of $1,000. Then, we could do narrowcasting really easily, and economically." Right now Gemme says TWC is paying $2,000 to $2,500 for such units, which, combined with other costs, makes this dream unattainable.

But money isn't the only thing concerning these engineers about fiberization. For instance, Balsdon would also like to see standardized specifications. "A lot of the vendors still specify reverse transmitters using analog video loading," he says. "Essentially, none of the operators are using it for that. They're loading it with data, status monitoring signals, and high-speed data modem signals, and there have been a number of people in the industry who are pushing to standardize measurements using `noise in the slot,' which certainly tells you a lot more about the performance capability of that device."

For its part, Time Warner Cable isn't sitting back and waiting for the manufacturers to get their acts together. Instead, "we're reviewing and (are) going to be putting out new specifications for the products we want to use at Time Warner," says Gemme. "In fact, the optical manufacturers should be receiving their copy of that any day now."

What Time Warner wants is "tighter specifications," he explains. "We've looked for tighter end-of-the-line numbers to be more achievable by using better optical devices. Certainly the noise and composite contributions to the rest of the plant can be better than what they have been in the past . . . . We're reaching some of the limitations with amplifiers, so we have to look at the optics to do the rest for us."

Of course, cost isn't what vendors are focusing on: instead, they're promoting wavelength division multiplexing for boosting the capacity of existing cable networks. However, this technology has yet to capture the imagination of MSO engineers. For instance, when asked about WDM equipment, Paul Gemme says, "I think they're going to have their applications. We just haven't really figured out what those applications

continued on page 48

field, 1550 can cover up to 65 kilometers without an amplifier. In contrast, the other working frequency of 1310 nm is effective for only 30 km.

However, 1310 is considered to be the optimum medium for two-way transmission, says Jordan. The problem is that 1310 is very difficult to amplify.

"Semiconductor amplifiers tend to be quite noisy," explains Corning's Harris. Meanwhile, "1310 fiber amplifiers–while they can replicate performance similar to 1550 erbium-doped amplifiers–aren't nearly as efficient or stable."

The problem has to do with the nature of fiber optic amplification. "You've got light coming down a fiber at 1550," says Jordan. "You take a 980 nm pump laser, and a link of the erbium-doped fiber. You use the pump laser to excite the erbium atoms, and when the erbium atoms go from their excited state to their normal state, they emit light. That light comes out in step with the 1550 nm light in the main pipe. The result is the signal is effectively amplified."

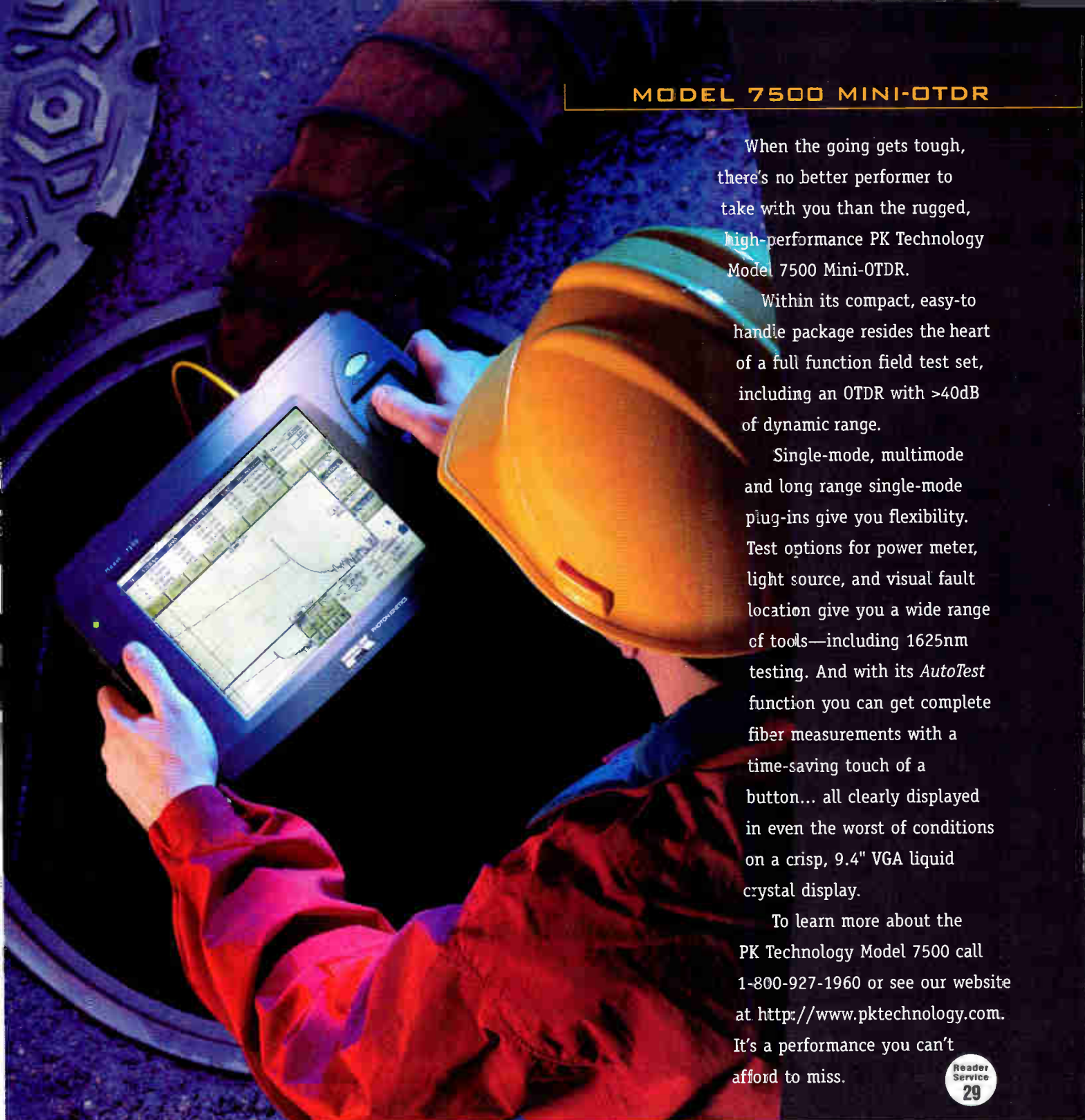
The problem is that erbium doesn't do this nearly as much with 1310 nm light. To create a truly economical and efficient 1310 amplifier, "you'd have to find a material that has optimal performance in that region," says Paist. So far, no one has.

Of course, glass fibers are an expensive and somewhat delicate medium to work with. This is why some in the industry hope that plastic fibers–arguably inferior in performance, but good enough for short distance applications such as connecting computers–could one day find their way into the network.

Alas, there's no sign that plastic's attenuation problems will be addressed in the near future. That's why, at present,"I think plastic has its place for very, very short distance applications," says Harris. "As for serious network applications? No, I don't think we'll see the performance of plastic compete with glass."

Still, Siecor "is curious about potential applications for plastic fiber," says David Paist. Based on what he saw at last month's Consumer Electronics Show in Las Vegas, "plastic fiber is being seriously considered for home applications."

Still, until the attenuation problem improves, plastic fiber is impractical for



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continued from page 46

are going to be yet."

David Fellows, senior vice president of Internet engineering and operations at MediaOne, is similarly noncommittal about WDM. "We're not particularly looking at that technology out to the fiber node," he says, "but it's sort of a nice thing to know it's there."

"Because we're just now deploying fiber, for right now, we have adequate fiber," Fellows adds. "But if history has taught us anything, it's that no matter how much fiber we put in, we'll wish we had more. Wavelength division multiplexing is a good technology to have in your back pocket."

Still, cost-conscious cable engineers aren't in a big rush to dump coax. "One of our biggest physical assets is our coaxial plant," explains Balsdon. "It works very well, even though it's 10 years old." Combined with the cheaper equipment costs involved in running a mixed HFC plant, "it makes more sense for us to leverage that than to install fiber-to-the-curb, or to the home, and basically abandon that asset. It would have to be 10, 12 or 15 years out before we'd want to consider going fiber-to-the-curb or fiber-to-the-home," he says.

The bottom line is that, although engineers are watching fiber optic developments with interest, they're watching for cost-efficiencies even more closely. Hence, it will take a marriage of the two before WDM, 1310 amplifiers or new optical cables catch their fancy.

cable networks. The one circumstance where it could possibly be used is in fiber-to-the-curb applications. Glass fiber could bring signals right up to the subscribers' houses, and plastic fiber could then ferry the signal right to their TVs, computers and telephones.

Which brings us to the big, big question: just how close to the home can fiber really go? Those engineers interviewed by *CED* say that fiber-to-the-home remains an unaffordable pipe dream. However, there is support for what Bob Jordan calls "fiber deep," which means fiber to the last amplifier between the network and the subscriber's house.

Pushing this trend is the demand for two-way services such as Internet access, telephony and interactive TV. Whichever of these one considers, the answer always comes out the same, he says: a 750 MHz, two-way plant. "So when you look at the costs involved (in) operating such a system, `fiber deep' makes sense," says Jordan. As well, fiber deep makes it possible to build self-monitoring into the network equipment, where status reports are supplied automatically from the field to the cable headend. All told, the advantages of this make `passive coax,' as it's called, "cost-competitive probably within a few years," says Jordan.

Which brings us to the Big Picture: right now, the best possibilities for fiber optics lie in improving the applications running on these networks, rather than replacing these systems with something radically new. However, that will change, says Paist, once the vision of a truly all-optical network becomes a reality. "That's the Holy Grail out there," he says, "where you get away from always having to convert from electrical to optical, and back again. The more you can eliminate the electronics, the more reliable, simpler, and less expensive the network gets. It's all this conversion that piles the costs up."

In the meantime, the best course is to do the best with what we've got, and that's exactly what savvy cable engineers are doing with fiber optics. ■

About the author

James Careless is a freelance communications writer. e-mail: careless@magi.com

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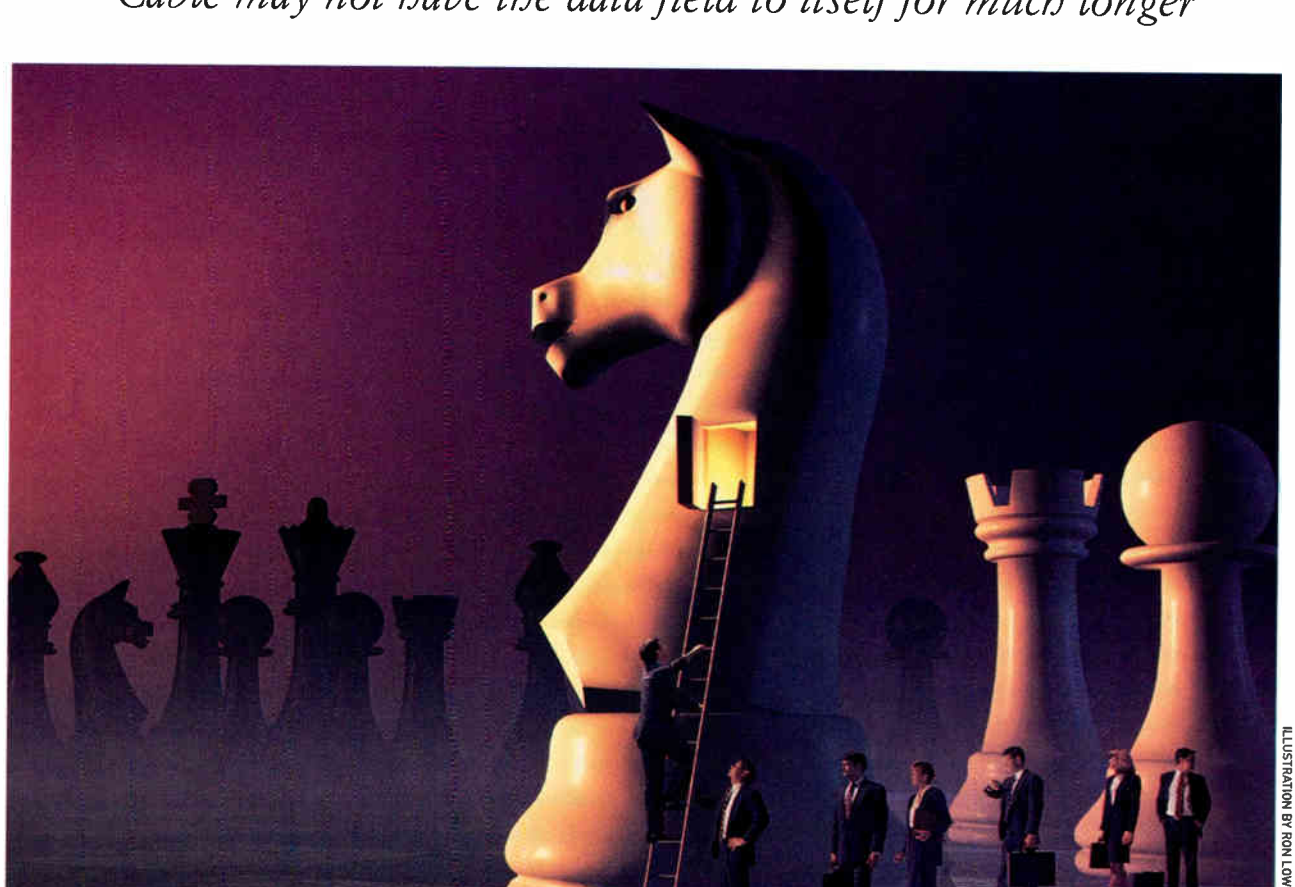

ILLUSTRATION BY RON LOWERY, THE STOCK MARKET

BY FRED DAWSON

It has taken longer than many people anticipated, but the local exchange carriers are finally getting their acts together in the use of high-speed digital subscriber line technology (DSL).

There's still a long way to go, with mass deployments still a year away in most regions. But there appears to be little reason to expect that the technical, regulatory and business operations barriers that have stalled rollouts so far will prevent most major carriers from responding to the competitive challenge posed by cable and other providers as broadband data services take off in the mass market.

"DSL is getting better," acknowledges Richard Green, president of Cable Television Laboratories Inc. "Cable has a finite window of opportunity to use in establishing its (high-speed data) platform in the marketplace without serious competition from the telcos."

That window will probably be open for another year or so. By most accounts from vendors, analysts and the carriers themselves, the telephone industry, despite pockets of intensifying activity, won't be moving to mass deployment of high-speed data services over copper-

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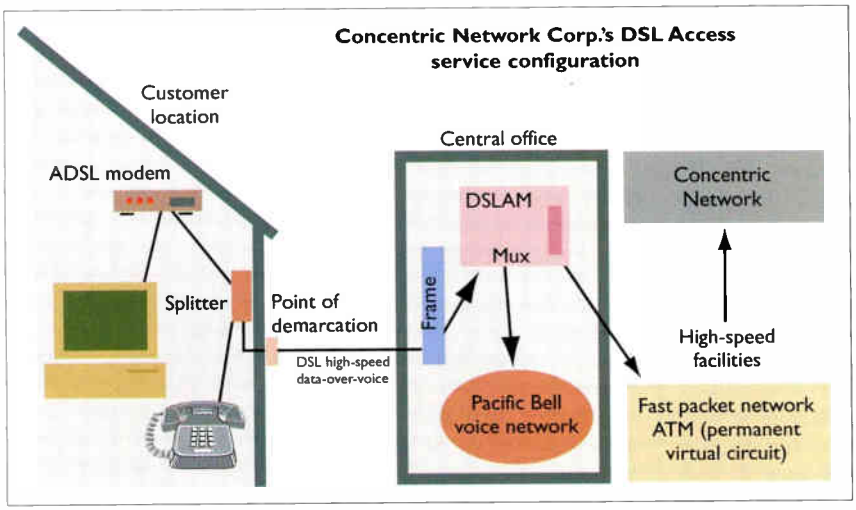
based DSL technology in '98.

Asked whether '98 will be the big volume year vendors have been waiting for, Westell Technologies Inc. Senior Vice President of Sales, Mark Zionts, responds with a candid, "No." Westell, a leading supplier of DSL systems, sees '98 as an "extremely important, ramping-up year," he says.

But it would be a mistake to think cable will have the high-speed data field in the residential and small office markets to itself for much longer. US West, Ameritech and SBC Communications subsidiaries Southwestern Bell and Pacific Bell all say they've crossed the line from testing to commercial deployment of DSL services, though the Pacific Bell, Southwestern Bell and Ameritech efforts are still in the pre-tariff early launch phase. GTE, whose CLEC subsidiary has MDU DSL service underway in southern California, is set to begin commercial service in some markets this quarter. Bell Atlantic says it will do likewise by the third quarter, leaving only BellSouth to say what its '98 plans are.

The SBC Communications launches, in the Bay Area of California and Austin, Texas, and the Ameritech rollout, in Ann Arbor, Mich., are true DSL deployments using gear from Alcatel that delivers up to 1.5 megabits per second in the downstream, and 384 kilobits per second upstream. US West, which is marketing service in Phoenix, is relying on IDSL technology at the outset, that uses ISDN modulation techniques to deliver data at 192 kbps, while employing IP packet transport, rather than the time division multiplexing used in standard ISDN services. The company says it will also soon bring HDSL (high-speed DSL) technology to market in Phoenix and other areas targeted for DSL rollouts this year. This is a symmetrical technique geared to single-line applications at 750 kbps that has long been used in delivering T-1 (1.544 Mbps) over two standard telco lines to business customers.

Making matters more challenging for cable is the fact that, with deployment of DSL infrastructure, the carriers are putting in place a platform that can be used by competitive carriers and Internet service providers as well, ensuring that DSL data services will be marketed harder and further than if the telcos were doing it all themselves. The shape of what can be expected along these lines can be found in the Bay area, where Pacific Bell's DSL service is now being made available through several ISPs and two CLECs,



after an initial marketing phase involving just one ISP. SBC's own ISP unit will itself become a provider over the platform later this year, says Michael Powell, director of DSL marketing for SBC.

The carrier plans to expand the Pacific Bell DSL offerings, now available from 13 Bay Area central offices, to most of the COs there, as well as to a large share of COs in Los Angeles and Orange Counties, San Diego and Sacramento over the next year, Powell says. SBC, now offering DSL through four COs in Austin, Texas, also plans a big push in that state this year, with rollouts planned for Houston and Dallas as well as additional COs in Austin, he says.

PacBell's "FasTrak" DSL service offers a symmetrical 384 kbps line rate priced at $80 per month for residential users and $135 for business users, and an asymmetrical service at 1.5 Mbps downstream and 384 kbps upstream priced at $150 and $250 per month. Users also must pay $450 for the modem and an installation fee that averages about $125.

"These are not mass consumer prices at this point," Powell acknowledges, noting that pricing is still in flux prior to

filing of tariffs. Adding to the costs, he notes, is the fact that users must also pay an ISP for Internet access and other value added services.

Until now, the only ISP authorized to use the FasTrak facilities was Concentric Network Corp., a Palo Alto-based entity that targets business users with services offered from points of presence covering approximately 90 percent of the nation's population base, according to company data. Concentric, which has been supplying Internet access and a multitude of other value-added services such as virtual private networking capabilities over the FasTrak system since November, currently charges residential and business customers alike a monthly flat rate of $95 for unlimited usage at the lower speed, with the higher-speed service priced at $195.

Eventually, the company will implement usage-based rates, says Jim Southworth, director of advanced networking services and technologies at Concentric.

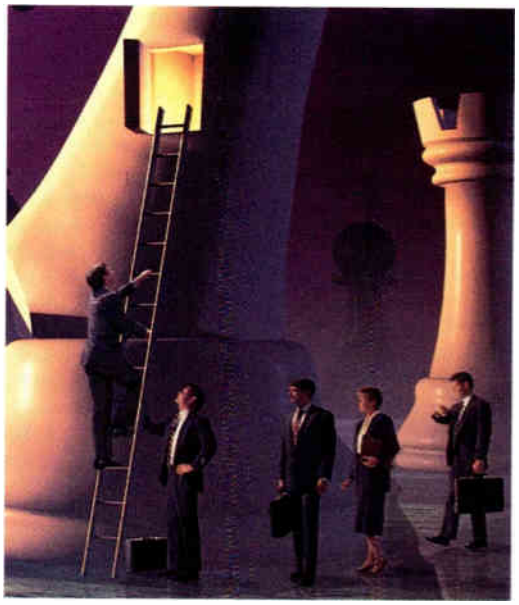
Concentric plans to expand the offering in California to wherever Pacific Bell expands its DSL platform, Southworth says. In addition, the company is preparing to roll out DSL services in a number of other major markets this year, including New York, Atlanta, Dallas and Washington, D.C.

Most of Concentric's customers receive the DSL service over their existing lines rather than taking a second line to get the service, Southworth notes. The carrier supplies a coupler at the premises that siphons off the DSL data signal to a line that is directly installed to the user's modem. A typical customer might be a telecommuter with a single modem outlet or a small business with a unit serving multiple users.

Installation has proceeded slowly through the early phase of the rollout, with PacBell pursuing a conservative policy of line qualification before it hooks customers up.

"We've seen only about a third of the service area qualifying for connectivity, rather than the 60 percent or so we anticipated," Southworth says.

But Southworth and Powell both assert this will change now that PacBell has had enough field experience to set more liberal parameters on line qualification, which, along with distance limitations, include limits on the presence of bridge taps and line coils and on the number of interfering high-speed lines that can be included in any bundle of twisted pair wires. "We're adjusting the line qualification numbers with the intention of getting to the 70 to 75 percent qualification level over time," Powell says.



One factor improving the percentage of coverage for DSL involves second line installations

One factor improving the percentage of coverage for DSL involves second line installations, where the new lines often have fewer impediments than existing lines. PacBell will install second lines "when requested," Southworth says, but

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it is not pushing this approach, given its interest in using DSL to leverage greater value out of existing plant.

An important element in Concentric's expansion plans is the emergence of "P-CLECs," a new category of CLECs that are committed to operating in packet mode and supplying ISPs the facilities and expertise they need in moving to higher speed services. One of the first P-CLECs, Covad Communications Co., is offering services directly to corporate customers and to ISPs using its own DSL platform in conjunction with leased lines from PacBell.

Covad, with investment support from venture capital firms and Intel Corp., is offering IDSL at 144 kbps in each direction, as well as two versions of higher speed symmetrical DSL at 384 kbps and 1.1 Mbps, and a 1.5 Mbps/384 kbps asymmetrical service, says Lou Pelosi, director of marketing at the CLEC. "IDSL gives us the opportunity to offer a higher speed service over the 30 percent or so of the lines that are too long to support the high-speed rates," he notes.

The company's flat monthly rates are $90 and $125 for the lower-speed symmetrical services, and $195 for the higher speed symmetrical and asymmetrical services. The price is the same for ISPs as it is for direct corporate customers of the CLEC. "With ISPs, we supply the platform and install the line as a supplier of second-tier support, leaving ownership of the customer and first-tier support to them," Pelosi says.

Covad is supplying modems for the IDSL service from Cisco Systems and Pulsecom Corp. at about $250 per unit, while the higher speed modems, from Diamond Lane Communications, sell for $550. The firm will consider higher speed options as the technology evolves but is satisfied with these performance and price levels at this point, Pelosi says, acknowledging that equipment and monthly prices now are well above the levels that will support a mass-consumer market product.

The high cost disparity between DSL and cable data on the residential side could soon disappear

Covad, currently passing about 400,000 households and small business locations in the Bay area, has already negotiated or is negotiating interconnection agreements with telcos in a number of regions around the country, with plans to expand to a number of additional states in '98, Pelosi says. "ADSL is proving to be a cost-effective technology that will allow us to move quickly to widescale service offerings," he adds.

Covad calculates its costs with regard to arranging interconnection agreements and setting up its equipment "cage" at the central office come to about $5 per household across the 30,000-40,000 households served from the typical CO. Beyond that, the costs of provisioning are covered on a pay-as-you-go basis as modems and second lines are installed to accommodate each new customer, Pelosi notes.

Ambitious plan

As long as DSL services are based on economic models that have a high-priced facilities piece as well as a service provision piece in the monthly rate, the primary competitive impact where cable is concerned will be in the pursuit of the small office and work-at-home markets. But, if the aggressive pricing and expansion plans put into play by Ameritech are any indication, the high-cost disparity

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between DSL and cable data on the residential side could soon disappear.

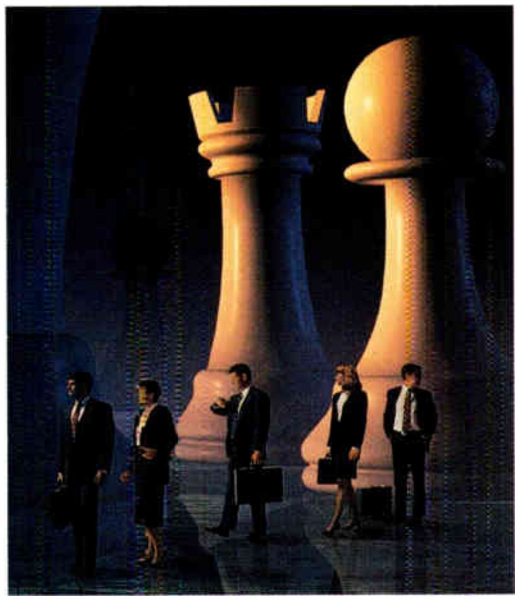
Ameritech's cautious, low-key rollout in Ann Arbor is the beginning of what officials promise will rapidly become a widescale offering, reaching Chicago by mid-'98 and extending to 70 percent of all Ameritech customers within three years. It is by far the most ambitious plan for use of DSL technology yet announced in the telephone industry.

"We're targeting early adopters right now, but we see this as a mass market product and have priced it accordingly," says Steve Rawls, product manager for high-speed access at Ameritech Interactive Media Services. The monthly rate for 1.5 Mbps/128 kbps asymmetrical service through '98 will be $49.95, going to $59.95 later, with installation at $150 and the modem, priced at $199, offered at no charge in '98.

Ameritech is using gear spec'd to deliver data at 6 to 8 Mbps, leaving it a significant margin for improvement in service once it determines what the real-world parameters are at 1.5 Mbps. "DSL can't reach everyone," Rawls says, noting that marketing is limited to mail drops and phone calls that target individuals well within the distance reach of the technology. "We expect further enhancements to DSL technology will eliminate many of these concerns as we proceed," he adds.

These more robust systems improve coverage by raising the number of line coils and bridge taps that can be tolerated on any one line and by doing a better job of combatting line noise known as "near cross talk," which occurs when too many lines within the same wire bundle are operating at the high modulation levels, says Steve Makgill, director of ADSL product management at Alcatel. "One of the reasons the industry chose DMT (discrete multitone modulation) as a standard is that it offers superior performance against things like cross talk and noise impediments created by bridge taps (points of line extension into newbuild areas)," he adds.

The next generation gear also puts DSL in reach of customers served from digital loop carriers, which are the high-speed connections from COs to remote terminals serving new growth areas that would otherwise be out of reach of the CO. The new systems use "DSLAMs," which are DSL access multiplexers that take the multiline high bit rate signal directly from the digital loop carrier, avoiding the need for installing DSL modems on individual lines at the remote terminal. Makgill contends that DSLAMs, by extending DSL into areas served by newer lines, will improve the overall



Makgill contends that DSLAMs will improve the overall coverage ratio to something on the order of 90 percent

coverage ratio to something on the order of 90 percent.

DSL detractors often cite high modem costs as intrinsic long-term barriers to mass market deployment, especially as compared to the fast-dropping cost curve for cable modems, which are now selling at or just under $300 per unit in large quantities. @Home Network, for instance, in a recent document listing the drawbacks to DSL, puts the cost of DSL modems, two of which are required per line, at between $500 and $2,000 each.

However, says Westell's Mark Zionts, even the low end of that spectrum "is way too high." "Our financial reports show we shipped 5,000 lines over the past year with revenues of $4 million, which translates to $800 per (end-to-end) system," he says. "Next year, we're talking more about $500 end-to-end."

While Rawls acknowledges that Ameritech's post-'98 modem charge of $199 is below cost, he says it's close enough to the anticipated volume deployment benchmark to be sustainable as the carrier rolls out its major markets over the next two years. "We think this is a realistic price point to get started at, given we want to reach the mass consumer market," he says.

One of the most significant advances in DSL technology concerns efforts to make installation easier, starting with the aforementioned splitting of the DSL signal from the POTS line at the customer premises for delivery over a separate inside wire to the PC, which overcomes the home wiring problem. Equally important is the progress being made in development of installation software, led by the efforts of Microsoft Corp. in conjunction with its year-long test of DSL with GTE around Redmond, Wash., where about 1,000 users are now connected to 1.5 Mbps service.

Microsoft is "doing several things to foster a plug-and-play capability for ADSL modems," says Bill Anderson, director of marketing for Microsoft's Internet customers unit. Along with working with GTE, which is providing service over CAP (carrierless amplitude phase) modulated systems, the company has entered into a software development agreement with Ameritech, which is using gear based on DMT (discrete multitone) modulation. The software will allow users to configure their PCs for DSL by simply clicking onto an icon to be supplied with future versions of Microsoft's operating systems, Anderson says.

While the multiplicity of DSL systems complicates matters, he adds, Microsoft is

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"figuring out how to abstract as much as possible above the network interface" to achieve plug-and-play capability across multiple systems, much as it did in creating a printer interface for its operating systems that works with many different types of printers. The company is also working with PC manufacturers to foster DSL connectivity, Anderson says.

Ameritech, too, is working with various hardware manufacturers to make PCs DSL compatible, Rawls says, suggesting that DSL modem-equipped PCs could be in retail stores by Christmas of '98. Retail availability of DSL-ready PCs "could very well occur" by next Christmas, Anderson agrees.

Regulatory issues

Beyond technical issues, a factor slowing DSL has been telcos' concern over regulatory issues, where pricing a consumer-level service at 1.5 Mbps or higher speeds is complicated by efforts to maintain high prices for 1.5 Mbps T-1 commercial lines, and where deregulation threatens to force telcos to make DSL lines available to competitors.

Ameritech is biting the bullet on this issue by offering DSL through its unregulated ISP (Internet service provider) subsidiary, while making the platform available to all ISPs, Rawls says.

"High-speed access is the future of the Internet," Rawls adds. "Our intention is to distinguish our service by making it enjoyable to use, with full customer support available through an 800-number 24 hours a day."

None of this suggests the telcos are in a position to roll out DSL like sliced bread, but it is clear that they are moving into that interim stage of graduated deployments well known to the cable industry in its early going with high-speed services. "The telcos are starting to make DSL move now," Anderson says. "Over the last three months, we've seen a real spirited interest taking shape throughout the industry." ■

About the author

Fred Dawson is a regular contributor to Multichannel News and other industry publications and publishes the monthly newsletter "Broadband Commerce and Technology." He is also a long-time, regular contributor to CED and is principal of Dawson Communications.

Adding tools to the fiber toolbox

Exploring options for future-proofing networks

By Jeffrey R. Jacobs, Patrick C. Brown, Dan O. Harris, Corning Incorporated

Cable television networks in the U.S. have evolved from an all-coaxial cable plant to today's hybrid fiber/coax (HFC) networks. These networks are still evolving, and new optical fibers, optoelectronics and architectures optimized for transmission at 1550 nm are widening the options available to today's network planner. These advanced networks allow for longer transmission distances with lower dispersion, and provide the ideal medium for delivery of advanced interactive services. This article gives an overview of the use of optical fiber technology for cable television delivery, and explores leading-edge technology options for future-proof, two-way, state-of-the-art networks.

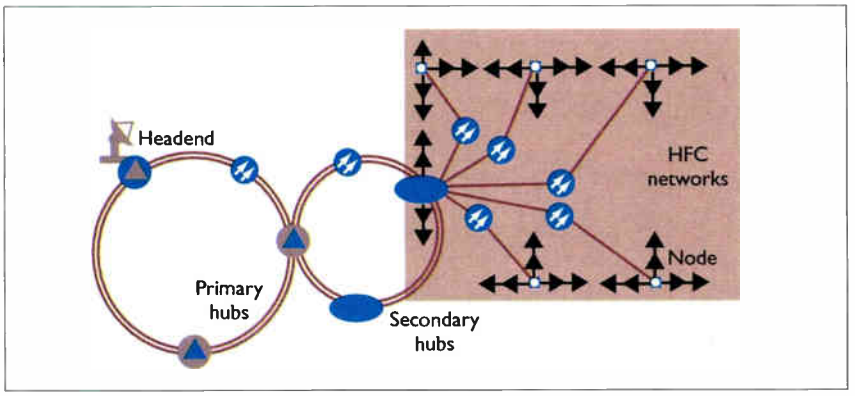

Figure 1: Regional networks are used to reduce costs by consolidating video modulation and public network interconnections at central locations. HFC access networks reduce the number of RF amplifiers in cascade.

Architecture evolution

Cable television networks in the U.S. have been historically based on the "tree-and-branch" coaxial architecture, where analog signals are collected at a headend, demodulated, then amplitude modulated onto various carrier frequencies for transmission. Although the coaxial medium can support two-way transmission at bandwidths in excess of 1 GHz, long cascades of 20 to 40 RF amplifiers produce noise and distortion that ultimately limit either the reach of the system or the number of usable channels to a functionally equivalent bandwidth of approximately 200 MHz to 300 MHz. Furthermore, long cascades of RF amplifiers reduce system reliability, degrade transmission quality and require more scheduled maintenance [1].

In the late 1980s, pioneering work by engineers at ATC Inc. (now Time Warner Cable) allowed conventional tree-and-branch networks to be upgraded with fiber into "hybrid fiber/coaxial" (HFC) networks. In the typical HFC network, the amplitude modulated vestigial sideband (AM-VSB) signal is transmitted from a headend or hub via optical fiber to a node serving about 500 homes. There typically are no more than three or four RF amplifiers in any coaxial branch. Given the high bandwidth, reliability and excellent signal quality of the fiber link, these systems cost-effectively provide 550 MHz to 1 GHz of bandwidth to a small group of end users with better signal quality and less maintenance than the tree-and-branch network.

Dual-ring-star "regional networks" (see Figure 1) are now being adopted by most major multiple system operators (MSOs). Regional networks allow maximum sharing of expensive resources, like satellite receiving stations, RF modulators and Internet routers. Typically, digitized analog video, digital telephone and data traffic are transmitted in a baseband format–Sonet or proprietary–over fiber to all the primary hubs in the upper ring. There, the digital video is converted to AM-VSB format, and in some cases, digital data is subcarrier modulated and combined with the video for transmission on fiber down to the secondary hubs. There may also be baseband data transmission between primary and secondary hubs.

The HFC portion of the network begins at the secondary hub. Remaining baseband data is subcarrier multiplexed for transmission with AM-VSB video on a single fiber down to the node. For two-way applications, subcarrier multiplexed data is sent up to the secondary hub from the node. Depending on the architecture, this data may be converted to baseband for transmission back to the primary hub.

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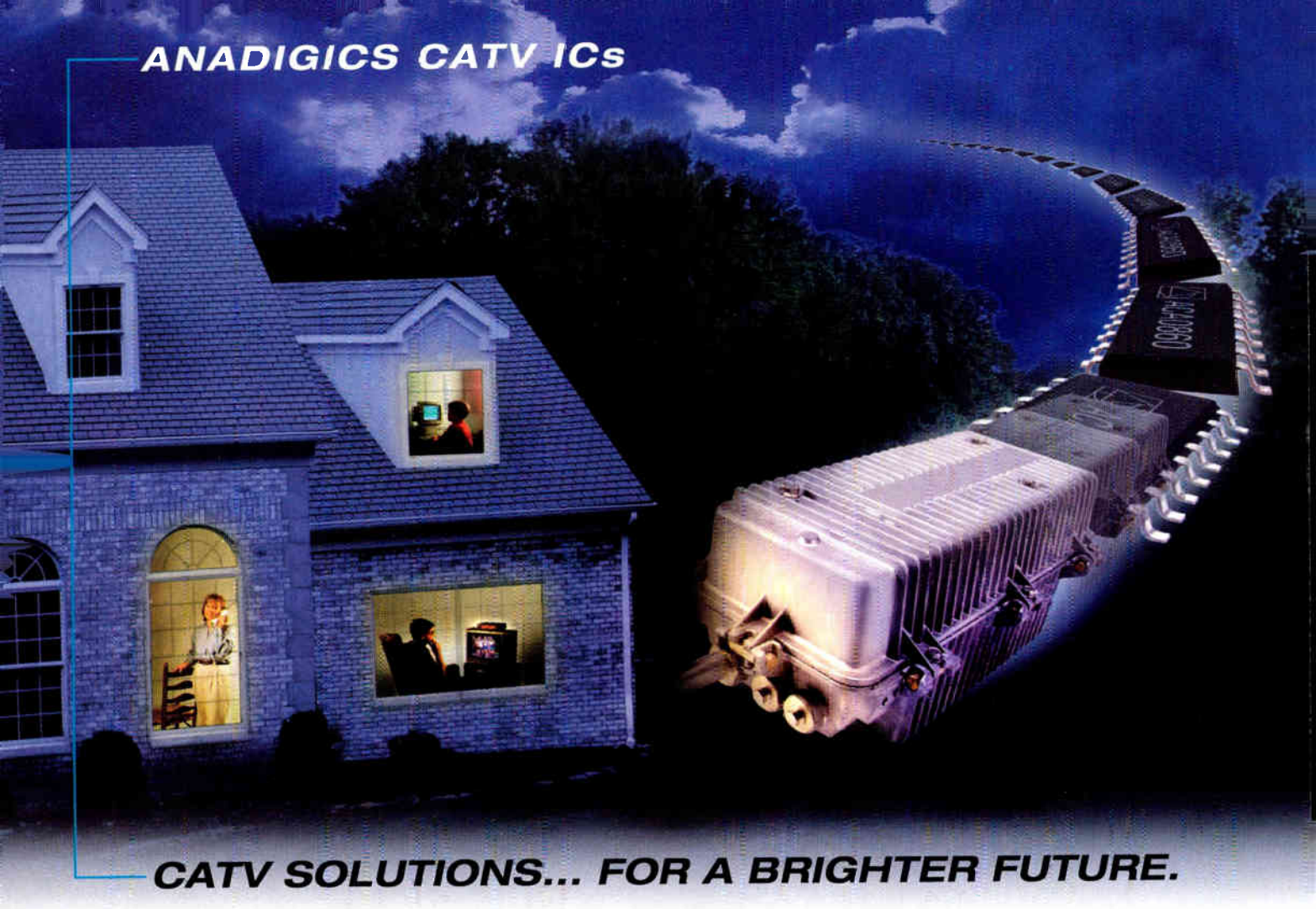

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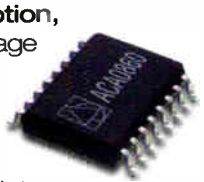

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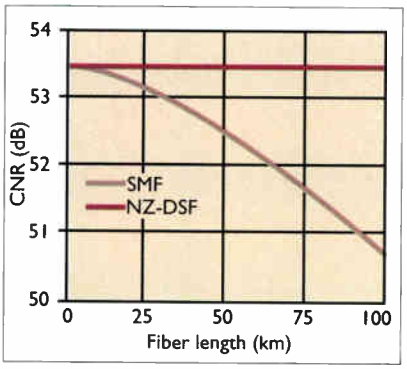

Figure 2: LPN degradation to channel 77 CNR for a 1 MHz linewidth, externally-modulated 1550 nm DFB laser. Laser phase fluctuations interact with dispersion to create significant noise.

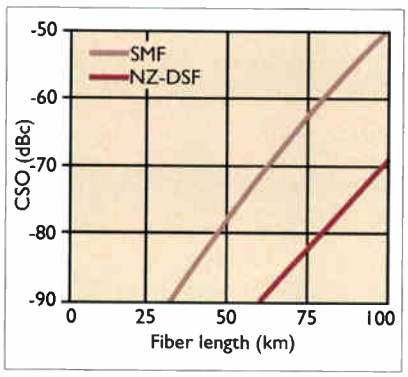

Figure 3: SPM degradation to channel 77 CSO for an externally-modulated, 1550 nm DFB laser; input power is sufficient to maintain 0 dBm at the receiver. SPM creates unacceptably high CSO in SMF systems.

The move to 1550

The standard singlemode optical fiber (SMF) used in HFC networks has a natural low dispersion point–less than 3 ps/(nm*km)–around 1310 nm and a typical attenuation of 0.35 dB/km. Although the attenuation at 1550 nm is lower–typically 0.2 dB/km–the dispersion is higher at this wavelength. Historically, most HFC networks have been deployed using SMF, and transmitters and other component technologies have been optimized for the low-dispersion 1310 nm window. But transmission distance requirements continue to increase, and more power-efficient solutions must be found to achieve performance requirements.

Today's typical requirements for carrier-to-noise ratios (CNR) at the fiber node are on the order of 50 dB, while second- and third-order distortion levels (CSO and CTB, respectively) must be 65 dB below the carrier. And because AM-VSB transmission is very sensitive to signal degradation, solutions with lower attenuation than that provided by 1310 nm technology had to be found. Because of its lower attenuation, transmission in the 1550 nm window was a natural solution, but because of the higher dispersion at this wavelength, more work had to be done.

Now, advanced fiber products such as dispersion-shifted fibers (DSF) and newer, non-zero dispersion-shifted fibers (NZ-DSF), have the zero-dispersion wavelength shifted up to the lower attenuation point near 1550 nm. These fibers allow network designers more flexibility as 1550 nm technologies are beginning to make their way into cable TV networks.

Erbium-doped fiber amplifiers (EDFAs) are another advance that is beginning to be accepted as a practical 1550 nm cable TV technology. EDFAs are being deployed as part of the 1550 nm transmitter, and some are being used "in-line" to boost a signal mid-span. They are especially good for AM-VSB transmission in the 1550 nm window, because they are efficient, do not add much noise, and are practically distortion-free [2]. Amplifiers for the 1310 nm window are still in development, but will need to be twice as efficient or half as expensive as EDFAs, because they must compensate for almost twice the attenuation of the 1550 nm window.

Transmission at 1550 nm has its challenges. Externally-modulated 1550 nm transmitters typically have a narrower linewidth, one ramification of which is the onset of a fiber nonlinearity known as stimulated Brillouin scattering (SBS). At high transmitter output powers, SBS creates unacceptable levels of noise and distortion. For an externally-modulated 1550 transmitter amplified with an EDFA, typical output power is about 17 dBm. For the compact linewidth of externally-modulated transmitters, SBS sets in at about 10 dBm, placing an artificial limit on transmitter power and, in turn, transmission distance. Therefore, SBS suppression circuitry is usually required. This works extremely well, but adds cost and complexity to the transmitter. SBS is not a problem for directly modulated (DM) transmitters because chirp sufficiently spreads the laser spectrum to suppress SBS at the maximum output power levels available today.

For 1550 nm transmission on SMF, random fluctuations in the externally-modulated distributed feedback (DFB) laser's output wavelength can interact with dispersion to produce laser phase-to-intensity noise (LPN) [3]. This

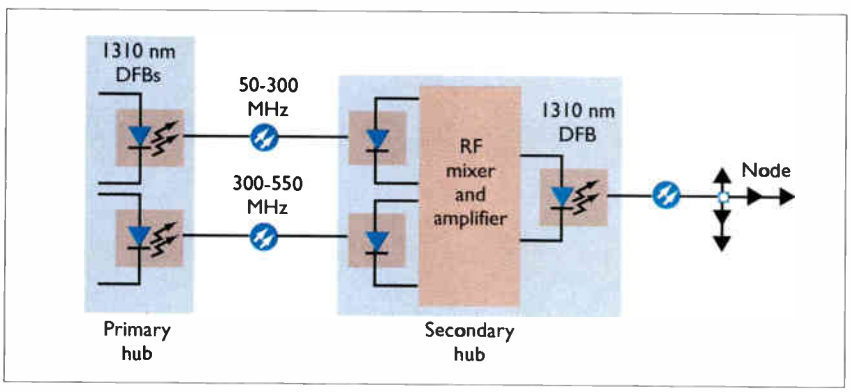

Figure 4: A 1310 nm splitband system used to transport AM-VSB from a primary to secondary hub. The subsplit is required because composite distortion for two cascaded 550 MHz, 1310 nm DFB systems is unacceptably high.

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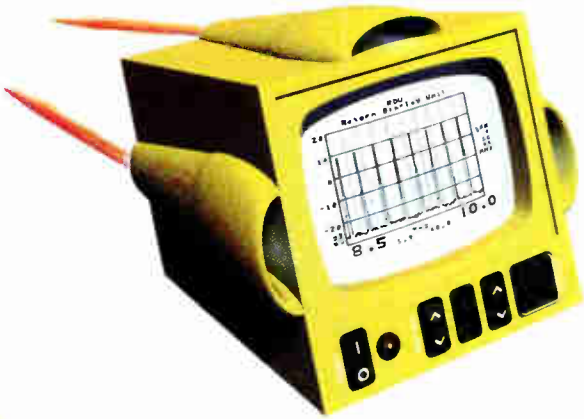

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The RDU is a new piece of test equipment. It allows technicians to monitor the return system from any point in the cable system without the traditional and cumbersome HE spectrum analyzer / camera setup.

The RDU allows system installers and technicians to view on any TV screen, the RF Levels, Ingress and Noise present back at the HE from a subscriber's home, system amplifier, feeder tap or fiber node.

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The RDU displays HE return levels on two user selectable test carrier frequencies in the 4-44 mhz. bandwidth. Test carriers and ingress / noise levels can be easily documented from every installation and service call. Simple and easy to implement.

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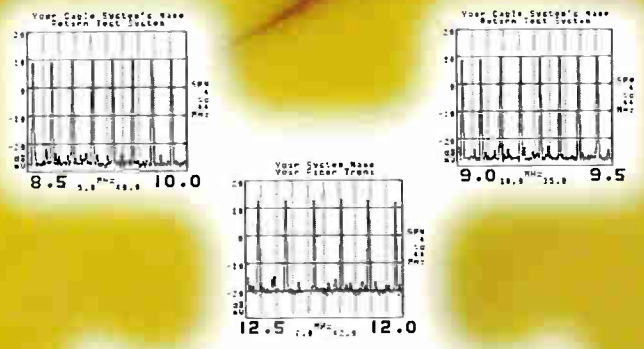

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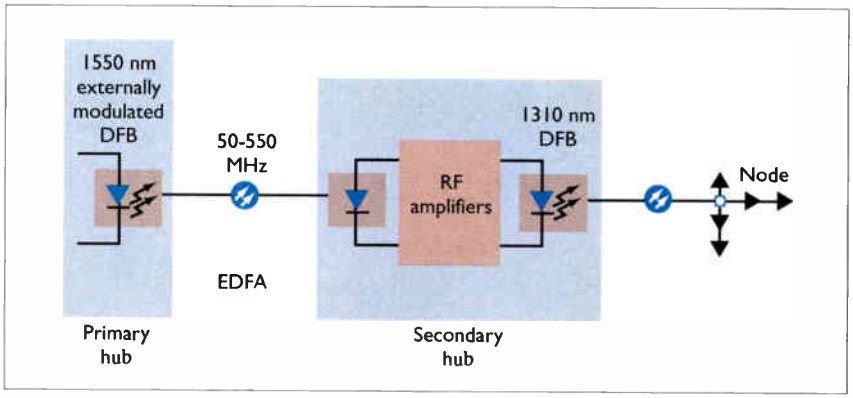


Figure 5: A high-quality, 1550 nm externally-modulated DFB can be used to transmit AM-VSB video from the primary to secondary hub so that the splitband system of Figure 4 is not necessary. 1550 nm technology is cost-comparable with 1310 nm DFB technology in this application, and can also be used to extend system reach.

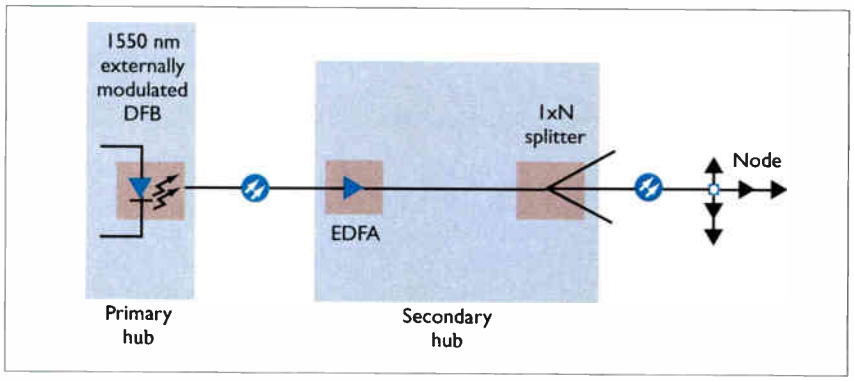


Figure 6: When a 1550 nm externally-modulated DFB is used to transmit AM-VSB video to the secondary hub, the operator has the option of amplifying the signal at the secondary hub with an EDFA for distribution to the nodes.

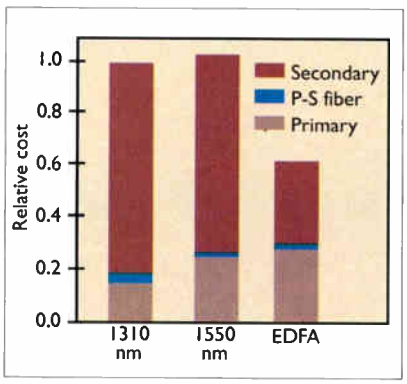


Figure 7: Relative differential cost comparison for AM-VSB transport from primary hub to 40 nodes using architectures shown in Figures 4 (1310 nm), 5 (1550 nm), and 6 (EDFA). The system using an EDFA to amplify the AM-VSB signal at the secondary hub proves to be least-cost.

affects CNR significantly at higher RF frequencies and increases with transmission distance, as illustrated in Figure 2. Because LPN is caused by the interaction with dispersion, it can be reduced by electronic or passive dispersion compensation techniques, or eliminated through the use of zero or low dispersion fibers such as NZ-DSF.

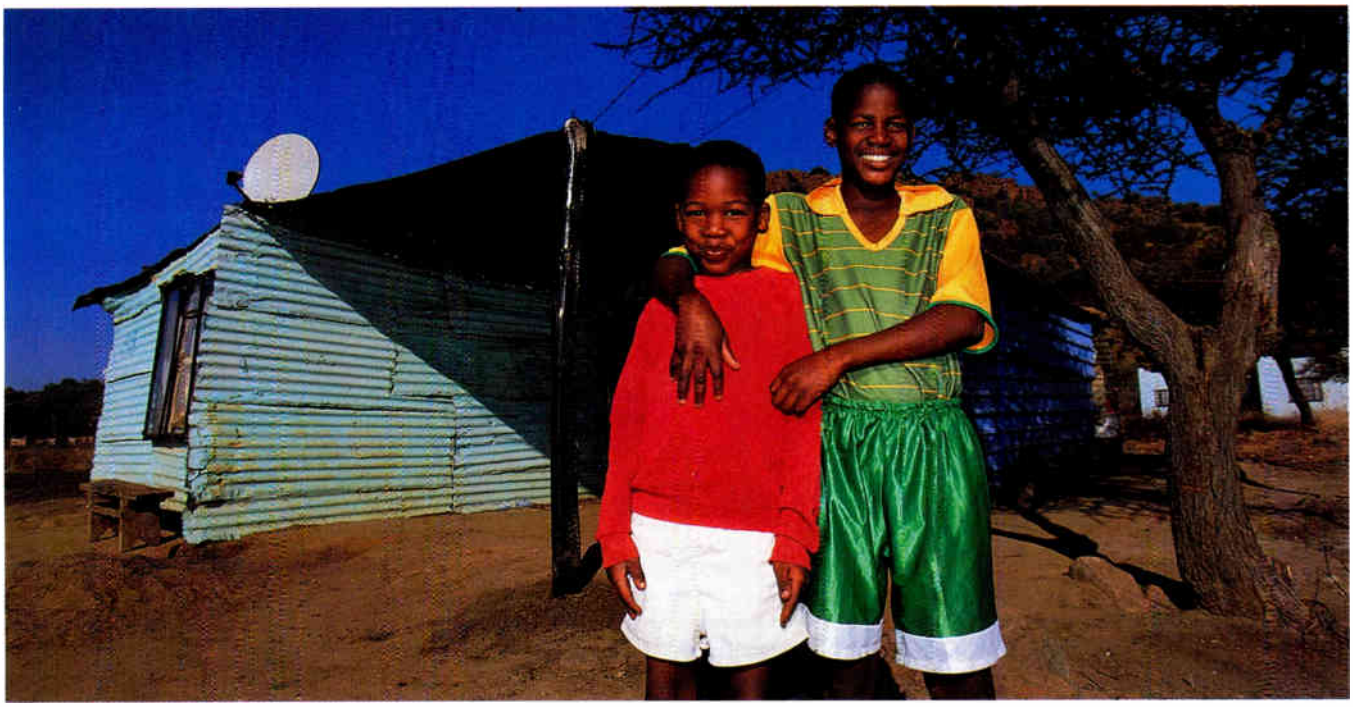
Self-phase modulation (SPM) may also appear when transmitting at 1550 nm on SMF. Here, high optical power creates a chirping effect that interacts with dispersion, creating CSO [4], [3]. SPM is not significant unless fiber span lengths are extremely long (see Figure 3). Like LPN, SPM can be reduced by electronic or passive dispersion compensation, or with NZ-DSF.

Options for cable TV applications

- **1310 nm DFB technology.** While 1310 nm DFB technology is ubiquitous in the HFC portion of the network, it has not been readily adopted for transmission of a full 80-channel AM-VSB payload from the primary to the secondary hub. Two main reasons for this are: 1) distances between primary and secondary hubs often exceed the 1310 nm DFB limitation of 20 to 30 km; and 2) cascaded DM-DFB systems will not meet system distortion requirements. When 1310 nm DFBs are used, a splitband system (see Figure 4) is usually required. Here, CNR, CSO and CTB are improved by dividing the channels among several fibers. This adds to the cost of the primary-to-secondary transport, and adds complexity to the signal processing at the secondary hub.

- **1550 nm externally-modulated DFB.** An alternative approach is to replace the 1310 nm DFB links between the primary and secondary hubs with a single 1550 nm externally-modulated DFB link (see Figure 5). This approach is more robust because the link limit for the 1550 nm system with SMF can exceed 50 km, and the cascade of an externally-modulated system with a 1310 nm DFB exhibits acceptable distortion levels [2]. The 1550 nm link is also cost-competitive with the 1310 nm splitband system. As a result, several of the larger MSOs are beginning to use 1550 nm AM-VSB technology for primary to secondary hub links in their regional networks.

- **EDFAs for AM-VSB distribution at secondary hubs.** Another option considered by MSOs takes 1550 nm technology even deeper into the network [4]. In this configuration, the 1550 nm signal transmitted from the primary hub is amplified with an EDFA and split for distribution to 10 to 20 nodes (see Figure 6). This provides a low-cost means of broadcasting information for applications where a 1310 nm HFC network is not already in place (see Figure 7). Although it does not provide true multicasting capability, this architecture does deliver a



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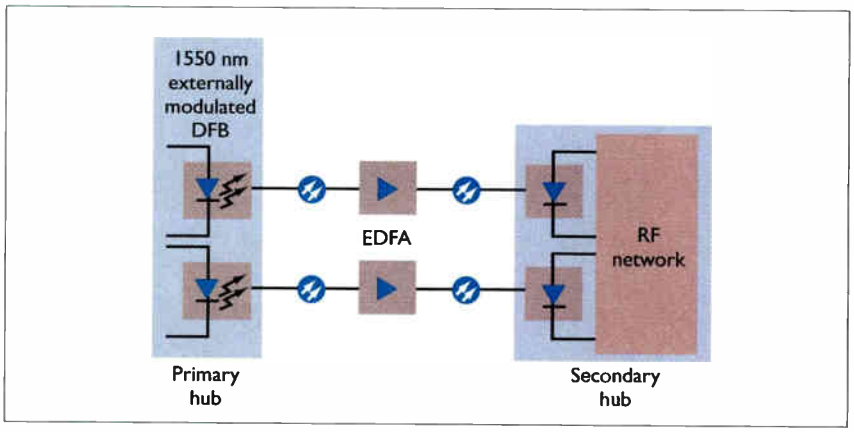

Figure 8: Example of a two-fiber SMF system required for transmission of AM-VSB over distances on the order of 100 km. Splitband or "push-pull" technologies are used in these applications.

unique signal to clusters of nodes, which could be sufficient for interactive data for quite some time.

• **AM-VSB transmission over long distances.** As MSOs consolidate headends and build regional networks, distances over which video must be transported continue to increase. In fact, applications exist today that call for transporting video over distances in excess of 70 to 100 km. Until recently, the only means available to transport video over such distances was via baseband digital format. Recent advances in transmission electronics and the use of NZ-DSF have made it possible to transmit 80 channels of AM-VSB video over these extended distances.

Signal corruption from effects like SPM and LPN makes standard 1550 nm SMF performance unacceptable for distances approaching 100 km. As a result, splitband transmission or the use of a two-fiber "push-pull" system is required with SMF [5] (see Figure 8). When NZ-DSF is employed, noise and distortion are reduced to the point that single fiber systems may be acceptable. Figure 9 illustrates the considerably lower differential cost of the single fiber system, and also shows that if two parallel NZ-DSF systems are deployed, push-pull technology can provide better performance than the NZ-DSF system alone, and provide true redundancy for improved system reliability, all at a relatively small cost premium.

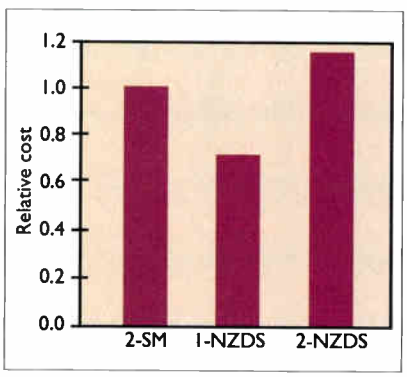

Figure 9: Relative differential cost for 1550 nm transport of AM-VSB over 100 km for three architectures: two-fiber push-pull using SMF, single fiber using NZ-DSF, and two-fiber push-pull using NZ-DSF. The single fiber system is the least-cost, while the two-fiber NZ-DSF system is not much more expensive than its SMF counterpart and provides the best performance, as well as improved reliability from true redundancy.

Conclusion

Fiber is now used in virtually every segment of cable TV plant, and provides the basis for increasingly sophisticated networks. The workhorse fiber technology in cable TV systems is standard single-mode fiber. As networks continue to be consolidated and complexity increases, newer fibers optimized for use with 1550 nm technology are beginning to be used.

Cable TV is a prime example of a communications industry segment that has successfully exploited the capabilities of optical fiber. Through aggressive fiber deployment, MSOs now own extremely reliable, state-of-the-art, high-capacity interactive networks that are the most capable of any in the telecommunications industry. As a result, cable TV operators are now in a position to take advantage of a wide array of emerging revenue-producing video, voice and data services. ■

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About the authors

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HFC: The 'Ethernet' of broadband

What broadband designers can learn from the history of LANs

By Scott C. Chandler, C-COR Electronics Inc.

At this moment, throughout the world, there are thousands of network engineers who are designing the broadband network of the future for their company. The type of telecom company they are with (e.g. domestic cable operator, international, telephone company) heavily influences the key drivers used in making this network decision. Table 1 shows the major drivers.

Network decision-makers face a blizzard of technology options to satisfy their needs. Switched digital video (SDV), digital subscriber loop (xDSL), fiber-to-the-curb (FTTC) and hybrid fiber/coax (HFC) all appear to be viable architectures. Each one of these technologies claims to fulfill the requirements outlined above. The key question is, which technology is the right one to recommend that your company use to provide robust and cost-effective services to your customers?

Network decision-maker	Major drivers
Cable TV (existing network in place)	• More bandwidth (more TV channels) • 2-way (high-speed data, telephony, etc.)
Phone company (existing network in place)	• Shared platform for new services (cable TV, high-speed data) • Reduce operational costs of providing telephony (local and long distance)
International (no network in place)	• Best new architecture for cable TV, telephony and high-speed data

Table 1: Drivers by market

One tool to help in this decision-making process is to look back in time. The adage that "history repeats itself" can be useful in gathering data to assist in the decision process. This method can help reduce the complexity of the decision and provide case studies to understand key attributes for success. The following comparison will look back to the technology decisions that engineers and designers of local area networks (LANs) were forced to make in the early '90s. Perhaps you will be surprised at many of these similarities between what they faced, and what broadband engineers face today.

LAN market (circa 1990)

The LAN market in the early 1990s could be described as "poised for explosive growth." At that time, internetworking, or the Internet, as we know it today, was just starting as an industry. LANs began sprouting up, primarily in large businesses. The key driver was the deployment of laser printers in departments of these large businesses. The laser printers were a quantum improvement in price and performance over dedicated "tractor feed" printers that were part and parcel to the first generation PCs of the late '80s. However, the laser printers were too costly to attach to each personal computer. Companies like Novell and others invented special software (network operating system–NOS) that would allow multiple computers to communicate with a shared peripheral (e.g. printer, etc.) over a shared medium, or network.

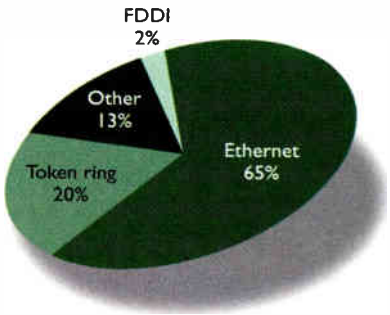

Figure 1: LAN market share (early 1990s). Source: Analyst reports/ company estimates.

The key decision these LAN network engineers had to make was, what is the best LAN technology to use? Similar to the broadband engineer of today, the LAN engineer faced a plethora of options. Ethernet, Token Ring, Arcnet, and Fiber Distributed Data Interface (FDDI) were only a few of the options available. Other LAN technologies such as Asynchronous Transfer Mode (ATM) were still in the discussion phase and lurked as potential future substitutes.

Each of these technologies had its own story as to why it was the greatest. Ethernet argued they were the first, the biggest and the most established. Token Ring argued they were the "bluest" (IBM invented the Token Ring protocol) and the most efficient. FDDI argued that they were the best for the needs of the future (FDDI started at 100 Mbps). Figure 1 shows the market share of each of these

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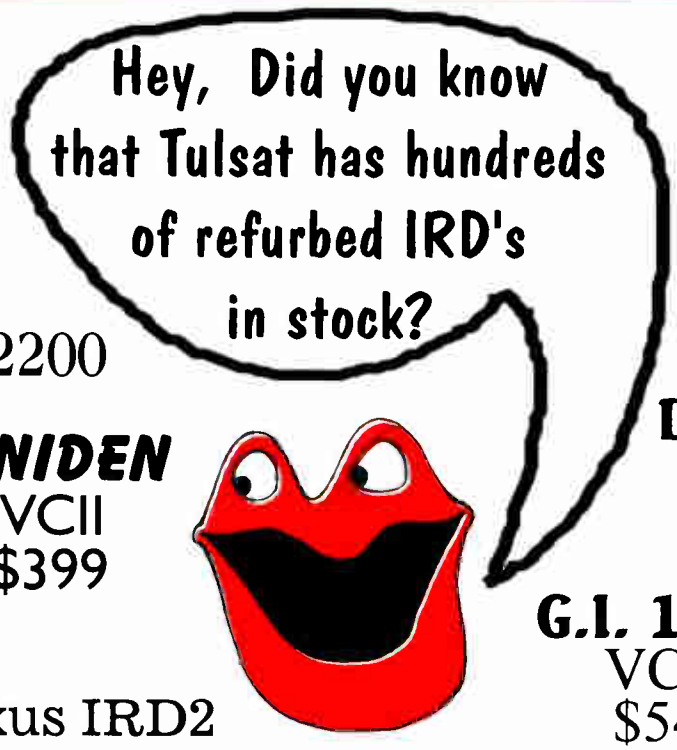

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LAN technologies in the early '90s.

Seven years later, the LAN market has changed dramatically, with LANs in almost every business in the U.S., and implementation taking place rapidly throughout the rest of the world. It has become one of the largest segments in the communications industry. Annual revenues have increased from $6.7 billion to $10 billion-plus, with an annual growth rate over this period of 20-plus percent. Figure 2 shows that Ethernet continued its domination as the technology of choice during the 1990s.

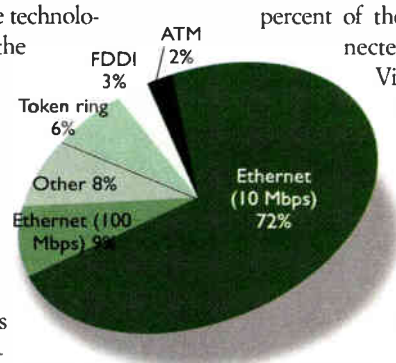

Figure 2: LAN market share (1997)
Source: KMI Corporation (1997)

This continued market domination is even more impressive when factored with the huge increase in bandwidth that occurred during this period. This increase explains why these newer, higher-bandwidth, non-Ethernet solutions were created in the early '90s.

Ethernet became the technology of choice for next-generation LANs because it satisfied the major needs of its customers. These needs can be summarized as follows: strong vendor support; large existing market share; established product in the field; scalability for additional bandwidth; and price/performance.

Applying the model to broadband

The remainder of this article will address the key reasons why Ethernet won its "technology war" and apply them to the broadband technology decisions that engineers face today. Each of these technology options today will be analyzed based on the success factors of Ethernet.

Strong vendor support. Like Ethernet, HFC enjoys support from a broad range of vendors, including Motorola, Philips, Siemens, Lucent, NEC and Pioneer. Unlike Ethernet, HFC also enjoys the support of vendors who have been in the HFC business for more than 15 years, such as C-COR Electronics, NextLevel, Augat, Anixter and Scientific-Atlanta. HFC vendor support is also international; in addition to the multinationals listed, there are numerous international vendors, including Aichi, Teleste, Fuba and Katrein. In fact, the total global HFC market for 1997 alone is projected to be in excess of $2-3 billion.

Large existing market share/established product in the field. More than 90 percent of homes in North America are passed by cable. In the U.S., more than 70 percent of the homes passed are connected to an HFC system. Virtually all international broadband networks are utilizing HFC. Figure 3 shows a comparison of installed base by broadband technology.

HFC backbone products have been in the field for more than 15 years. HFC modem technologies have been in the field for more than 20 years. HFC modems have been used in set-tops and in point-to-point RF modems, as well as Ethernet modems. In fact, Ethernet was the winner of the RF portion of the LAN battle of the late '80s. The technology to deliver multimedia to the home is an adaptation of these technologies and is already deployed.

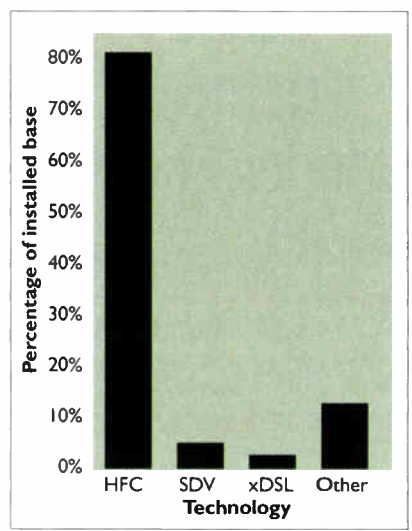

Figure 3: Estimated installed base of broadband technologies. Source: Analyst reports/company estimates

Scalability

HFC's wide bandwidth and its ability to be segmented allows additional scaling of services. The bandwidth is divided up into channels (typically 6 MHz wide in North America) and subchannels. Once the delivery technology's (e.g. Ethernet) limit has been reached on one subchannel, then another can be used. Once the total reverse capacity is used up, a simple fiber upgrade to the existing plant allows capacity re-use by segmenting the system into smaller customer units.

Because the HFC system is wideband, it can take advantage of newer technology without the need to replace its backbone technology. An example of this is the addition of digital compression to increase channel capacity within existing cable TV systems. This means that HFC's cost-effectiveness can be increased. New services and/or increased capacity can be added to an HFC system on an incremental basis, limiting the capital exposure.

HFC has been a cost-effective delivery technology throughout the '90s. It has been cost-justified just on the delivery of entertainment video alone. The cost to add multimedia services is relatively low, with the primary incremental cost comprised of the network interface units (NIU, cable modem), making it extremely price/performance competitive.

Summary

Many technology options have been, and will continue to be, developed that can be used by broadband network operators. If the history of a similar high growth industry (local area networks) is an accurate predictor of the future, HFC is uniquely positioned to continue its dominance to date as the broadband technology of choice. ■

About the author

Scott Chandler is president and CEO of C-COR Electronics.

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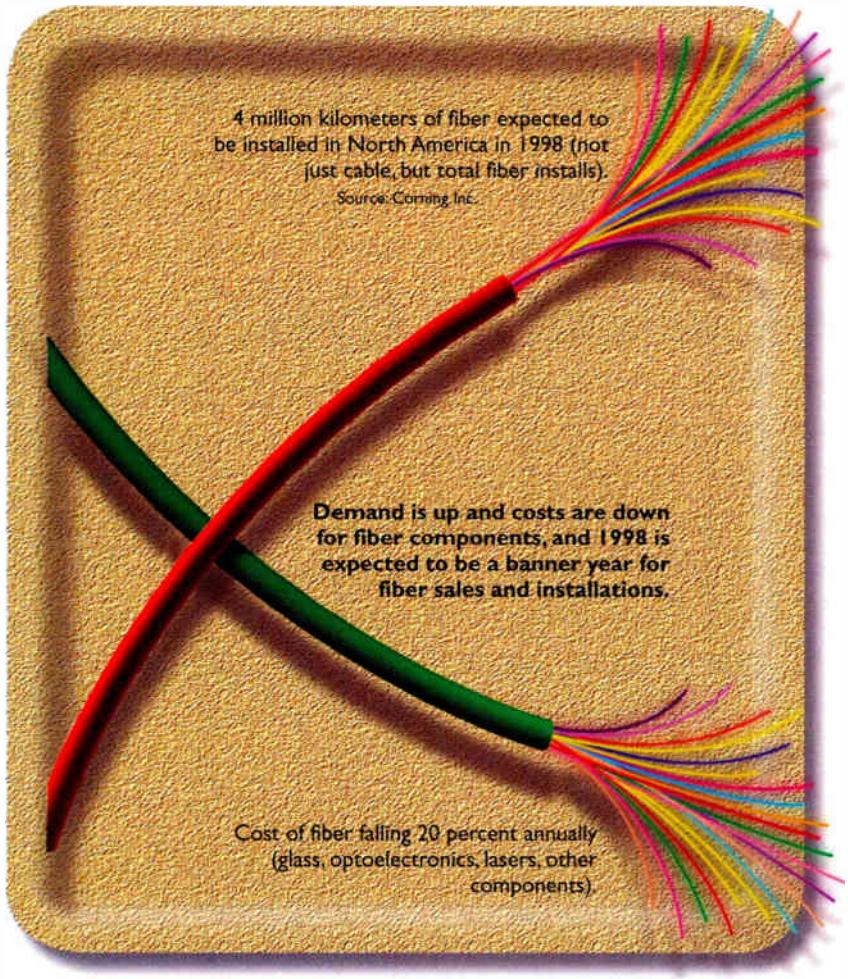
The economies of fiber

Fiber economics have leveled the playing field and added players



BY CRAIG KUHL

The economics of fiber optics, from the earliest manufacturing stages to the last mile of installation, are enabling cable operators of all sizes to not only re-shape and re-energize their operations, but re-define their businesses, strand by strand.

Today's economic and cost-friendly fiber has been dropping in price across the board each of the past three years, allowing even the smallest and most capital access-challenged operators the opportunity to upgrade their plant to greater reliability and performance. But even more appealing to operators is a chance to use fiber to enter uncharted revenue waters such as high-speed data, Internet, HITS (Headend In The Sky) and more yet to come.

Lasers, transmitters, receivers and even the fiber's core product, glass, have steadily dropped in price, and are expected to drop even more, making the economics of fiber that much more appealing. Most cable operators are now convinced that fiber, at the end of the day, is in many cases less expensive to buy and install than coax, yet has expanded the operators' revenue universe significantly.

Fiber's friendly economics and eventual payoffs have elevated it to near "no-brainer" status when it comes to installing the fiber plant mileage needed to streamline cable plant and in generating new revenues. According to Paul Kagan Associates, in 1996, 105,720 miles of cable TV fiber route were installed; in 1997, that number jumped to 134,370, and in 1998, operators are expected to install 164,760 miles, proving that the economies of fiber remain strong.

"Fiber is an absolute necessity for future networks. We've embraced a 750 MHz platform, and we can't do it without fiber, and as we upgrade all of our networks, fiber is integral to all of them. It is an absolute enabler to two-way service," says Wayne Davis, vice president, technical operations for Jones Intercable.

And new services usually translate to increased revenues. Add the reliability and increased performance benefits inherent with fiber, and the economies of fiber become even more pleasing. Adds Davis, "Fiber is cost-effective to build, and operationally, a no-brainer. What's driving us is the combination of opportunities for new revenue streams, which include improved operational costs. Fiber also enables us to get into new businesses and

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e-mail: cakuhl@compuserve.com

BUSINESS BRIEFS

Belden launches fiber division

RICHMOND, Ind.–Belden Wire & Cable Company has formed a North American Fiber Optic Product Group, dedicated to the development, manufacture and marketing of an expanded line of tight buffer and loose tube fiber optic cables. In forming the new group, Belden has consolidated existing fiber optic cable manufacturing operations from its Tomkinsville, Ky. facility into the former Independent Cable Inc. plant in Charlotte, N.C. In late 1996, Belden acquired the assets of ICI, a specialty wire and cable manufacturer serving the telecom and transportation industries.

To accommodate increased production capacity, Belden plans to build a new fiber optic and specialty cable manufacturing facility in nearby South Carolina. Fiber optic cable manufacturing will also continue in Belden's facility in The Netherlands.

Cox picks Bay gear for Conn.

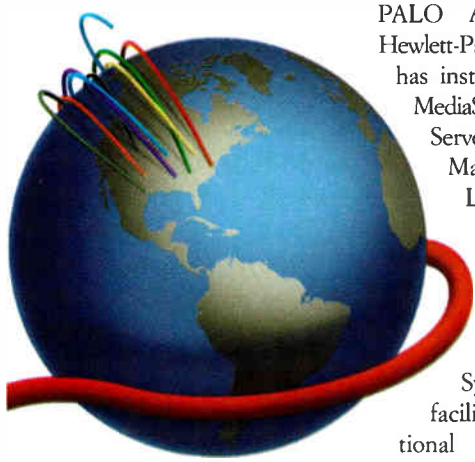
ANDOVER, Mass.–Cox Communications has selected Bay Networks Inc.'s broadband equipment for the delivery of its high-speed Internet access service, Cox@Home, in Meriden, Conn. Cox began deploying the Bay Networks LANcity Personal cable modems in Meriden in August.

". . . Bay offers a reliable and easy-to-deploy solution which provides our customers with high-speed data services and Internet connectivity at speeds significantly faster than typical telephone dial-up modems," said Gary Perelli, vice president and general manager of Cox Communications' New England operations.

Williams expands with Pirelli fiber

LEXINGTON, S.C.–Pirelli Cables and Systems North America is providing fiber optic cable to Williams Network for about 900 miles of an 1,800-mile section of Williams' multimedia fiber optic network, now under construction.

Pirelli's fiber optic cable link is being installed in a segment of the network which runs along Williams' natural gas pipeline right-of-way between Houston and



Washington, D.C.

Williams' multimedia network construction project, combined with other construction efforts and fiber exchange agreements, will add more than 8,000 miles of high-capacity fiber to the entire 11,000-mile network. The network carries Internet and video traffic, live broadcasts of some of the world's largest sporting events, news, entertainment, commercials and syndicated programming.

Pirelli is supplying single-mode fiber cable under a multi-million dollar contract, cable which is designed for maximum compatibility with wavelength division multiplexing and optical amplification technology, says the manufacturer.

Williams' telecommunications division burst onto the national scene in the mid-1980s when it installed fiber optic cable in decommissioned pipelines owned by its parent company.

Aussies install HP servers

PALO ALTO, Calif.–Hewlett-Packard Company has installed eight HP MediaStream Broadcast Servers at the Foxtel Management Pty. Ltd. facility, a digital broadcasting site in Australia and New Zealand. Based in Sydney, the Foxtel facility went operational with the new servers last October and is currently running more than 16 channels to-air.

The installation at Foxtel consists of seven HP MediaStream Broadcast Servers connected via a Fibre Channel network. Each server delivers one input channel and five output channels and will accommodate up to 15 hours of spot and promotional insertion material. This provides Foxtel with the capability for up to 30 on-air channels. Additionally, an eighth HP broadcast server manages spot and promo insertions for the Foxtel music/video channel. All servers are controlled by Louth Automation software.

Daewoo joins Harmonic's modem program

SUNNYVALE, Calif.–Daewoo Electronics Company has joined Harmonic Lightwaves Inc.'s Cable Modem Partnership Program, which offers operators standards-based, end-to-end systems for providing high-speed Internet services to subscribers. The program combines Harmonic's cable TV headend equipment with consumer electronics vendors' modems.

"Daewoo Electronics has invested a substantial amount of resources into development of the MCNS-compliant cable modem business," said Kyu-Hwan Chang, executive director of the company's Advanced Technology Laboratory. "A key element to succeed in that business (is) to ensure interoperability between components of end-to-end systems, and Daewoo is pursing strategic partnerships with such leading vendors as Harmonic Lightwaves, which makes this outlook strong."

Program partners will work with Harmonic to ensure the interoperability of each others' products, to support MCNS and other standards, to promote joint sales opportunities and to participate in joint marketing activities. ■

Ciciora's Corner

Have a comment? Contact Walt by e-mail at: wciciora@aol.com

Standard Could Lead To Protocol Chaos

By Walter S. Ciciora, Ph.D., Recognized Industry Expert On Cable and Consumer Electronics Issues

The decoder interface developed by the Joint Engineering Committee of the NCTA and the Consumer Electronics Manufacturers' Association (CEMA) was partitioned into two "levels," each having two parts. This was done to divide the development work into manageable segments and to clearly delineate the boundary between the minimum necessary to reach the objectives set by Congress and a degree of capability that would provide true consumer satisfaction.

Level One includes the basic elements necessary to meet the 1992 Cable Act, while Level Two is more capable and will accommodate more cable services and after-market "feature boxes." The first part of each level's specification contains the mechanical and electrical details. The second part of each level's specification contains the protocols necessary to make the system work. The two parts of Level One are termed IS-105.1 and IS-105.2, while the corresponding parts of Level Two are IS-105.3 and IS-105.4.

Protocols

In response to demands from the computer industry, the 1996 Telecommunications Act limited the FCC's authority to standardize protocols to only the absolute minimum necessary. This law requires that anything above the minimum be left to the marketplace.

In the case of the protocols for the decoder interface, there is disagreement over what is the absolute minimum necessary.

The decoder interface Committee split the specification of the standard into two levels in order to separate out the minimum and contain it in Level One. Thus, the majority of the committee believes IS-105.2 is the minimum protocol necessary for the decoder interface to work. This is easy to understand. IS-105.1 defines the physical interconnections between TV, VCR, descrambler, and after-market feature boxes. The physical interconnections form a "bus architecture." That is, all units are connected to the same set of wires. Some units "talk," while others "listen." This is the way in which computer peripherals are connected and operate. IS-105.2 tells which unit is a source of signals, and which unit or units is a user (or sink) of signals. Without IS-105.2, there would be chaos. The units wouldn't know who is authorized to talk and who is required to listen on the bus. The standard cannot function without this minimum specification to maintain order.

Because there is disagreement as to what is the minimum protocol, with a minority holding that IS-105.2 goes beyond the minimum, some have suggested that the FCC adopt IS-105.1 as a standard and remain silent on IS-105.2. This would leave IS-105.2 as an industry voluntary standard. While this is a potentially workable political solution, it is important to appreciate that this approach unilaterally places important

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provides a robust network. Ultimately, we'll get a return on our investment."

Those returns will be helped by the falling prices of fiber components. Glass prices have come down, while laser and optoelectronics (transmitters, receivers, amplifiers) costs have dropped an average of 20 percent in each of the past three years, and will continue dropping, according to Paul Connolly, vice president, optoelectronics for Scientific-Atlanta. "Optoelectronics costs are coming down significantly, and the benefit is targeted services. Fiber can play a critical role in take rates and business models. You want to make the investment, but can't make the network burdensome."

Patrick Brown

Bob Jordan

The trend in fiber technology, Connolly says, is for operators to use the cost-savings gained by lower fiber and maintenance costs to push fiber deeper into their networks. Last year, optoelectronics costs dropped 30 percent, yet according to Connolly, the quality of the equipment is actually increasing, fueling the drive by operators to deepen their fiber networks. "The value of the equipment is increasing, and that is what's fueling the drive to deeper fiber into networks. You can narrowcast twice as deep without additional costs. And, as fiber gets closer to the subscriber, it means better performance, flexibility and bandwidth."

John Dahlquist, vice president of marketing for Harmonic Lightwaves, concurs. "Most operators are spending the

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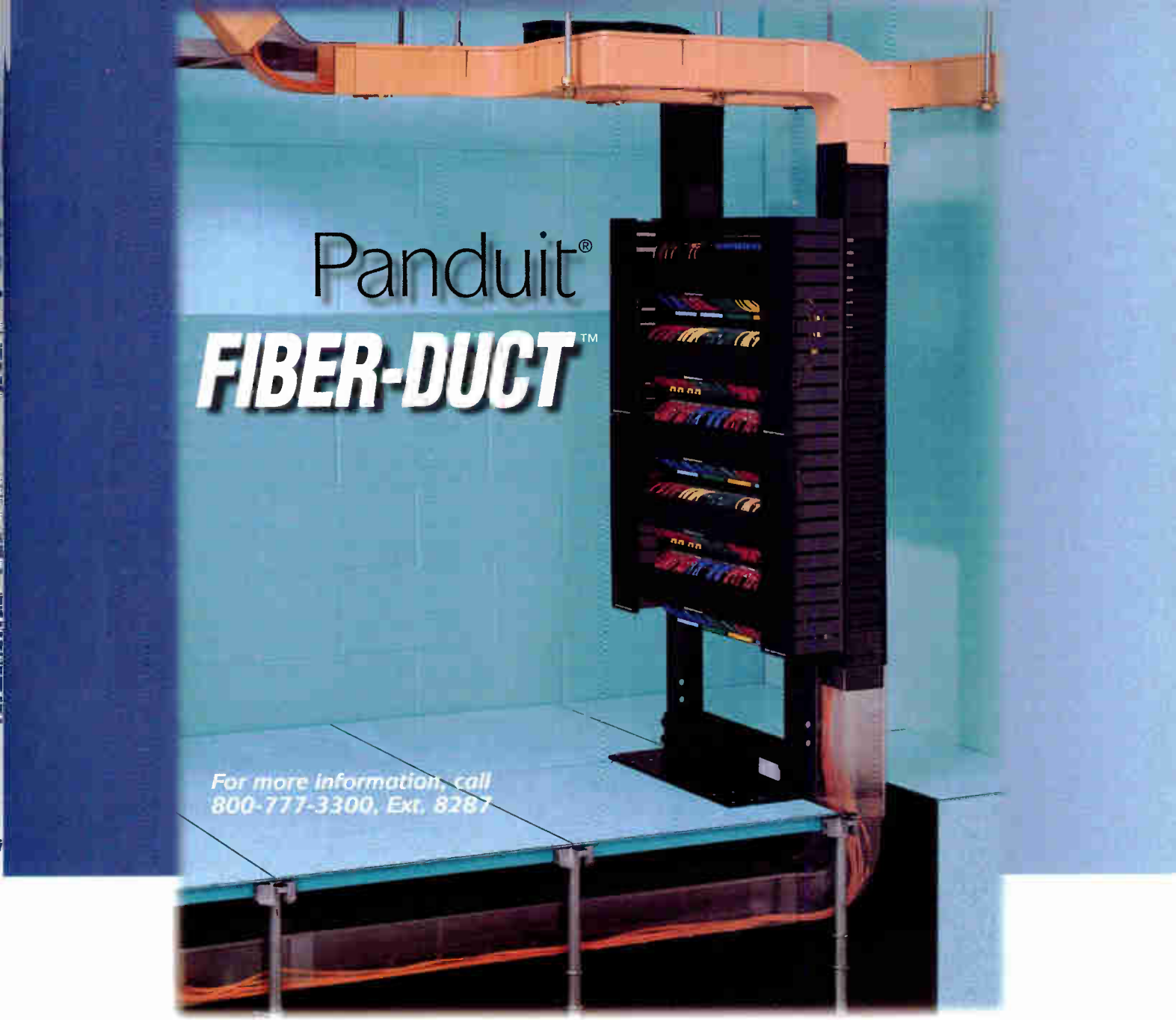

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Ciciora's Corner

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burdens on cable.

Recall that the FCC's Notice of Proposed Rule Making (NPRM) suggested that cable would be required to provide plug-in modules to any subscriber who purchased a "cable-ready" product and requested a module. Recall also that the NPRM suggested that the rules might preclude cable from using any security system that didn't work with the decoder interface. Further, the FCC suggested that the decoder interface module might have to be supplied at no additional cost. None of these are rules yet, but all of them were put into consideration by the FCC's NPRM. They are potential headaches.

> This is a burden that falls exclusively on the cable industry

Consider what happens if the FCC allows IS-105.2 to be a voluntary standard. If the majority of consumer electronics manufacturers abide by a voluntary standard, but a small minority–perhaps a very small minority–of consumer electronics manufacturers produce products using a different protocol, will the FCC's rules require the cable operator to supply a decoder interface module which works with the non-standard protocol? If so, the burden could be very heavy indeed. Software is a major expense in the development of any system–often costing a multiple of the hardware development costs and taking several times longer to complete. It is now rare that a project is delayed for hardware reasons. The cause of nearly all delays is almost always software. If the FCC required that the cable operator supply a decoder interface module for any non-standard version of decoder interface protocol, the costs and difficulties would be horrendous. This is a burden that falls exclusively on cable! It does not cost the consumer electronics manufacturer anything.

The only fair solution would be for the FCC to either 1) accept IS-105.2 as a standard, or 2) not require cable to provide decoder interface modules, but simply to let cable respond to market demand, or–as a minimum–3) only require that the cable industry supply decoder interface modules which comply with the voluntary standard, leaving the supply of non-standard decoder interface modules to be governed by the demands of the marketplace. The alternative is protocol chaos!

If the FCC adopted both IS-105.1 and IS-105.2, it would not be forcing the consumer electronics industry to do anything other than to include both in just the products labeled with cable-ready or with some similar terminology. The FCC would not be shutting out other suppliers of hardware. Products could be built with any other protocols, or with no protocols at all, as long as they weren't labeled cable-ready.

Careful consideration of the decoder interface and its role in cable-ready TVs and VCRs reveals that it applies equally well to set-top boxes (navigation devices) sold at retail. If the decoder interface fails to satisfy the requirements of set-top boxes sold at retail, it must also fail with cable-ready TVs and VCRs.

The decoder interface has been carefully crafted to pass digital signals through the tuner and IF to an external plug-in digital module which would decode the digital signals and return them as analog signals to the TV receiver. Without this capability, the consumer who purchased a cable-ready receiver would be frustrated when he had to add a set-top box for digital reception. Because the 1992 Cable Act did not exempt digital signals from its rules, they must be covered.

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savings in fiber to push it deeper into their networks. Initially, they used fiber to reduce (RF amplifier) cascades. But as the cost of lasers, transmitters, receivers, etc. dropped, they built to 1,000-home node areas and went deeper into the network at the same cost."

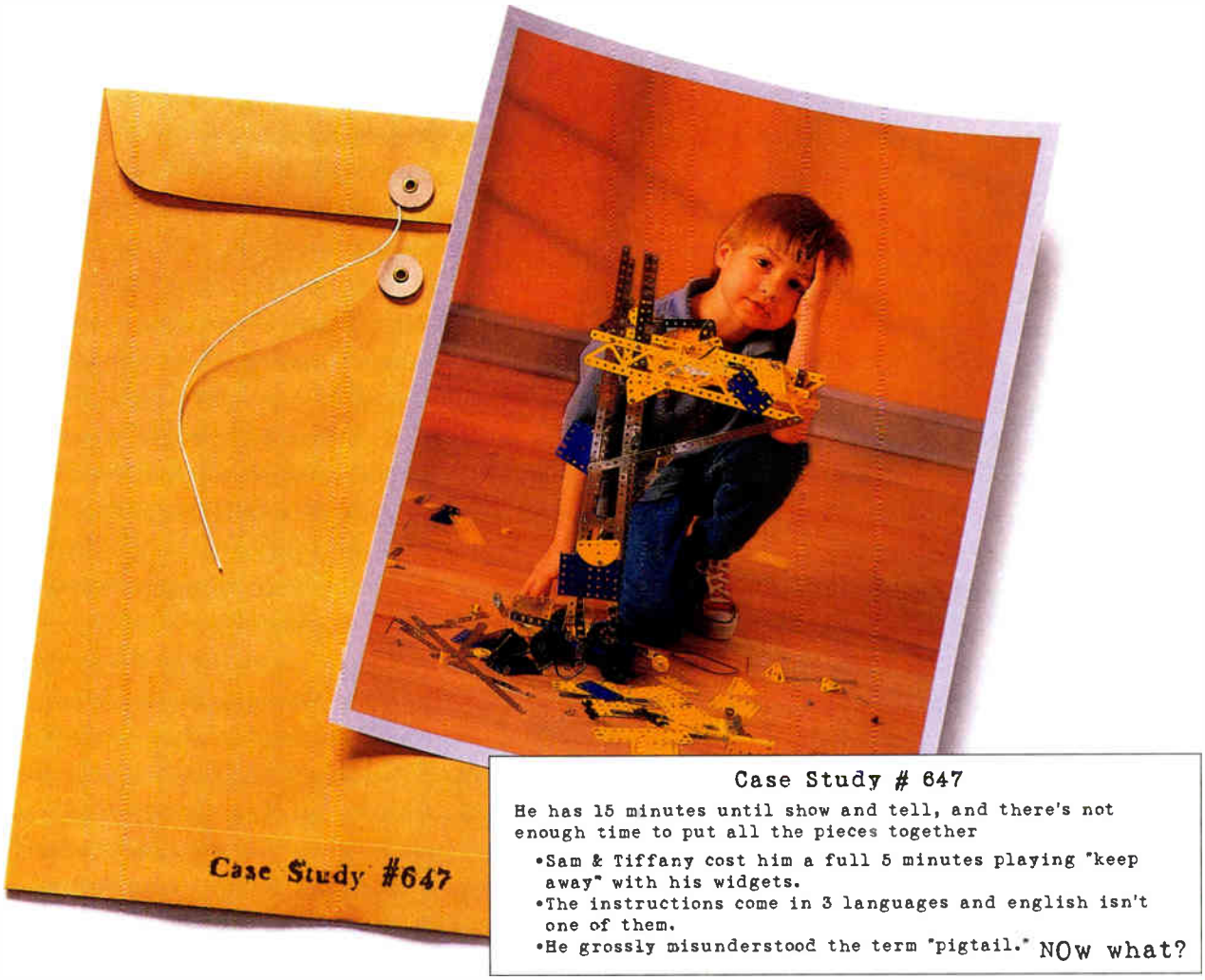
Like other manufacturers of hardware, Harmonic Lightwaves will soon announce a new transmitter at a lower price, says Dahlquist.

Component	AFR (%)	MTTR (hrs)
Optical transmitter	2.33	2.0
Optical receiver	1.05	2.0
HDT electronics	1.65	2.0
Internet electronics	1.65	2.0
NID	3.33	4.0
Amplifier	1.82	2.0
Power supply	4.00	1.0
1 km fiber	0.27	6.0
1 km coax	3.00	2.6
Drop	5.00	4.0
Splitter	0.06	3.0
Tap	0.20	3.0

Table 1: Typical component failure and repair rates. Source: Corning Inc.

The economics and cost savings of fiber run deep and wide, and are allowing cable operators to not only add depth to their fiber plant and explore new revenues, but enjoy inherent cost savings for their business. In the case of Galaxy Telecom, the installation of fiber has saved the company $500 a month per headend by eliminating maintenance costs such as electricity, repairs and more, after collapsing several headends. "We installed 600 miles of fiber in Nebraska and eliminated 45 headends, and in 1998, we will offer Internet access to all of our consolidated headends, and will get into the advertising insertion business," according to Terry Cordova, vice president of engineering for Galaxy Telecom.

"The economics for us were straightforward. We took the total cash and revenue from all of our systems and fac-



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tored in the cost of fiber construction. Through our headend consolidation, we offset about a $1,600 per channel credit for re-use of equipment, and in our business analysis, we developed new capital adjustment costs with new cash flow, and included programming costs. Without gaining any subscribers, we started seeing a payoff within months," says Cordova.

Galaxy added channels, raised rates slightly and aggressively marketed the system. The result has been a four percent to eight percent subscriber lift. "The lower cost of fiber has really been a factor. Now, when you run the numbers, there's too much of a reason not to do it," he adds. "We're now building a network and pouring the savings back into the fiber count for additional capacity."

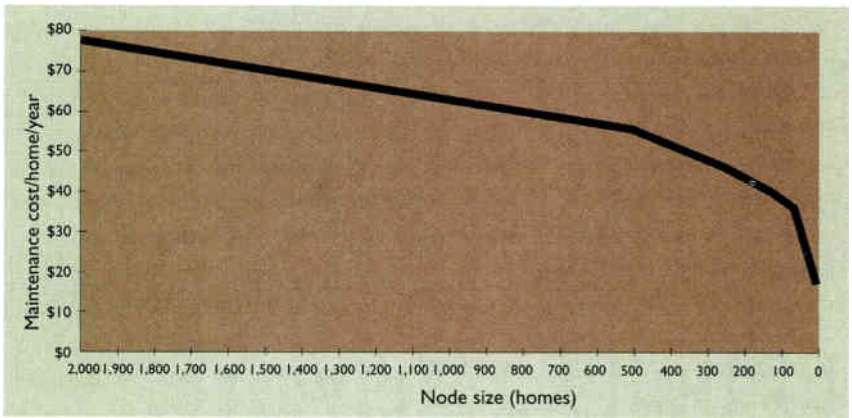

Figure 1: Comparison of HFC network yearly maintenance costs per home passed for various node sizes. Source: Corning Inc.

Adding incremental fiber to an existing network is an economically sound idea, according to Rob Buckfelter, chief financial officer for Prestige Cable, a 150,000-subscriber system in Georgia. "If you're going to go through the cost of fiber, adding strands will not be that expensive. Adding incremental fiber is a good idea, because when you purchase fiber strands per sheath, the incremental costs are low and very economical."

Adding fiber strand, Buckfelter says, costs about $150 a mile for extra fiber. "We think putting 40 to 50 spare fibers in a sheath is economical for us and will build-in excess fiber capacity. Our feeling is with the continued explosion of potential applications–medical, education and more–we want more bulk bandwidth around."

Schools and medical facilities, Buckfelter says, are fertile grounds for incremental fiber, and depending on an operator's access to capital, he says that loading up fiber sheaths is a place that will be lucrative.

The total market demand for fiber in North America, according to Pat Brown, cable TV marketing manager for Corning, a major manufacturer of glass fiber, is more than 4 million fiber kilometers, up a tad from 1997. The cable TV industry alone accounts for about 25 percent of that figure, but the demand will soon be tapering off as cable networks reach a saturation point. Already, the cable industry is approaching the 50 percent saturation point, which will lead to an annual three percent decline in fiber demand, says Brown. "Cable fiber won't continue to grow after 1998, which is expected to be its peak year. It's just a natural consequence that somewhere at around 50 percent you crest, and then even out. So, 50 percent of what cable TV will install has been installed."

Cable represents one-fourth of the total fiber market, Brown says, but that slice of the pie will soon begin to shrink. "In cable TV, we expect maybe a three percent decline (per annum), then three more, and so on in North America." Does that worry Brown? Not really, because the company has a global reach, "and worldwide, there's tremendous growth," he says.

The cost of the laser component of fiber will continue to decline as well, according to Bob Jordan, vice president and business manager, broadband communications, for Ortel. "Laser prices have been dropping about 20 percent a year, and anytime a market begins to saturate, there is concern." Jordan points to the United Kingdom as an example.

"The U.K. just hit that 50 percent wall and is essentially a completed market."

Jordan, however, is unshaken in fiber's ability to generate new revenues, which he hopes will lead to a steady pace of fiber demand. "Eventually, the U.S. will be built out, and one would think the building would slow. But many don't agree. There's a need for drivers of Internet access. The initial take rates are ahead of projections, and that should drive new business, which must be modern, two-way. I think we'll see continued pressure to build out with fiber."

Dean Petersen, president of Southwest Missouri Cable, a small (approximately 11,500-subscriber) system, is installing fiber for $5,100 a mile, which includes 86-count fiber from the headend and 400 new digital customers. The changing economics of fiber has been a major factor in the company's re-shaping, and its leap into Internet access and other potential revenue-makers.

And, there are additional cost-saving benefits for Petersen. "There are benefits to adding fiber that go well beyond the revenues: Better proof-of-performance for the FCC (requirements), better reliability and performance, and lots of bandwidth. From a business perspective, the improved reliability and performance are worth the cost. If there's a way to improve customer attitudes and technical performance, fiber does it, at about the same cost as coax. When you talk to me about fiber, you're talking to a happy man." ■

About the author

Craig Kuhl is a contributing editor to CED and a Denver-based freelance writer.

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DWDM no longer too costly for hub interconnects

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BY TIM WILK,
SCIENTIFIC-ATLANTA

As broadband operators work to reduce costs and achieve economies of scale, many are consolidating their local networks into large, regional systems by connecting them with digital fiber rings.

Where each system previously had its own headend, they are now tied into a regional network of one or two primary signal source "super headends" and several distribution hubs. Economies of scale are achieved by consolidating video headend equipment such as scramblers and stereo encoders, as well as the digital switching and routing equipment for high-speed data and voice services.

These regional fiber networks consist of multiple fiber overlays, with individual fibers dedicated for specific services. A typical model consists of at least five fibers for the transport of analog broadcast video (note: uncompressed digital systems support 16 channels per fiber), a second fiber for the delivery of digital broadcast services, and at least two fibers for all interactive services placed on Sonet overlays. Implementing these services in a self-healing, counter-rotating ring doubles this physical fiber route requirement.

With more services being demanded, and competition requiring cost-effective solutions, cable operators face the challenge of adding more services to networks that are already at, or near, capacity. Many are aggressively searching for more bandwidth to

e-mail: tim.wilk@sciatl.com

make room for additional channels, special programming, telephony and Internet capabilities.

However, creating extra bandwidth can be expensive and time-consuming, particularly if miles of new fiber must be constructed.

A viable solution to this problem is dense wave division multiplexing (DWDM), which enables many information streams to be transmitted over a single fiber. While DWDM technology has existed for several years, recent improvements have made it even more efficient and cost-effective than other options for expanding bandwidth. This article discusses the benefits of DWDM technology for cable operators.

Implementing DWDM

Deploying more fiber has been the primary choice for many years for expanding network capabilities. Each new fiber could add up to 2.4 gigabits per second. This has always been an expensive procedure, but increases in associated costs have made it an even greater investment. First, the average price for deploying new cable is estimated to be as high as $70,000 per mile, and it can be even higher in densely populated areas. This doesn't include expenses for support systems and electronics.

In recent applications, DWDM has been accepted as a cost-effective alternative when there is not sufficient fiber in place to meet requirements. Many operators have pulled sufficient fiber for their primary headend interconnect routes, but as additional hubs are added to the primary ring, certain segments may contain insufficient fiber.

As a simple cost comparison, Scientific-Atlanta established a hypothetical model to calculate the estimated cost of DWDM vs. the estimated cost of fiber. The modeled regional fiber network had a single headend with up to five subtending hubs, and the hubs were spaced 30 miles apart. In this model, six fibers would be used in the headend-to-hub interconnect. Using DWDM, 16 video channels would be delivered over each OC-48, making the ring capable of transporting either 96 uncompressed analog video channels or 16 QAM IF digital channels and 80 uncompressed analog video channels–all over a single fiber.

Figure 1 compares the estimated cost of using DWDM in this application with the direct cost of fiber cable. The DWDM estimated cost includes ITU wavelength 1550 nm OC-48 lasers, a DWDM multiplexer and DWDM demux. For fiber cable, only the estimated cost of the cable and splicing is considered. Construction costs are not included.

As anticipated, the model shows that the estimated cost of DWDM is favorable to the estimated cost of the alternative option of constructing new fiber routes. What was not anticipated is the favorable degree of the DWDM interconnect. The DWDM approach for the model is expected to reach cost parity to the cost of dedicated fiber for a single headend-to-hub link at just over 30 route miles, or at the initial hub location. (Note: For routes less than 30 miles, traditional linear 1550 nm transmitters are anticipated.) After the initial interconnect, the expected cost differential is obvious. Estimated savings for DWDM, compared to the cost of fiber, range from 12 percent to 30 percent.

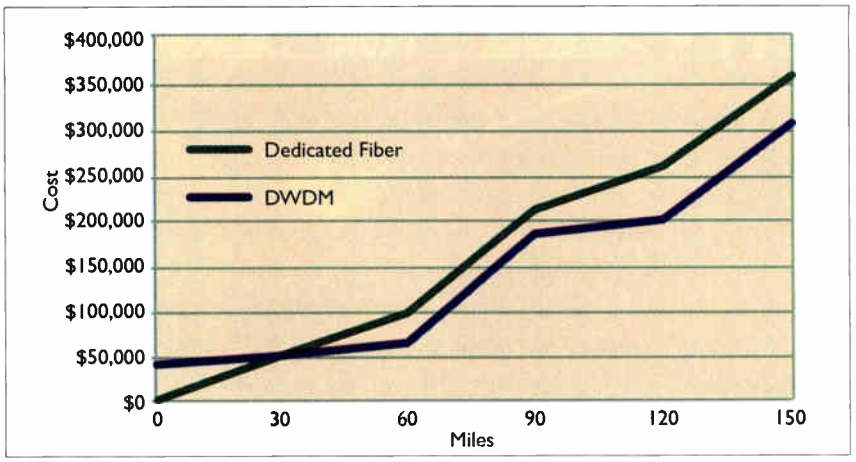


Figure 1: Economic advantages of dense wave division multiplexing. As shown in the hypothetical model, the estimated cost of DWDM is favorable not only to the alternative option of constructing new fiber routes, but also to the cost of dedicated fiber for a single headend-to-hub link over 30 route miles, or at the initial hub location. Assumptions: 1. Six fibers are required for the headend-to-hub interconnect. With 16 channels transported in each OC-48, the ring network is capable of transporting either 96 uncompressed analog video channels, or QAM IF digital channels and 80 uncompressed analog video channels. 2. The regional fiber network consists of a single headend, with up to 5 subtending hubs. Each hub is spaced 30 miles apart on the ring network. 3. The model compares the incremental cost of using DWDM with the direct cost of fiber cable. This DWDM cost includes a) ITU wavelength 1550 nm lasers, b) DWDM multiplexer, and c) DWDM demux. Only the cost of the actual fiber cable and splicing is used. No consideration is given to construction costs.

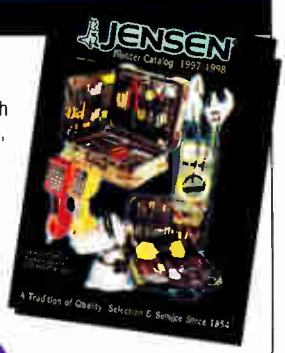
The implications of this simple analysis are significant. Not only is DWDM technology expected to prove cost-effective for the case of insufficient fiber, but another strong business case for DWDM may be realizable even when sufficient fiber does exist.

DWDM application drivers

In addition to the cost savings associated with the utilization of DWDM

Catalog

TEST EQUIPMENT



Jensen Tools is the premier designer/developer of tool kits for the communications and electronics industries. Their catalog is a major source for hi-tech test equipment, specialty tools, telecom accessories, fiber optics, wire/cabling products, crimpers/strippers, shipping cases, and more, representing major manufacturers like: Fluke, Tektronix, and Wavetek. 100% satisfaction guaranteed. http://www.jensentools.com

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(800) 327-4966 or fax
(954) 427-0934

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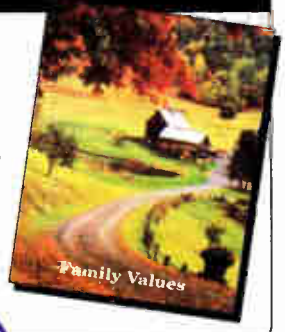
Technical Software

TEST EQUIPMENT



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! FamilyWare@aol.com

(702) 852-5200 or fax
(702) 852-5255

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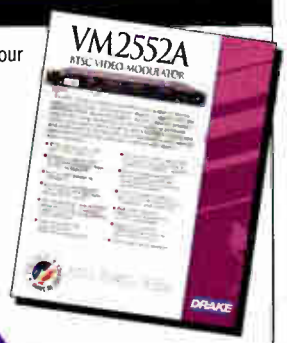
Stereo Video Modulator

HEADEND EQUIPMENT



Enhance your system with stereo audio and bring your system up to FCC regulations with **R.L. Drake's** VM2552A Stereo Video Modulator, which incorporates BTSC stereo encoding providing significant cost savings when compared to purchasing separate components. EAS-ready ensures that you can be prepared to meet FCC regulations governing emergency alert broadcasts. The frequency agile VM2552A features frequency coverage up to 550 MHz. Call today for more information.

(513) 746-4556

Reader Service 503

CATV Test Equipment

TEST EQUIPMENT

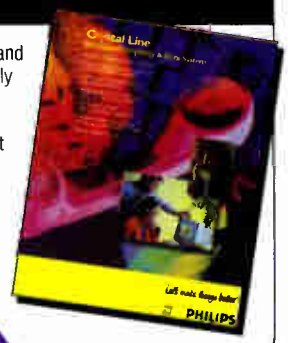
TRILITHIC is pleased to announce the new 1998 Broadband Instruments Catalog. This 88-page catalog features an all-new format, new applications and material and many new products. Call the **TRILITHIC** Sales Department or contact your local **TRILITHIC** representative for your copy. **TRILITHIC, INC.**, 9202 E. 33rd St., Indianapolis, IN 46236 Internet at http://www.trilithic.com.

(800) 344-2412

Reader Service 504

Telephony/Data System

TELECOM EQUIPMENT



Philips' new **Crystal Line ™** broadband telephony and data system allows HFC network operators to reliably and affordably deliver two-way voice and data services. **Crystal Line** features equipment at the headend and subscriber sites, and a unique element management system that monitors and controls components at both ends to support telephony and on-line multimedia services. Visit our web site at http://www.be.philips.com/pbn or call for more information.

(800) 448-5171 or outside the U.S.
(315) 682-9105

Reader Service 505

Fiber Optic Information Center

FIBER OPTIC EQUIPMENT

Get the latest information about fiber-optics and cable TV **FREE!** This recently updated manual from **Corning** will help you answer questions on key fiber parameters, the importance of consistent fiber manufacturing, how to specify the right fiber for your system and much more. Call The **Corning Optical Fiber Information Center** at (800) 525-2524, ext. 583 and ask for your **FREE** copy of "Just the Facts."

(800) 525-2524, ext. 583

Reader Service 506

Aerial Lifts

CONSTRUCTION EQUIPMENT

Armlift, Division of TG Industries, manufacturer of telescoping and articulating lifts for the cable and telephone industry. Truck and van mounts available with working heights to 41'. Fiber optic splicing units with working heights to 37' feature climate control, natural and fluorescent lighting and up to 232 cubic feet of working space. Contact factory for detailed information.

(712) 864-3737 or fax
(712) 864-3848

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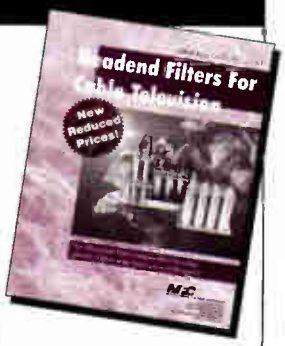
Headend Filters

HEADEND EQUIPMENT



At Microwave Filter Co., Inc. prices have been reduced up to 30% on most popular filters featured in our new short form catalog, "Headend Filters For Cable Television, Vol. 1 #1." It features a full line of "Brickwall" notch filters with passbands up to 1 GHz. Also included are bandpass filters, deletion and reprocessing networks, and TVRO interference filters among others. For more information call today.

(800) 448-1666 or fax
(315) 463-1467

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Tools

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Cable Prep's *Light Weight Series* of drop cable preparation tools are manufactured from high quality light wieght aluminum that maintains the strenth and reliability you've come to expect in a Cable Prep® tool. The Hex Crimp Light and TerminX® weigh one third less, and the Pocket TerminX® weighs in at a mere half pound! Call today. www.cableprep.com

(800)-394-4046

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Tools & Test Equipment

TEST EQUIPMENT

FIBER OPTIC TOOLS - **Specialized Products Company's** FREE 378-page color catalog features over 100 standard tool kits for installation, field service, and repair. Fiber optic test equipment includes OTDRs, light sources, power meters, cleavers, strippers & more. Extensive stock case selection. Contains descriptions, specifications, and prices. Contact on the Internet at www.specializedproducts.com or call us today for more information. **Specialized Products Company**, 1100 S. Kimball Ave., Southlake, TX, 76092

(800) 866-5353 or fax
(800) 234-8286

Reader Service # 510

PathTrak Brochure

TEST EQUIPMENT

Wavetek's new PathTrak™ Performance Monitoring System is the first return path monitoring system devoted to monitoring and analyzing multiple return paths in today's advanced HFC networks. This full color brochure provides information about PathTrak's key benefits and features. Designed to improve the availability and quality of return path networks, PathTrak reduces maintenance costs by improving troubleshooting and fault location time. www.wavetek.com

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or fax **(317) 782-4607**

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Budco markets and distributes installation tools, construction supplies, marking, identification, and security products to the CATV industry: 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. For more information, call today.

(800) 331-2246

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Transmissions Systems

FIBER OPTIC EQUIPMENT

Harmonic Lightwaves: Transcending the Ordinary. Harmonic Lightwaves is a worldwide supplier of highly integrated fiber optic transmission, digital headend, and element management systems for the delivery of interactive services over broadband networks. Products include: MAXLink™ 1550 nm transmission system, PWRLink™ DFB transmitter family, optical nodes and receivers with return path options, TRANsend™ family of digital video compression and modulation equipment, and the NETWatch™ element management system.

(800) 730-4099 or fax
(408) 542-2511

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Custom Products

FIBER OPTIC EQUIPMENT

Storm Products manufactures low back reflection attenuators (in-line, bulkhead and variable), hybrid adapters (plug, bulkhead and bare-fiber styles), couplers and cable assemblies. Custom products and assemblies built to spec for a variety of applications; semi-rigid fiber optic assemblies, line simulators, pulse suppressers, and composite assemblies with RF Microwave, Electronic and Fiber Optic. Pictured: 77 Series -55dB attenuators — for consistent performance throughout the network.

(630) 323-9121 or fax
(888) 347-8676

Reader Service # 514

Electronic Enclosures

TELECOM EQUIPMENT

Equipto Electronic Corp. FREE Electronic Enclosures Catalog. Modular cabinets, sloped front consoles, electronic desks, computer furniture and instrument cabinets are shown and described in this free, 300-page catalog. Included are sections on EMI/RFI shielded enclosures, earthquake reinforced enclosures and express shipping. Catalog is available in print version or as an IBM-compatible software program. http://www.equiptoelec.com

(800) 204-RACK or fax
(630) 897-5314

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CED

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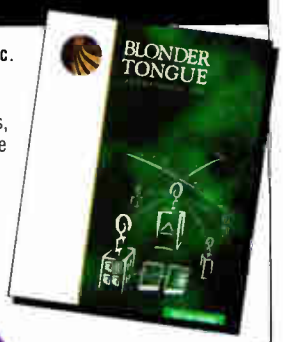
Changes to existing information should be faxed to Shannon Sanchez: (303) 393-7449 x233; FAX (303) 393-6654.

Catalog/CATV Reference Guide

HEADEND EQUIPMENT

For over 40 years, **Blonder Tongue Laboratories, Inc.** has been manufacturing professional quality, commercial cable television products. BT's catalog includes product photos, descriptions, specifications, and application notes for the entire product line. The reference guide is a "must" companion for today's engineer. Products include: Reception, Headend, Microwave, Analog & Digital Distribution, Fiber Optics, Interdiction, Test Equipment Residential and Specialty Equipment. Call Today.

(800) 523-6049



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Switchers

HEADEND EQUIPMENT

Monroe Electronics designs, manufactures and markets - to worldwide customers - a full line of electronic programmable audio/video switching, timing and remote control equipment. Used by the cable, wireless, broadcast, and telephony industries, our products have a time proven record of reliability. For support or information, call today or visit Monroe at http://www.monroe-electronics.com

(800) 821-6001 or **(716) 765-2254** or fax **(716) 765-9330**

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Modulator/Demodulator

HEADEND EQUIPMENT

Pico Macom, Inc. manufactures a complete family of high quality cable television products. Our current catalog is packed full with exciting new products for cable television. The catalog contains photos, full descriptions, specs, and application information. Look for their new receivers, agile modulators and demodulators, 1 GHz amplifiers, and the new 950-2150 MHz satellite products. Call today for a free copy.

(800) 421-6511 or **(818) 897-0028** or fax **(818) 834-7197**

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Telephony Distribution System

TELECOM EQUIPMENT

A new, full-color brochure from **Tellabs** describes the benefits of the 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 today.

(800) 445-6501

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Cable Plow

CONSTRUCTION EQUIPMENT

Line-Ward Corp. has been meeting the CATV and telephone industry's buried service wire needs for nearly 25 years with its patented line-layers. The small but rugged L-2 Line Layer was designed specifically for burying drops effectively. It drives on rubber tracks to provide superior traction with minimal lawn damage. A boring attachment adds to the L-2's versatility. http://www.lineward.com

(800) 816-9621 or **(716) 675-7373** or fax **(716) 674-5334**

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Integrated Receiver Descrambler

HEADEND EQUIPMENT

The **Drake** ESR1260 IRD is a high quality commercial integrated receiver descrambler with synthesized frequency tuning of IF and subcarrier audio. The VideoCipher® module can be accessed through the front panel, providing added convenience. Operating functions are also selected via the front panel and programming is simplified with liquid crystal display of operating parameters. The ESR1260 IRD's compact design optimizes valuable rack space. Visit our website at www.rldrake.com or call for more information.

(513) 746-4556

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Node/Amplifier

FIBER OPTIC EQUIPMENT

C-COR introduces NAVICOR™, an innovative product family that integrates advanced RF bases with a complete selection of lid-mounted optics modules and a network management agent. This gives you two ways to navigate the future of HFC: take advantage of our family of complete optic nodes, or choose from an array of lid optic upgrades to your existing RF amplifiers. www.c-cor.com

(800) 233-2267 or fax **814-238-4065**

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Integration, Cable Modems

ADVANCED NETWORKING

Electronics, knowledge, support and commitment. **Toshiba** has it all. As one of the largest system integrators in the cable industry, Toshiba offers cable companies a complete high speed, turnkey system for data over conventional cable networks. Toshiba can provide all hardware and software to initiate and maintain your network, including digital video equipment, MCNS based cable modems and headend equipment.
http://www.toshiba.com/taismsd/

(714) 587-6631

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EAS Compliance Video

TEST EQUIPMENT

If your cable system serves 10,000 or more subscribers, the time has come to act on EAS compliance. **Trilithic** makes it easy with a free video describing EAS compliance step-by-step. In the video, you'll find the answers you need to create an effective EAS compliance strategy that deals with IF substitution, crawls/all-channel messaging, video substitution, and control of remote hubsites. Internet: http://www.trilithic.com

(800) 344-2412 or fax
(317) 895-3613

Reader Service 524

Transmission Systems

FIBER OPTIC EQUIPMENT

Synchronous Group Constellation Series offers multiple fiber architectures and the best 1550 nm performance available. Transmitters and EDFA optical amplifiers exceed all industry requirements. Up to 110 analog channels may be carried on a single fiber. Constellation also includes 1310 DFB transmitters, optical switches and high performance optical receivers. E-Mail: al@syngroup.com

(800) 659-6750 or fax
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Network Power Protection

DISTRIBUTION EQUIPMENT

Multipower has introduced DPS™ power protection for networks using the patented Network Protector system well known in Israel. Protectors complement or completely replace power supplies and batteries-at lower cost. Mounted in amplifiers, Protectors respond to outages by redirecting power to affected locations from unaffected areas. Self-contained Protectors are available for use with Fiber Optic receivers.

(954) 467-1039 or fax
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Cable TV Test Equipment

TEST EQUIPMENT

Hewlett Packard's cable TV test equipment brochure highlights their complete line of test equipment, including the HP Calan 3010R/H sweep/ingress analyzer - the industry's most essential tool for two-way system activation and maintenance, and the HP 8591C cable TV analyzer - the industry's only one-box tester for all non-interfering RF and video measurements. Call Hewlett-Packard today for more information.

(800) 452-4844, x2009

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Anti-Icing System

DISTRIBUTION EQUIPMENT

GeoKlein's SteadyState Anti-icing System prevents the accumulation of ice and snow allowing the reflector to remain clear and the signal strong under virtually any climatic condition. The key to long life and reliability of SteadyState is the unique construction of the heater strip. SteadyState's system uses a heating element that is a continuous core of semiconductive polymer that actually regulates its own heat output. http://www.geoklein.com

(303) 440-7770 or fax
(303) 541-9099

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Fiber Panel Products

TELECOM EQUIPMENT

ADC's fiber panel family meets the needs of a wide range of customer applications. All fiber panels feature superior cable management and maintain a 1.5" or 2" minimum bend radius (depending on the panel). The Fiber Panel Products catalog features product descriptions and specifications, as well as application and ordering information for **ADC's** complete line of fiber panels, components, and accessories.

(800) 366-3891 or fax
(612) 946-3292

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Design Software

CONSTRUCTION EQUIPMENT

CADIX International, Inc. is proud to announce CX-P21 "Light Speed Design System." "Light Speed" is the next generation in Fiber, RF and Telephony Design and Management Software. For Windows 95 and Windows NT, CX-P21 is OBDC compliant. Designs can also be accessed through a remote field computer. Email: cbenes@nb.cadix.com. Call today for more information.

(714) 223-8881 or fax
(714) 223-8871

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Fiber Optic Management Systems

FIBER OPTIC EQUIPMENT

FONS (Fiber Optics Network Solutions) Corp. offers complete fiber optic management systems, including enclosures and patch panels for datacom, telecom, and CATV applications. **FONS** also manufactures standard and custom singlemode and multimode cable assemblies, connectors, attenuators, couplers and adapters.

(800) FONS-995 or fax
(508) 393-3657

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WAVETRACKER Products

TEST EQUIPMENT

CABLE LEAKAGE TECHNOLOGIES offers a new family of WAVETRACKER products. The Wavetracker system has undergone major enhancements, with a new compact size, a VGA quality LCD display, and a new low price. CLT's new Windows-based A.P.L.A.S. software offers one step data processing, using the newest, most current mapping product available. The DELTAWARE Differential G.P.S. Base Station now offers 2 to 5 meters accuracy.

(800) 783-8878

Reader Service 532

Satellite and Headend Equipment

HEADEND EQUIPMENT

Dawn Satellite is a distributor of complete satellite downlink systems, headend equipment and component parts. The Dawn Satellite "Full-line" catalog is available, showing descriptions and prices for commercial-grade products from the most recognized manufacturers. Call for more information.

(800) 866-6969 or **(248) 391-9200**
or fax **(248) 391-9207**

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Fiber Optic Systems Equipment

FIBER OPTIC EQUIPMENT

Philips Broadband Networks' new Diamond™ Series RF and fiber-optic systems and equipment provide a total infrastructure for transmitting video, voice and data services. Several new products are featured, including fiber-optic transport systems (750 and 862 MHz), four-port optical amplifiers, taps and passives, as well as element management systems to control network components. Visit our Internet site at http://www.be.philips.com/pbn or call for more information.

(800) 448-5171 or outside the U.S.
(315) 682-9105

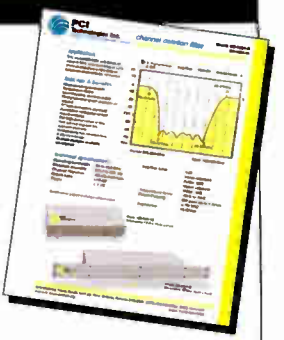
Reader Service 534

Filters/Traps

HEADEND EQUIPMENT

PCI Technologies Inc. features "advanced" designed filters and traps from DC to 1 GHz, Bandpass, Brickwall, Channel Deletion, and Diplex Filters with the best specifications, fastest delivery, and the most competitive prices. "Custom Filters" are our specialty! Other products include custom and standard Pilot Carrier Generators, Frequency Stackers, and installers Field Strength Meters. Call for our brand new catalogue and price list.
E-Mail: sales@pcitech.org

(800) 565-7488 or fax
(905) 427-1964



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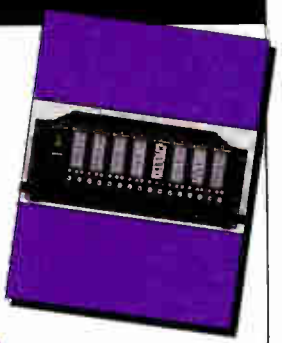
Satellite and Headend Equipment

HEADEND EQUIPMENT

Standard Communications Corp., a global manufacturer of complete cable system solutions, offers satellite receivers, frequency agile modulators, BTSC generators and custom system proofing. Products include the new STRATUM Modulation System, the Agile IRDII receiver/descrambler, DSVR8800 and DSVR9000 digital IRDs. The near future will feature the DVB digital compression series. For more information contact Standard Communications Corp.
http://www.standardcomm.com

(800) 745-2445 or fax
(310) 532-0397



Reader Service 536

Cable Products

CONSTRUCTION EQUIPMENT

Times Fiber Communications, Inc. is an ISO 9001 registered manufacturer of coaxial cables for the telecommunications industry. Committed to quality, service and technology, TFC is standardized on 1 GHz bandwidth for trunk, feeder and drop cables, featuring T10 Semi-flex, TX10 Low-Loss and T10 Drop cables with lifeTime. With over 40 years of experience, we continue to lead the industry in product advancement and innovation.
http://www.timesfiber.com

(800) 677-2288 or fax
(203) 265-8749

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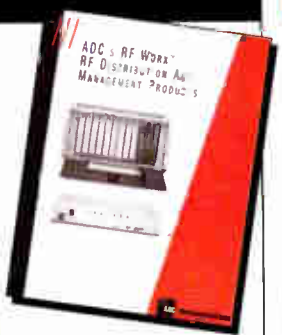
RF Worx™ Products

TELECOM EQUIPMENT

ADC's RF Worx ™ products provide design engineers with the ability to combine, split, distribute, and manage RF signals. RF Worx™ products are suitable for any 5 MHz to 1 GHz application, including passive reconfiguration, system balancing, monitoring redundant switching of amplifiers, and signal/cable management. The new RF Worx ™ products catalog contains product descriptions, features/ benefits, and complete application and ordering information.

(800) 366-3891 or fax
(612) 946-3292



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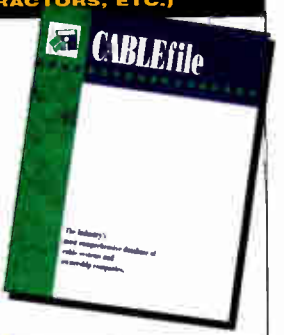
Cable Database

SERVICES (BILLING, CONTRACTORS, ETC.)

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

(303) 393-7449 or fax
(303) 393-6654



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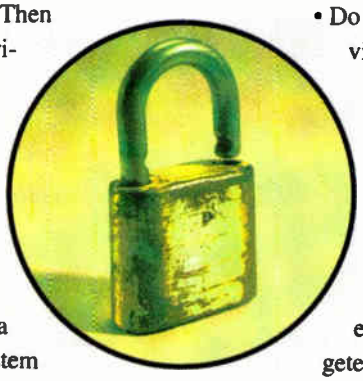
UNLOCK THE POWER OF CABLEFILE

The cable industry's most comprehensive database of cable systems and ownership companies will be the key to your sales, marketing or research plan.

Cablefile has all the information you need, all in one place—and better yet, it's information you can really use. Because the data is stored electronically, you can import it into most data management and spreadsheet software programs. Then you are limited only by your creativity. Select any number of criteria to find a group of potential buyers for your product or service—subscriber count, location and build-out plans, for example. The next day, a week later, a month later, six months later, select a different group based on another set of criteria such as channel capacity, billing system vendor or number of coaxial and fiber optic cable miles. There are over 60 fields of data that you can use to select just the right group! Cablefile is such a flexible tool that once you begin using it, you won't know what you did without it.



- Do you market a service to a specific group of decision makers at cable systems—Chief Engineers for example?
- Do you sell a product to the cable television industry?
- Are you conducting research on cable TV?

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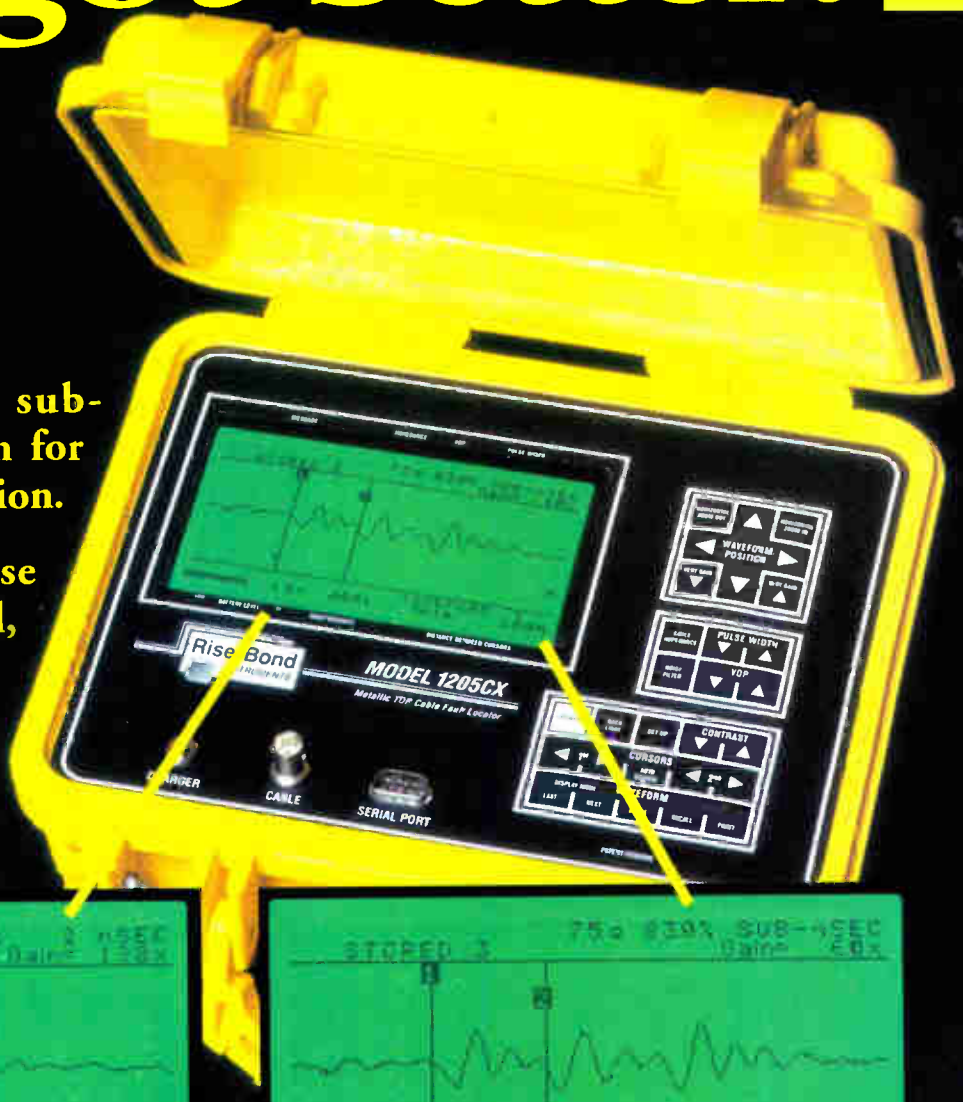

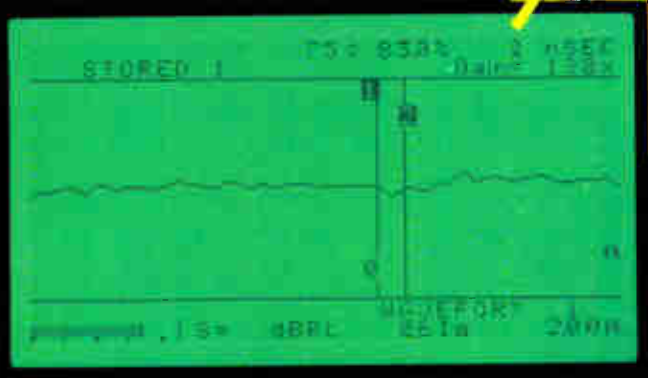

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Com21 develops, manufactures and markets high speed cable modem communication systems. The ComUNITY Access System enables a cable operator to maximize revenues through multiple priced data services. The system provides virtual networks to serve the business, SOHO (small office, home office) and residential markets. ComUNITY Access (ComPORT cable modem, ComCONTROLLER headend switch, NMAPS software), permits the cable operator to add future services such as voice or desktop video.

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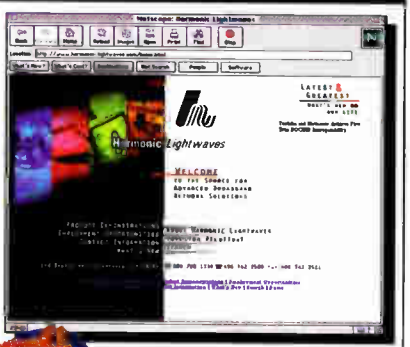
Visit our site for up-to-date information on Harmonic's full line of integrated fiber optic transmission, digital headend and element management systems for broadband networks. You'll discover advanced optical transmitters, nodes and receivers, plus digital video compression and modulation equipment and our Windows™ - based element management system.



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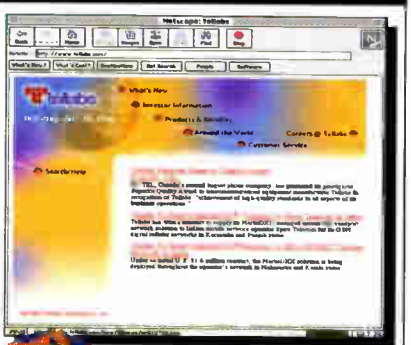

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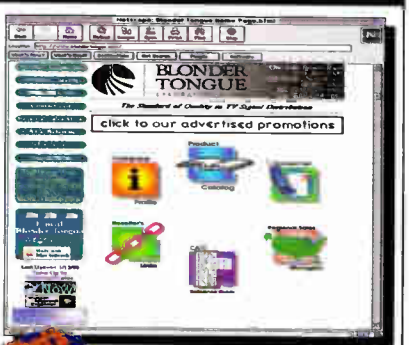
Blonder Tongue Laboratories, Inc.

For over 40 years, Blonder Tongue Laboratories, Inc. has been manufacturing professional quality, commercial cable television products. BT's web site includes catalog and CATV reference guide excerpts along with product photos, descriptions, and specifications. Products include: Reception, Headend, Microwave, Analog & Digital Distribution, Fiber Optics, Interdiction, Test Equipment, Residential and Specialty Equipment. Visit our web site today!



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Speed has never been as important in the race to install and maintain your return path as it is today. So the last thing you need is a problem with ingress. That's where the HP CaLan 3010R/H Sweep/Ingress Analyzer comes in.

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HP CaLan 3010R field unit

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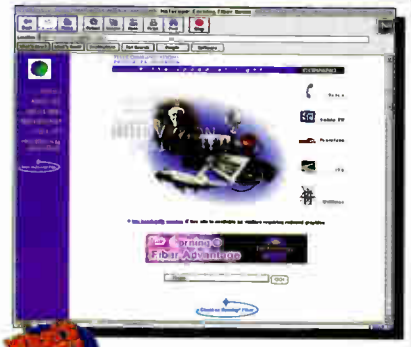
Corning Incorporated

The world's best resource for information on optical fiber is now at your finger tips. Corning Incorporated, the inventor of the first low-loss fiber, has brought the Optical Fiber Information Center to the internet. Here you will be able to access Corning's extensive library that includes case histories, product specifications, manufacturing insights and much more!



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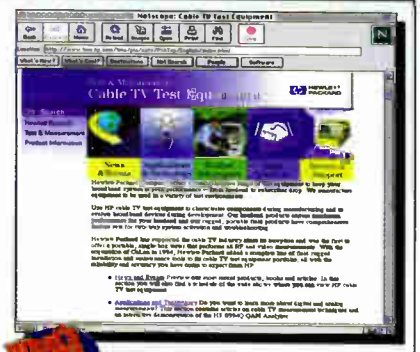

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- Product Data Sheets On-line
- Hyper-links to Other HP Division Web Sites

www.riserbond.com

TEST EQUIPMENT

Riser-Bond Instruments

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HOT!

- Product Data Sheets
- Basic TDR Training and Applications

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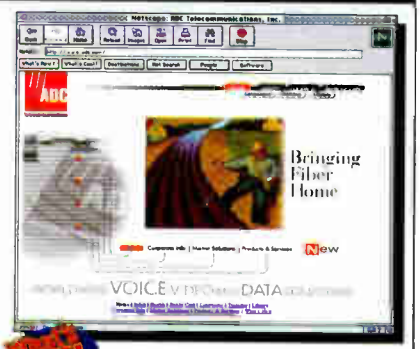
TELECOM EQUIPMENT

ADC Telecommunications

ADC offers service providers a diverse portfolio of solutions for residential broadband service access, business broadband service delivery and mobile wireless markets worldwide. With expertise in fiber-optics, video and wireless technologies, ADC provides end-to-end network solutions for telecommunications, cable television, wireless and enterprise networks. Visit our web site for the most current information about ADC's products and markets and our latest industry news.



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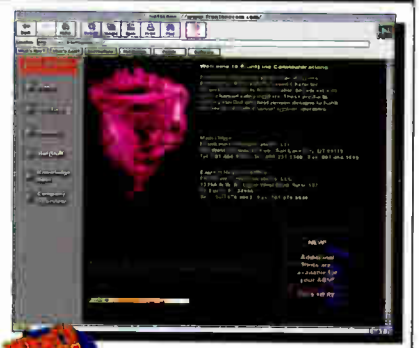

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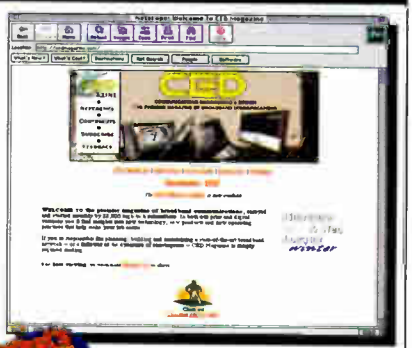

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Reader Service 65

ProductShowcase

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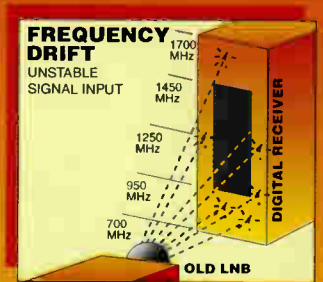

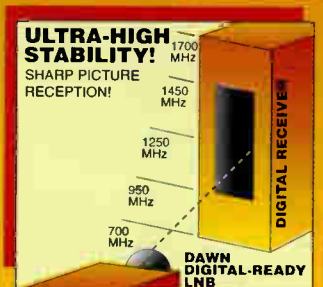

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RS # 57

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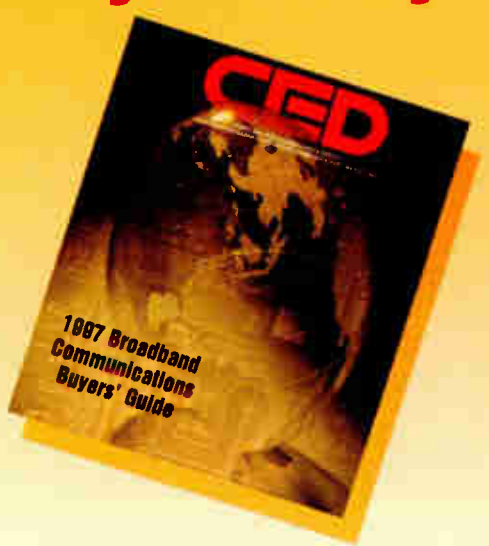

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PRODUCT REVIEWS


MediaPlay

Character generator

MISSION VIEJO, Calif.–D.Co Marketing Inc. has released its latest character generator system, the MediaPlay. The unit incorporates advanced text, graphics and crawl line capabilities into one system that gives the user the ability to create "professional looking" video message pages. The MediaPlay offers a variety of ways to communicate with cable viewers through extensive scheduling, graphics and font capabilities. Shortcut keys and clickable icons aid in creating text messages and adding graphics and photos. Dynamic page-to-page transition effects and text crawl lines can be inserted for any cable broadcast video message. Sports updates and stock market figures can be automatically retrieved from the Internet or other sources and reported to cable viewers via a MediaPlay-created page. Equipped with CorelDRAW! software, a color Hewlett-Packard scanner, and a 17-inch SVGA monitor, the unit is available as a rack-mount that conserves space and integrates easily into the headend.

Circle Reader Service number 75.

Modulator

IRVINE, Calif.–Leaming Industries has announced its SVM450, a stereo, audio/video modulator tailored for cable TV, SMATV, private and wireless cable systems. The unit, which fits in one-half of a standard rackspace, generates a TV channel output from video and left and right audio baseband signals. Built-in features include: BTSC stereo encoder, SAW filter, output from 50-450 MHz, front panel agility, and video AGC.

In addition, the company's SG-100 BTSC TV Stereo Generator offers cable-broadcast quality; typical separation greater than 26 dB; and 14 kHz frequency response.

Circle Reader Service number 76.

Adaptors

SOUTH PLAINFIELD, N.J.–Radiant Communications Corp. has announced its new line of ST style adaptors, the Series STA, which offer low-light-loss adaptors in a rugged, heavy-duty, metal housing. The product family comes with three types of sleeves available to meet diverse fiber applications. A polymer sleeve is designed for multimode

FIBER OPTICS

Cross-connect/express closure

CLEVELAND, Ohio–Preformed Line Products has announced its Coyote Cross-Connect/Express Closure, which allows the user to splice fibers, cross-connect and store "expressed" fibers in the same closure. It can be placed in aerial, underground, hand-hole or building applications. The closure provides bulkhead connections for up to 18 pigtails on both the field (office) side and the service (distribution) side. Individual splice trays are provided to splice the pigtails to the feeder cable and branch cable fibers. Space is provided for up to two additional splice trays for through-fiber splices (up to 36 splices per tray) or for spare pigtail splices. The closure's central region allows for storage or "express" uncutting of buffer tubes of the feeder cable, for cables as large as 288 fibers.

The closure provides the user with a choice of connectors, depending on the application. Customizing the closure saves money, because only the parts being used need to be ordered, according to the company. Circle Reader Service number 77.

Adaptors

fiber; for both multimode and singlemode applications, a metal sleeve made out of phosphor bronze is available. And to meet the ultra low-loss requirements in singlemode applications, the company offers a ceramic sleeve made out of zirconia. All three types meet EIA/TIA specifications for insertion loss and retention force. The performance of the adaptor reportedly does not significantly change after repeated connector matings, or over a wide temperature range.

Circle Reader Service number 78.

Unidapter

Curing oven

MEDFORD, Mass.–Fotec Inc. has introduced the Fiber U Portable Connector Curing Oven, which can lower the cost of terminating fiber optic cables in the field by allowing the fast termination of low-cost connectors available from many manufacturers, according to the company.

Careful thermodynamic design allows the oven to require so little power to heat up that it runs on 12VDC from an AC adaptor or vehicle adaptor, or even an optional battery. Because it's molded from hard rubber, the oven is rugged enough for field use.

Using the Fiber U oven, epoxy cure times are as low as five minutes, about the time it takes to attach a connector to the fiber cable, says Fotec.

The company has also announced its new "Unidapter," a single adapter that fits all Fotec fiber power meters to allow measuring optical power with cables terminated in either ST, FC, SC or duplex SC style connectors. The Unidapter positions the 2.5 mm ferrule used in all three connectors directly over the center of the meter's detector for proper measurements, without affecting the NIST-traceable calibration of the instruments. The large body of the Unidapter protects the connector from sideways pressure, which can cause the ceramic ferrule to break.

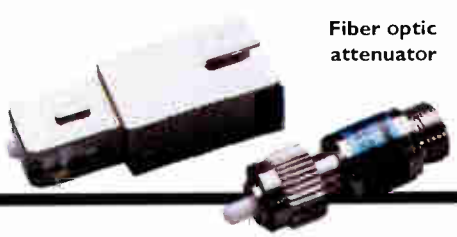
Circle Reader Service number 79.

Attenuators, fiber tracing system

HICKORY, N.C.–Siecor Corporation has expanded the selection of its Inline, Single Wavelength Fiber Optic Attenuators which allow the fiber optic connector ferrules to maintain physical contact with the attenuator's components.

The attenuators are compatible with SC, ST compatible, D4, FC or APC fiber optic connectors. The Non-Air Gap design maintains a high return loss (low reflection) value for the connection. The attenuators are extremely stable and constant at the 1310 nm wavelength range.

Attenuation values from 3 dB to 20 dB are available in 1.5 dB increments for SC, ST compatible and FC types. Attenuation values from 5 dB to 15 dB are available in 5 dB increments for D4 type. Each dB value is color-coded for easy identification.

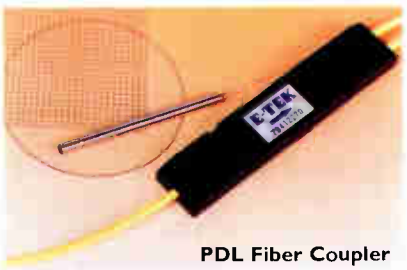


Fiber optic attenuator

Siecor also announced the introduction of its new SearchLite Tracing System that has been designed for easy identification of the origin and termination points of traceable fiber optic patch cords in central office applications. The SearchLite can be hand-held or mounted to a distribution frame.

The system can be operated over a distance of several meters in central office locations and uses a replaceable nine-volt battery that provides more than 50 hours of continuous operation. A magnet on the back of the unit allows it to be easily attached to a metal frame while testing.

Circle Reader Service number 80.



PDL Fiber Coupler

PDL coupler

SAN JOSE, Calif.–E-Tek Dynamics Inc. has introduced its Single Mode Ultra-Low PDL Fiber Coupler (SMUC), a narrowband splitter with polarization dependent loss (PDL) of only 0.03 dB (max.). Available in 1x2 or 2x2 configurations, the SMUC's "excellent" PDL makes it an ideal and stable device for monitoring systems and applications in cable TV, telecom, optical networks and fiber sensors, says E-Tek.

The SMUC is available in various coupling ratios, from one percent to 50 percent, with excellent uniformity and low excess loss. It is currently offered in 1550 nm, 1480 nm or 1310 nm wavelengths.

E-Tek has also announced a series of high-performance fused biconic taper couplers made using Unifuse, a new

continued on page 108

Products continued from page 107

manufacturing method that eliminates the conventional coupler fabrication technique requiring pre-treatment of fibers. Couplers made using this technique exhibit low loss and excellent uniformity, says the company.

The monolithically fused couplers are available in 1x3, 1x4 and MxN port configurations, in single or dual 1310 nm and 1550 nm wavelengths. The specially-fused coupler structure not only improves performance, but also increases humidity resistance, making it suited for use in power monitoring and other advanced communications systems, says E-Tek.

Circle Reader Service number 81.

Video and stereo demodulators

POTTSTOWN, Pa.–Videotek Inc. has introduced two new demodulators–the DM-100 Utility Demodulator and the BTSC-100 Aural TV Stereo Demodulator.

The DM-100 provides video and BTSC stereo outputs from antenna, cable or HRC cable inputs and can operate from a variety of power sources, including 12 VDC, 120 VAC and -48 VDC. Packaged in a one-third rack width module size, the frequency-agile, 154-channel cable TV and broadcast demodulator includes a clear numeric indication of channel selection. Operators can confirm unit operations, including power, channel tuning and mode, at a glance. It also features a rear panel switch that locks the front panel and prevents any accidental front panel adjustments.

DM-100 Demodulator

The BTSC-100 converts a 4.5 MHz carrier or composite aural input into both stereo and SAP baseband audio outputs. It also provides a composite aural output from a 4.5 MHz IF input and contains an internal 115/230 VAC power supply.

Circle Reader Service number 82.

Fiber components

NEW BEDFORD, Mass.–Fiber Optic Center Inc. has announced the availability of the complete line of precision fiber optic components and custom devices from Europlus of Woodbridge, England. The components include standard, hybrid and custom connector adaptors; machined panel and board-mount device receptacles; adaptor safety covers (shutters); adaptor caps for test sets; metal and plastic secured connector and adaptor dust caps (with chains or lanyards); plastic throw-away connector and adaptor dust caps; bare fiber adaptors; laser and pigtail housings; waterproof bulkhead and connection housings; splice holder clips and package lead keepers; and connector strain relief boots.

Fiber optic components

Circle Reader Service number 83.

Elite Series

Filters and traps

SYRACUSE, N.Y.–Eagle Comtronics Inc. has introduced its new line of mini filters and traps for the cable industry. All Eagle Elite Series filters and traps feature performance to 1 GHz with selectivity for narrow bandwidth and low adjacent insertion loss.

The series includes: Pay Television Single Channel Notch Filters (EMN Negative Traps, EMD Positive Traps); Pay Television Multi Channel Tier Traps (8-pole–8MLP, 8MNF, 8MHP, or 10-pole–10MLP, 10MNF, 10MHP); and Return Band Noise Suppression Filters (EHP, EMHP Highpass Filters, EXSH Window Filters, EMSA Step Attenuators).

The Single Channel Notch Filters feature a small size (1.965 inches) for easier installation, and enhanced environmental stability because of patented dome seal and double "D" outer shield, as well as dual O-ring seals. The Multi Channel Tier Traps also feature small sizes (2.965 inches for 8-pole traps, 3.465 inches for 10-pole traps) and sharper band selectivity for reduced filter guardband, especially at higher frequencies.

Circle Reader Service number 84.

EAS audio/video comb generator

HURST, Texas–Spectrum has introduced its new EASpectrum Generator, an audio/video comb generator designed

EASpectrum Generator

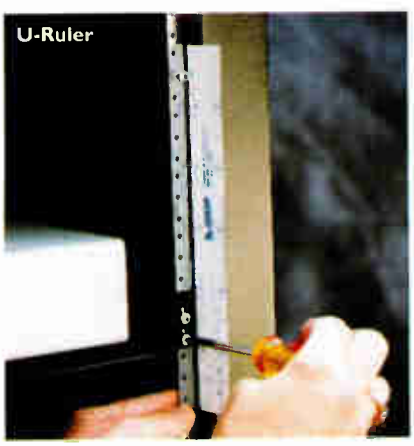
to operate continuously. Available in either a 450 MHz, 550 MHz or 750 MHz configuration, all products come in a 1 3/4-inch housing to minimize rack space. In addition, the 450 and 550 MHz units are upgradable to 750 MHz. The unit can be used with the Sage ENDEC (encoder/decoder) for an EAS solution. With the addition of the generator to its product line, Spectrum says it can interface EAS to any headend, whether the operator is using IF, dual IF, audio/video (baseband, including stereo), or Spectrum's new trunk switch.

Circle Reader Service number 85.

Installation ruler

INDIANAPOLIS, Ind.–General Devices Co. Inc. has designed its new U-ruler to aid designers and assemblers when calculating equipment locations in 19-inch electronic cabinets.

The ruler serves as a guide to the Electronic Industries Association's RS-310 hole configuration. The magnetized ruler comes in a six-unit length with each unit separated into a pattern series of 0.25, 0.625, 0.625, 0.25 and matching RS-310 hole configuration.



U-Ruler

During installations, the ruler can be placed along the vertical mounting rails when securing equipment such as receivers, transmitters or amplifiers in 19-inch racks. Installers can easily locate the bracket positions and assure accurate horizontal alignments. The U-ruler is currently available at no charge upon request.

Circle Reader Service number 86.

Cable management

Fiber viewer, plenum raceway

HICKORY, N.C.–TII-Ditel has announced the availability of its new Fiber Connector Viewer (FCV-1) and Plenum Raceway System. The company's new viewer has been designed for easy inspection of fiber optic connectors in patch panels and sophisticated transmission equipment.

A 14-inch insulated rigid probe with built-in miniature CCD camera allows for easy access to the rear of the chassis, where it focuses on the ferrule surface of the installed connector. It eliminates the need to disassemble a connector from the adapter in order to inspect a panel-mounted or backplane-mounted connector. It comes with a lockable carrying case and includes a connector adapter, one connector adapter tip (FC, ST, SC or SC backplane), a four-inch LCD monitor, rechargeable battery, 6 AA batteries, and an AC main power adapter.

The company's Plenum Raceway System features a patented telescoping design and all-metal construction that installs without cutting.

Additionally, unique fastening clips allow sections to be joined without tools. Other features include bend radius protection, complete open access through easy-open covers and lightweight, all-aluminum construction that allows for mounting under raised floors without the need for external support.

It conforms to industry specifications and is available in three sizes: 4 x 2.5 inches, 5 x 3 inches, and 10 x 3 inches.

Circle Reader Service number 87.

Attenuator

WOONSOCKET, R.I.–AWC/US Fiber Optics has introduced its new multimode Loopback Attenuator.

The Loopback Attenuator has been manufactured with a proprietary process for network analysis, testing and simulation. Standard attenuation values available include 0, 5, 10, 15 and 20 dB increments. Custom attenuation values are available upon request.

Loopback Attenuator

Performance specifications are ± 1 dB at attenuation value and available with standard return loss of -45 dB, with -55 dB available upon request.

Circle Reader Service number 88.

readerservice

Advanced Networking

C-COR Electronics, Inc. RS# 17
C-COR's RF amplifiers, AM headend equipment, and customized service and maintenance provide global solutions for your network. p. 33

Panduit Network Systems Group RS# 48
Complete line of fiber optic and network cabling solutions, including PAN-NET ™ Network Cabling Systems, PAN-WAY ™ Surface Raceway Systems and PAN-CODE ™ Network Identification Products. p. 81

Passive Devices Inc. RS# 15 p. 29

Construction Equipment

CommScope, Inc. RS# 20
CommScope: ISO 9001 registered manufacturer of a comprehensive line of coaxial and fiber optic cables for all telecommunications applications. p. 35

Keptel RS# 36 p. 56

Telecrafter Products RS# 5, 28
Supplies drop installation products for CATV, DBS, and wireless operators, single and dual cable fastening products, identification tags, residential enclosures. p. 10, 60

Datacom Equipment

3Com Corporation RS# 35 p. 55

Terayon Communication Systems RS# 9
Terayon Communication Systems delivers high-speed, two-way cable modem systems — based on S-CMDA technology — that operate over any cable plant and support both business and residential services. p. 17

Toshiba Multimedia RS# 32 p. 51

Distribution Equipment

Alpha Technologies Inc. RS# 3
World leading manufacturer of power conversion products, widely used in cable television, telecommunications, and data networks around the world. Offer a complete line of AC and DC UPS systems. p. 7

Exide Electronics, Emerging Technologies Group RS# 18
Our Lectro brand is the industry's first true uninterruptible power supply, provides innovative decentralized and centralized power solutions for CATV and high speed data networks. p. 31

Lindsay Electronics RS# 27
Our revolutionary new technology creates 1 GHz communication amplifiers, passives, taps, and subscriber materials to solve system problems before they become subscriber problems. p. 42

Philips Broadband Networks RS# 33
A global supplier of broadband RF and fiber optic transport equipment, is also a leading provider of advanced systems used to access broadband telephony and data services. p. 52-53

Times Fiber Communications, Inc. RS# 11
TFC is an ISO 9001 registered manufacturer of coaxial cable for the telecommunications industry. Committed to quality, service and technology. p. 21

Viewsonics, Inc RS# 52 p. 90

Distributors

ITOCHU Cable Services RS# 47
iCS, Inc. is a leading full service stocking distributor, operating ten sales offices and nine warehouses conveniently located in North and South America. p. 77

Power & Telephone Supply Co. RS# 25
Power & Telephone Supply serves the power and communications material distribution needs of the U. S. through 18 strategically placed stocking warehouses, including a specialized export facility in Miami, Florida. p. 40

Sprint North Supply RS# 49
Sprint North Supply's Materials Management Services include Engineer, Furnish & Install, Vehicle Provision-ing, CPE Fulfillment, Project Management, and Model Programs. Reduce your cost to compete. p. 83

TeleWire Supply Company RS# 10
TeleWire Supply is a leading nationwide distributor of products needed to build and service a broadband communications network. p. 19

Tulsat RS# 45, 51
Tulsat Sells, Repairs and Purchases Headend and Line Equipment. We specialize in Traps, Taps, Connectors, Modulators, VCII, IRDs and Receivers. p. 71, 89

Fiber Optic Equipment

Corning Incorporated RS# 22
The Corning Optical Fiber Information Center gives you FREE access to the most extensive fiber-optic library in the industry. p. 37

FONS Corp. RS# 14
Manufactures fiber optic communications products, including patch panels, cable assemblies, adapters, attenuators, fiber management software, and transmission products for tele-communications, data communications, and cable television markets (508) 393-4268. p. 28

Synchronous Group Inc. RS# 60
The Actair and Antares 1550 nm external modulation transmitters offer outstanding performance and the best specifications in the industry. Perfect for super trunks and direct distribution. p. 43

Headend Equipment

ADC Telecommunications, Inc. RS# 1
Leading global supplier of transmission and networking systems. The company holds a pre-eminent market position in physical connectivity products for fiber optic, twisted pair, coaxial and wireless networks worldwide. p. 2-3

Anadigics RS# 41 p. 63

Blonder Tongue RS# 19
Quality manufacturer of headend equipment (including pre-fabricated headends), reception, distribution, MDU interdiction products and test equipment. p. 34

Dawn Satellite RS# 54
Technical information and competitive prices on products such as: satellite "dish" antennas, satellite receivers, digital ready LNBs, modulators, processors and a wide variety of related products. p. 104

FrontLine Communications RS# 24
FrontLine Communications manufactures patented, field proven, Emergency Alert and PC-based Character Generator products to fulfill the needs of cable and other multi-channel system operators. p. 39

Harmonic Lightwaves, Inc. RS# 7
A worldwide supplier of highly integrated fiber optic transmission, digital headend and element management systems for the delivery of interactive services over broadband networks. p. 13

Microwave Filter Co., Inc. RS# 53
Passive electronic filters, traps and filter networks for interference elimination and signal processing at the TVRO, headend and distribution equipment. p. 104

PCI Technologies RS# 55
PCI Technologies manufactures splitter/combiner networks, RF filters from DC to 1GHz, i.e.: deletion filters, diplex filters, bandpass, etc., and an array of test signal generators. p. 105

Pico Macom Inc. RS# 34
Pico Macom offers a full line of quality headend components including satellite receivers, agile modulators and demodulators, signal processors, amplifiers, and completely assembled headends. p. 54

Scientific-Atlanta RS# 59
Scientific-Atlanta's new Continuum™ Headend System for analog and digital applications. This features a vertical packaging design which allows for up to forty front-loaded modules to fit into a standard 70" rack. p. 124

Standard Communications RS# 4
The industry's leading manufacturer of rebroadcast quality satellite reception and RF broadband products. Delivering programs to thousands of CATV and SMATV systems. p. 9

Spectrum RS# 23, 38
The Sub-Alert utilizes the advanced features of the Sage Endec for total automation and will interface with your headend by IF, baseband video or comb generator. p. 38-39, 58

readerservice

Services (Billing, Contractors, etc.)

International Engineering Consortium (IEC) RS# 63
A nonprofit organization dedicated to advancing the field of business and engineering in the information industry through noncommercial and university programs. p. 30

IMMCO RS# 57
IMMCO provides competitively priced, quality HFC and fiber design, drafting and file conversions for CATV and telecommunications companies. p. 105

Subscriber Equipment

Pace MicroTechnology RS# 43 p. 67

Telecom Equipment

Fujitsu Network Communications RS# 8
Manufactures and markets advanced SONET transport and access equipment which maximizes network operational capacity and services. p. 14-15

Test Equipment

AM Communications, Inc. RS# 58
OmniStat by AM is the worldwide choice for monitoring HFC telecommunications networks. It is the standard for ADC, NextLevel, Philips and Scientific-Atlanta. p. 123

Avantron Technologies, Inc. RS# 44
Battery operated, portable Spectrum Analyzers, forward and reverse sweep and ingress monitoring test equipment for the cable TV industry. p. 69

Cable Leakage Technologies RS# 21
With the FCC imposing stiff fines for leakage, CLT presents operators with the only sure, comprehensive method of locating and documenting the nearest street address of system faults/signal leakage. p. 36

Cable Resources, Inc. RS# 42
Cable Resources offers test equipment to maintain 5-40 mhz return networks. The RDU displays ingress, noise and carrier levels. p. 65

CTV Inc. RS# 56
CTV Inc. offers quality repair and calibration of CATV test equipment, and specializes in the upgrade of CALAN 1776 RX and 1777 TX. Also available, refurbished CALAN equipment. p. 105

Hewlett-Packard Company RS# 6, 12, 64
Hewlett-Packard offers a comprehensive range of test equipment to keep your entire broadband system at peak performance - from headend to subscriber drop. p. 11, 22-23, 101

Norscan, Inc. RS# 16
Norscan manufactures fiber optic cable and drop monitoring equipment, outside plant database software and protection equipment for tone location. p. 32

Noyes Fiber Systems RS# 30
Manufacturer of fiber optic test equipment including mini-OTDRs, light sources, power meters, visual fault identifiers, network simulators, microscopics, optical fiber indentifiers, talk-sets and test kits. p. 48

P. K. Technology RS# 29 p. 47

Riser-Bond Instruments RS# 26, 61
Manufacturer of TDRs with unique and exclusive features to locate and identify faults and conditions in metallic two conductor cable. p. 41, 99

Sencore RS# 65
Sencore designs and manufactures a full line of CATV, Wireless CATV, QAM and MPEG 2 test instruments. Each instrument is designed to meet your system analyzing and troubleshooting needs with exclusive tests and measurements. Test Equipment p. 103

Trilithic, Inc. RS# 13, 37, 39, 40
Trilithic manufactures test equipment for the CATV and LAN industries and components for aerospace and satellite communications. Key products are SLMs, leakage detectors, and a comprehensive line of return test equipment. p. 27, 57, 59, 61

Wavetek Corporation RS# 2, 50 Manufactures equipment for CATV, telecommunications, wireless, and general purpose test. CATV equipment includes signal level, analysis, and leakage meters, sweep and monitoring equipment. p. 4-5, 85

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http://www.amcomm.com

Avantron Technologies, Inc.
http://www.avantron.com

Blonder Tongue
http://www.hometeam.com/blonder

C-COR Electronics, Inc.
http://www.c-cor.com

CommScope, Inc.
http://www.commscope.com

Corning Incorporated
http://www.corningfiber.com

CTV Inc.
http://www.budcocable.com

Exide Electronics, Emerging Technologies Group
http://www.exide.com

FONS Corp.
http://www.fons.com

FrontLine Communications
http://www.frontlinecom.com

Fujitsu Network Communications
http://www.fnc.fujitsu.com

Harmonic Lightwaves, Inc.
http://www.harmoniclightwaves.com

Hewlett-Packard Company
http://www.hp.com/go/catv

International Engineering Consortium (IEC)
http://www.iec.org

Keptel, Inc.
http://www.antec.com

Lindsay Specialty Products
http://www.linsayelec.com

Microwave Filter Co., Inc.
http://www.ras.com/mwfilter/mwfilter.htm

Noyes Fiber Systems
http://www.noyes-fiber.com

P. K. Technology
http://www.pktechnology.com

Pace MicroTechnology
http://www.pace.co.uk

Panduit Network Systems Group
http://www.panduit.com

Passive Devices Inc.
http://www.pdi-eft.com

PCI Technologies
http://www.pcitech.org

Philips Broadband Networks
http://www.be.philips.com/pbn

Pico Macom Inc.
http://www.piconet.com

Power & Telephone Supply Co.
http://www.ptsupply.com

Riser-Bond Instruments
http://www.riserbond.com

Scientific-Atlanta
http://www.sciatl.com

Showtime Networks
http://www.showtimeonline.com

Spectrum
http://www.spectrummhz.com

Sprint North Supply
http://www.sprintnorthsupply.com

Standard Communications
http://www.standardcomm.com

Synchronous Group Inc.
http://www.syngroup.com

Telecrafter Products
Email: teleprod@compuserve.com

TeleWire Supply Company
http://telewiresupply.com

Terayon Communication Systems
http://www.terayon.com

Times Fiber Communications, Inc.
http://www.timesfiber.com

Trilithic, Inc.
http://www.trilithic.com

Toshiba Multimedia System Div.
http://www.toshiba.com/TAISMSD/

Viewsonics, Inc.
Email: viewson@ix.netcom.com

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eventcalendar

FEBRUARY

18 Bluegrass SCTE Chapter, Technical Seminar. "Digital and Headend In The Sky." Location: TKR of Louisville Office, Louisville, Ky. Call Max Henry (502) 435-4433.

18 Central California SCTE Chapter, Technical Seminar. "CLI" and "Fiber Optics Basics." Location: TCI Office, Merced, Calif. Call Raul Esquivel (209) 384-1316.

18 Michiana SCTE Chapter, Testing Session. BCT/E and Installer certification exams. Location: LaPorte, Ind. Call J. J. Jones (219) 324-6943.

18 Ozark Mountain SCTE Chapter, Technical Seminar. Location: Executive Inn, Springdale, Ark. Call Mike Franke (918) 456-1102.

18 West Virginia Mountaineer SCTE Chapter, Technical Seminar. "Fiber Fundamentals." Location: Ramada Inn, South Charleston, West Virginia. Call Steven Johnson (740) 894-3886.

19 New England SCTE Chapter, Technical Seminar & Testing Session. BCT/E and Installer certification exams. Location: Holiday Inn, Boxborough, Mass. Call Brian Bedard (413) 562-9923, ext. 228.

26 Northern New England SCTE Chapter, Technical Seminar. "Power, Grounding and Bonding." Location: Doubletree Inn, Portland, Maine. Call Bruce Bolger (207) 967-5212.

MARCH

10 Cascade Range SCTE Chapter, Technical Seminar. Location: Holiday Inn, Wilsonville, Ore. Call Betty Reed (360) 891-3295.

11 Old Dominion SCTE Chapter, Vendor Show. Location: Richmond, Va. Call Maggie Fitzgerald (540) 248-3400 for further details.

11-13 Northern California SCTE Chapters, Vendor Show. Location: Concord Hilton, Concord, Calif. Call Steve Allen (916) 786-4353 for additional information.

12 Penn-Ohio SCTE Chapter, Technical Seminar & Testing Session. "Safety–CPR Certification and Pole Top Rescue." Location: Sheraton Inn North, Pittsburgh, Pa. BCT/E certification exams to be administered. Call Marianne McClain (412) 531-5710 for more information.

17 North Country SCTE Chapter, Vendor Show. Annual Vendor Day and Cable-Tec Games. Location: Hyatt Hotel, Minneapolis, Minn. Meeting to be held in conjunction with the North-Central Cable Show. Call Dan Shea (612) 572-9290.

18 Big Sky SCTE Chapter, Technical Seminar. Location: Locomotive Inn, Laurel, Mont. Call John Anderson (406) 755-7200.

For more extensive calendar listings, including training opportunities, see www.cedmagazine.com

TRADE SHOWS

FEBRUARY

22-27 OFC '98. Location: San Jose, Calif. Call the Optical Society of America (202) 416-1980.

25-27 The Texas Cable Show. Location: San Antonio, Texas. Call (512) 474-2082.

MARCH

TBD SCTE Telecommunications Vendors Day. Location: Omaha, Neb. Call Riser Bond Instruments (402) 466-0933.

APRIL

20-23 COMDEX Spring '98. Location: Chicago. Call Softbank (617) 433-1500.

MAY

3-6 National Show '98, produced by the National Cable Television Association. Location: Atlanta. Call the NCTA (202) 775-3669.

JUNE

7-11 Supercomm '98. Location: Atlanta. Call the U.S. Telephone Association (202) 326-7300.

10-13 SCTE Cable-Tec Expo '98. Location: Denver, Colo. Call (610) 363-6888; Expo hotline (610) 363-3822.

JULY

8-10 Wireless Cable '98. Location: Philadelphia. Call (202) 452-7823.

SEPTEMBER

22-24 Great Lakes Cable Expo. Location: Chicago. Call (317) 845-8100.

DECEMBER

1-4 The Western Show. Location: Anaheim. Call the California Cable TV Association (510) 428-2225.

Steven Gampp has been named president of Jones Cyper Solutions Ltd. With more than 20 years of managerial and financial business experience, Gampp will oversee all of the company's operations, products and services, including its customer management software product, Intelligent Customer Support System (ICSS). Prior to his new position, he held a number of executive posts in the natural resources and chemical industries. Gampp holds a master's degree in taxation from the University of Denver and a bachelor of science degree in business/accounting from Miami University in Oxford, Ohio.

Video Networks Inc. has named **Ronald Murray** as vice president for the company's electronic commerce business unit. Most recently, he was senior vice president, director of operations and information systems for National Cable Communications. In his new position, Murray will be responsible for the planning, development and implementation of VNI's electronic commerce products and services.


Murray

Pioneer New Media Technologies Inc. has announced a number of new appointments to its staff. **Larry Shulman** has been named vice president of engineering and operations for the company's newly-formed Network Systems division of Pioneer Digital Technologies Inc. In this new position, Shulman will be responsible for overseeing the development of the control systems for Pioneer's new Entertainer advanced analog and Voyager digital set-top terminals.

In two managerial appointments, Pioneer has named **Kendall Sandberg** as software engineering manager for the Network Systems division, and **Kenneth Sampson** as product manager in charge of analog set-top terminals for the Cable and Communications division. Sandberg will be responsible for developing the control system software for the company's advanced analog and digital set-tops. Sampson will oversee the day-to-day development of the company's new advanced analog set-top terminals.

Michael Carter has joined Fiber Optic Center Inc. as vice president of sales where he will be responsible for sales of components and systems worldwide. He spent 12 years with AMP Inc. and more recently was director of fiber optic products, worldwide, for Augat Inc. Carter will be based in Olympia, Wash. and cover sales throughout the United States and internationally.


Carter

Channell Commercial Corporation has named **John Kaiser** as vice president of sales for Channell's broadband division. He has also been named as an officer of the company. Kaiser previously worked with the company as its director of sales and marketing from 1985 to 1990. In his new position, he will be responsible for the development and implementation of the sales strategy for the domestic broadband division, primarily covering the cable television market.


Kaiser

TV/COM International Inc. has made four recent executive appointments. **Michael Zoretich** has become director of customer systems support. Most recently, he served as the company's applications engineering manager, where he was responsible for system integration and configuration challenges. In his new position, Zoretich will direct his department in the customer support, management and documentation of systems and products.


Zoretich

TV/COM has also named **Richard Phelps** as executive director of worldwide sales, where he will oversee all domestic and international sales programs for the company. Previously, Phelps was director of sales for Ibero-America at General Instrument. Prior to that position, he held various international sales and marketing positions in the computer and automotive industries.

Meanwhile, TV/COM has also named **Norm Fugate** as director of operations and **Mary Chimarusti** as director of quality assurance. Fugate will direct the development and execution of manufacturing and quality strategy for the company. He previously served as the company's director of quality assurance and was instrumental in helping the company receive ISO 9001 certification in June this year. Prior to TV/COM, Fugate held quality management positions with Applied Digital Access and General Instrument.


Chimarusti

Patrick Johnson has been appointed account manager for Hewlett-Packard Company, where he will provide broadband test solutions to the cable television industry in the company's Midwest territory. He is based in Chicago. Johnson holds a bachelor of science degree in electrical engineering and brings 10 years of experience in the test industry to his new position.


Johnson

Michael Ashworth has been appointed vice president of sales and marketing for Integral Corporation. Prior to this new position, Ashworth served in a number of posts for Southwire. His most recent position with that company was as field sales manager. In his new position at Integral, he will be responsible for all North American sales and marketing programs for the corporation. ■

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FIBER OPTICS

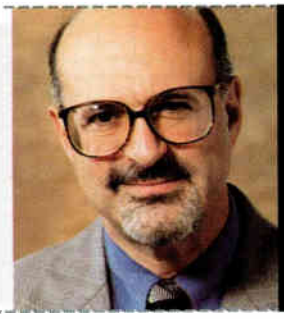
capital currents

Subsidized TV sets?

We have subsidized cellular phones and subsidized satellite receivers. Maybe we'll have subsidized cable boxes, if they're sold at retail. And a few people are now talking about subsidized digital TV sets. For cellular phones and satellite receivers, the subsidy is the bait, and then you're hooked. For TV set subsidies, what's the hook? The hook is that the TV becomes a bottleneck, controlled by the company paying the subsidies.

Cellular phone subsidies

The cellular phone that you bought for $29 from Circuit City really costs a lot more than that to manufacture and sell. You pay the total cost for it, but not directly. There's a subsidy involved, although not everyone calls it that. When you sign up for a year's worth of service, the cellular phone company sends a check for $200 to Circuit City. That covers the remaining cost of the phone. The cell phone company considers it a marketing cost or customer acquisition cost, a normal expense of doing business. If you terminate your service after one year, the cell phone company breaks even. If you continue your cell phone subscription for many years, the cell phone company makes big profits from you. Those profits cover the acquisition costs for other customers. The long-term subscribers are subsidizing those who churn after a year.



By Jeffrey Krauss, opinionated consultant and President of Telecommunications and Technology Policy

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

The picture is very much the same for satellite receivers. In order to get a low-price DirecTV or Echostar receiver, you must sign up for a year's worth of service. For cable boxes, once the piracy issues and interoperability issues are resolved, it will probably be the same story. Buy the advanced digital box from Circuit City for (say) $150, sign up for a year of advanced digital services from the cable company, and the cable company sends a check for $200 to Circuit City or to the box manufacturer. This could be attractive to a cable operator because the $200 is treated as an expense, rather than a capital cost. Ask your CPA for details.

TV set subsidies

Everyone agrees that digital TVs will be expensive in the early years. Broadcasters have to deploy digital transmitters, but they aren't sure if there will be any viewers. So maybe a broadcast network has an incentive to subsidize the rollout of digital TVs. Instead of buying a Sony TV, you buy a Fox/Sony TV. The TV carries the Fox brand.

But what's in it for Fox? Why should they subsidize the cost of a TV if you can use a Fox TV to watch CBS programs? And how does Fox derive any additional revenues to offset the cost of the subsidy?

The FCC has given broadcasters the option to broadcast a combination of free and pay programming. Digital compression makes this possible. Maybe you get the subsidy if you sign up for a year of Fox pay programming.

But maybe that isn't enough. What's it worth to Fox to prevent you from watching CBS programs? It's probably worth a lot, but probably not legal. The All Channel Receiver Act, which was enacted in 1962, probably makes it illegal to sell a TV set that can receive Fox channels, but not CBS channels.

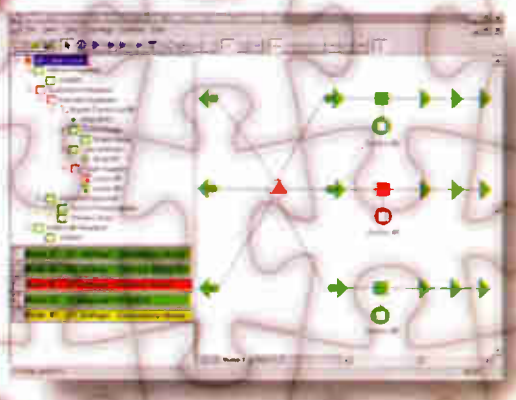
But it probably is legal to sell a TV set that can receive and descramble Fox pay programming, but cannot descramble CBS pay programming. The All Channel Receiver Act probably applies only to free broadcast programming.

So we can expect to see branded TV sets, with a TV network's brand, that are intended as a bottleneck, a gatekeeper. Is this all a figment of my brilliant marketing imagination? Afraid not. The idea was proposed in one of the standards meetings I attended during the week of the Western Cable Show.

So, you say, let the broadcasters use branded TV sets to compete with each other, but anything that speeds up the deployment of digital TV sets is good for the cable industry. Not necessarily. I agree that so long as the cable industry continues to use set-top boxes, it can escape the bottleneck control of a branded TV set.

But there are many voices today for the elimination of the set-top box, for incorporating the set-top box functions into the digital TV set. Standards groups are defining the "digital cable-ready TV set." In some versions, it has a slot to plug in a security card. It has an F-connector for the cable, a receiver to receive a standardized out-of-band data channel, and a transmitter for a standardized upstream channel. But it has no way for a digital set-top box to connect to the TV.

So I foresee the risk that a cable subscriber will buy a "digital cable-ready TV set" that is subsidized by a broadcast network, and will take it home and find that it can descramble Fox pay programming, but it can't descramble HBO programming. Would I buy such a TV set? It depends on how big the subsidy is. ■



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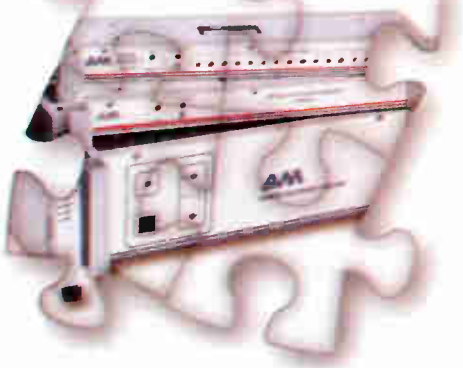

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